An Analysis of Roman Ceramic Building Material from York and its Immediate Environs

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Roman tile from York and its environs

Abstract

This study comprises the analysis of 8.11 tonnes of Roman tile from York and its immediate hinterland. The tile was recovered from 215 archaeological investigations undertaken by York Archaeological Trust, together with the tile from excavations at Heslington East undertaken by the Department of Archaeology of the University of York. The tile was analysed in terms of the chronological and spatial variations present, the results being examined in relation to three widely debated research themes, namely the nature and speed of Romanization, the role of the Roman army, and the economic relationship of the town to its hinterland.

Given that the use of tile was introduced to Britain by the Romans, and that it formed a key element of classical architecture, the speed of its adoption has been used to show that the process of Romanization occurred slowly in the York area, with many of the buildings outside the fortress reflecting state-sponsored building-campaigns, rather than the spontaneous growth of a Romanized town. Tile, in conjunction with Ebor Ware pottery, was produced by the military, primarily to supply its own needs, and the study has shown that the army were by far both the largest producers and consumers of tile in York, with 99 percent of tile stamps being military. Although a civilian tile industry must have existed in York, as a small number of civilian tile stamps are present, this industry clearly failed to develop on any scale, suggesting that there was insufficient demand for tile to support such an industry.

The study is accompanied by appendices cataloguing each form of tile, the fabrics and fabric groups present, and the surface markings seen, together with details of the stratigraphic sequences for twenty-one representative sites selected for detailed chronological analysis.

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Authors Declaration

The YAT database used for the present study includes records from excavations dating from the mid-1980s to 2004, some of which were originally recorded by S. Garside-Neville, on behalf of YAT.

Figures 123, 125, 130, 135, 137 and 139 were adapted from published YAT plans by Lesley Collett. The plans used as the basis for all figures relating to the location of features within the study area (as typified by Figures 1 and 2) were prepared by Lesley Collett for YAT publications, and were adapted for use in this study.

The fabric groups (listed in Appendix 5.2) were devised by Dr A. J. Finlay, Postdoctoral Research Associate, the Department of Earth Sciences, Durham University, as part of a YAT research project (Finlay 2011). The photographs of fabric thin sections given in Appendix 5.1 were prepared by Dr A. Finlay as part of this work. The fabric descriptions in Appendix 5.1 are based on previous work by both the author and S. Garside-Neville, which has been adapted in the light of Dr A. Finlay's work in terms of the level of sorting of the clay, the number of vesicles present, the size and quantity of quartz grains present, and the sphericity of the quartz.

With these exceptions the thesis is entirely the work of the author.

1 Introduction

The analysis of Roman ceramic building material is an important area of research, offering great potential for the study of several widely debated aspects of Roman history, notably, the process of Romanization and its spatial variability, the nature of the Roman economy, including the economic and social relationships of towns to their hinterlands, and the influence of the army both economically and culturally.

(It should be noted that for brevity ceramic building material is referred to as tile in the remainder of the text unless a specific form is noted).

York is an ideal place to study Roman tile, being one of only three permanent legionary fortresses and one of only four *coloniae* in Britain. The political and military importance of York ensured that there was considerable investment in buildings during the Roman period, and therefore widespread use of tile. There has also been an extensive programme of archaeological excavation in York over the last forty years, resulting in a large volume of archaeologically recovered tile, providing ample material for analysis. Furthermore, it is known that the production of tile in York was closely linked to that of local Ebor Ware pottery, offering the potential to compare patterns of production and supply for the pottery and tile industries.

Despite its potential, tile is an under-researched topic in comparison with other artefact types. YAT's own publications are a perfect example of this, in the seventy-two fascicule volumes YAT has produced relating to the archaeology of York there are less than twenty pages of text relating to tile (Whitwell 1976, 43, 45; Kemp and Graves 1996, 294-301; Richards 2001, 607-10; Hall and Hunter-Mann 2002, 852-3). The only major study of tile in York to date is an unpublished PhD thesis by Betts (1985). Given the volume of tile excavated since Betts undertook his work, it is clear that the subject of tile within York merits renewed investigation, hence the present study.

The aim of this study is therefore to examine the production and use of Roman tile from York and its immediate hinterland within a radius of 4km (corresponding to the area encompassed by York's Outer Ring Road, Figures 1 and 2), through an analysis of the chronological and spatial variations in the use of tile, in relation to the social, economic and military history of York.

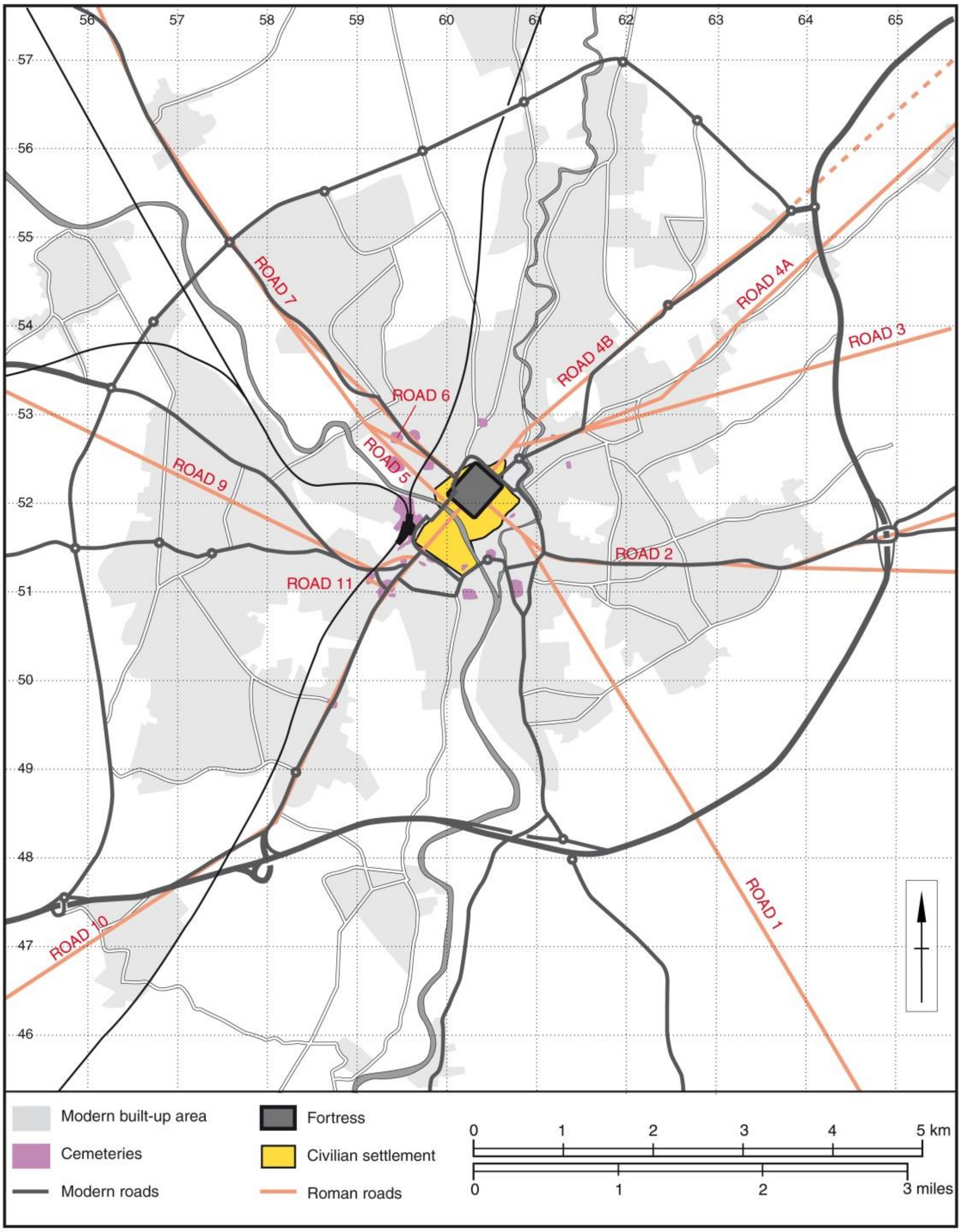


Figure 1. The study area, including Roman roads and the modern road layout (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

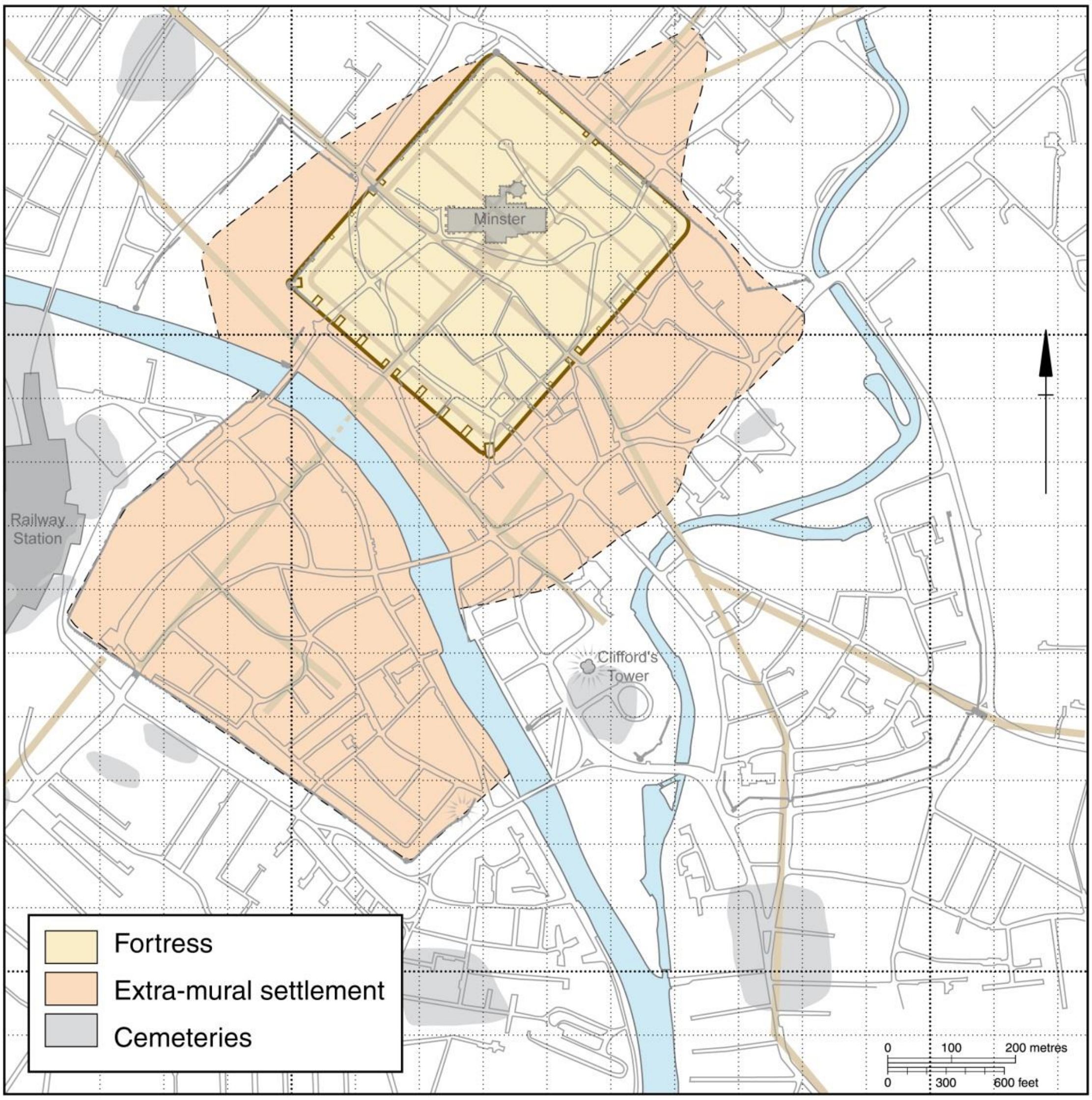


Figure 2. Detail of the central portion of the study area with the modern street layout superimposed (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

1.1 Previous approaches to the collection and study of tile

The importance of York as a Roman settlement has long been recognised and investigated. As early as 1737 antiquarians in York began collecting Roman tiles, a process which continued throughout the nineteenth century, resulting in the recovery of antefixes (see p77), tiles with legionary stamps, and several tile-lined tombs (RCHM 1962, 81, 85-6, 114). The creation of the York Excavation Committee in the 1920s saw archaeological investigations commence in the city (Ottaway 1993, 15), but tile from such works was often given less prominence than other categories of artefacts, perhaps reflecting its more limited aesthetic appeal. Thus, half a ton of tile recovered from excavations at Peasholme Green, York, was summarised in just five lines of text in the published report, as compared to a 3.5 page pottery report (King 1975, 213).

Professional excavation units developed across Britain from the 1970s onwards, undertaking what came to be termed 'rescue archaeology' in response to increasing threats posed by redevelopment. The founding of YAT in 1972 was part of this picture. This movement led to both a more systematic approach to excavation, and to a huge increase in the volume of artefacts recovered, including tile. Nationwide there were examples of detailed research into the subject of tile: McWhirr's (ed. 1979) highlighted its research potential, while Brodribb's (1979a) survey of the tile from Beauport Park showed the interpretative value of researching every single sherd of tile recovered. Further research by Brodribb culminated in his survey of Roman brick and tile published in 1989, which remains a standard text for the study of tile to this day.

In 1990 the Department of the Environment issued new guidelines for professional archaeology, entitled *Planning Policy Guidance 16: Archaeology and Planning*, (commonly known as PPG16). This emphasised the *in situ* preservation of archaeological remains wherever possible, with excavation being the less preferred option, thereby causing a fundamental shift away from large-scale to small-scale excavations. In York, though, there was a significant increase in the number of archaeological excavations post-PPG16. Few of these were of sufficient depth to uncover Roman remains, leading to a marked decrease in the volume of Roman artefacts recovered. Thus, 81 percent of the Roman tile examined in the present study is from excavations pre-dating PPG16. Although this may at first glance seem disastrous, the large number of small interventions undertaken since the introduction of PPG16 has provided a fuller picture of the distribution of the various forms of Roman tile across the York area, even though much of this tile occurs residually in contexts of post-Roman date.

The Department for Culture and Leisure (2010) issued new guidelines for archaeology, *Planning Policy Statement 5: Planning and the Historic Environment,* but this legislation has little relevance to the present study, as all but one of the excavations examined were undertaken or planned prior to the introduction of this legislation, the only exception being a small site on the City Walls (Project Code 5344) which yielded a small quantity of residual Roman tile.

1.2 The approach of the research

The present study developed from a review of YAT's tile collection undertaken in 2005 (see Appendix 1), which resulted in the creation of a database containing the details of over 33,000 sherds of Roman tile, to which were added a further 2,900 sherds from the University of York's excavations at Heslington East. The Heslington East site was excavated by both YAT and the University of York, necessitating the inclusion of both portions of the site in the present research. The data used in the study is stored on the YAT database (called IADB), and is available to researchers on request.

A number of tasks had to be undertaken to enable research into this important collection of tile to proceed. Firstly, a detailed catalogue was prepared detailing the forms, fabrics and surface marks relating to manufacture. The catalogue proved to be such a substantial piece of work that it far exceeded the word-count available for an MA study, and it has been placed in Appendices 4-6. This catalogue is of value in itself, representing a useful resource for the study of Roman tile in York.

The second task was to assess chronological variations in the use of tile. It would have been impossible within the time-frame of the present study to determine a stratigraphic/pottery based date for every tile-bearing context, it was therefore decided to select a smaller number of sites for detailed chronological analysis. Using a combination of pottery dating available in Monaghan (1997), together with various archive and published reports, a group of sites with excellent pottery dating and a detailed stratigraphic sequence were chosen for chronological analysis (these collectively accounted for 29.2 percent of the tile studied). The stratigraphic sequences of the sites concerned, together with details of the tile recovered in relation to chronological periods, are given in Appendices 7-13.

In order to analyse spatial patterning, the various excavations in the present study have been divided into three groups relating to geographical zones. The first group termed ‘fortress’ relates to the area of the legionary fortress, the second group termed ‘*colonia’* refers to the area bordered by the medieval city walls to the south-west of the river Ouse, and the third group termed the ‘environs’ encompasses all other excavations within the study area. Some clarification is required of the use of the term ‘colonia’ as the name of one of the zones in the present study; the settlement which grew up on the south-western bank of the river Ouse was elevated to the rank of *colonia* by AD 237, and it is generally assumed to have been walled, with the walling being located beneath the later medieval city walls (Ottaway 1999, 64, 145). Describing this area as ‘the settlement to the south-west of the Ouse’ would have been cumbersome in the column headings of tables, and the decision was therefore taken to refer to this area with the single word ‘*colonia*’ in the tables, irrespective of the date of the deposits concerned. Of the excavations examined, thirty-five were within the fortress, thirty-one were within the *colonia* and 150 were in the environs, though the bulk of large-scale excavations were in the fortress or *colonia*.

The catalogue and detailed stratigraphic analysis of selected sites form the basis of the current research. To set the results of the study in context, Chapter 2 summarises the key areas of theoretical research relating to the study, while the historical context is provided by a brief summary of the history of Roman York in Chapter 3, and the evidence for the production and use of tile in Roman Britain is given in Chapter 4. The methodology for the present study and a discussion of the problems inherent to the dataset are detailed in Chapter 5.

2 The aims of the study in relation to broader research questions

Among the areas of research relating to the Roman period there are three extensively debated issues which impact on the present study: the processes by which Roman culture was spread (Romanization); the nature of the Roman economy, including the inter-dependency of towns and their hinterlands; and the role played by the army, both in terms of spreading Roman culture and as an economic-force within the empire. The present study relates to all these areas of research; the Roman building industry, including tile production, represented an important economic activity, while the resultant buildings were a highly visible method of transmitting the Roman lifestyle, especially in a rural landscape such as that encountered by the Romans in Yorkshire. The presence of a legionary fortress in York makes the role of the army pivotal, both economically as producers and consumers of tile, and culturally through the influence that their architecture exerted on the area. These themes have each been debated for a considerable time, though the nature of the research has changed in line with developments in archaeological theory, as outlined in chapter 2.1 below.

2.1 The development of archaeological theory

2.1.1 Culture History

Archaeology, defined as the study of human society through the analysis of its material remains, developed from nineteenth century antiquarianism, and from then to the mid-twentieth century much archaeological work was aimed at the collection of artefacts, the development of typologies, and the interpretation of artefact distribution patterns into cultures, a culture being defined as a recurrent set of associated objects (Johnson 2010, 237). Changes to cultures were interpreted as resulting from migration, or the diffusion of ideas from more advanced groups (Johnson 2010, 18). This approach has become known as *culture-history*.

One of the earliest attempts to understand Roman Britain from an archaeological perspective, rather than an historical one, was Francis Haverfield's 1912 publication '*The Romanization of Britain*'. Such early works were undoubtedly influenced by

Britain's pre-eminent role in the world at that time, based on possession of a huge empire. Rome's imperialism was viewed in terms of military conquest, followed by a period in which 'superior' Roman culture was willingly adopted by conquered peoples. Such a view effectively sought to justify Britain's own empire and its treatment of conquered peoples, in terms of the benefits that a 'civilising' force could bring (Mattingly 2004, 5-6). This view of Romanization proved remarkably durable, and can be illustrated by Sheppard Frere's (1967, 298) statement that the process of Romanization was a "synthesis, intended by Rome, and welcomed by the British people as they came to realise the advantages of peace and wealth conferred by membership of the empire". This was a top-down view of ancient society, in which there was no recognition that the process of Romanization could vary geographically or socially, or that cultural influence could be a two-way process.

Early debates about the ancient economy were largely the preserve of economists and economic historians, rather than archaeologists. As early as 1893 Bücher argued that the economies of Greece and Rome were small-scale and predominantly aimed at household self-sufficiency, a view which became known as the *primitivist* model, while Rostovtzeff's opposing *modernist* model, suggested that the ancient economy was similar to that of the modern world but on a smaller scale (Finley 1999, ix-x). In 1944 Polanyi developed the *substantivist* model seeing economic activity in the ancient world as part of a wider pattern of social relationships, with goods exchanged through systems of reciprocity and redistribution (Finley 1999, xii). In a major archaeologically based contribution to the nature of the Romano-British economy, Collingwood and Myres (in Collingwood 1937) concluded that towns were parasitic on the countryside, consuming far more from their rural hinterlands than they ever gave back in terms of manufactured goods, seeing towns as a 'luxury' when viewed from an economic standpoint (Fulford 1982, 403).

2.1.2 Processualism

From the 1950s there was a shift away from the culture-history approach, to a period of theoretical innovation (Trigger 2006, 1). *Processual archaeology* grew out of neo-evolutionary anthropology, which was fashionable in the United States of America in the 1960s (Trigger 2006, 480). This school of thought stressed the complex processes by which cultures developed, seeing them as adaptive and influenced by their environments (Johnson 2010, 242). Processual archaeologists tried to develop a more scientific methodology by testing data against repeatable models (Trigger 2006, 480), such as using geographical settlement-pattern models to study ancient settlements (Johnson 2010, 42). By examining systems, processualism avoided the mono-causal explanations that had often been suggested by the culture-history approach. Taking the fall of the Roman Empire as an example, the culture-history approach would regard this as a result of one fatal cause, barbarian invasions, whereas processual thought would look at the territorial stresses and changes in political structure which triggered barbarian migration, the underlying factors such as population rise, and the internal factors that lessened Rome's ability to respond to the threat (Johnson 2010, 77). It has been noted that while this new archaeological approach made little impact on Roman studies, never replacing the culture-history approach, it did introduce ideas of both society and the economy as functioning entities, worthy of research in their own right (Whyman 2001, 53).

In the case of Roman studies there was particular emphasis on the issue of the economy, reflecting the wide political interest in economics in the aftermath of World War II, seen through governmental attempts to rebuild the economies of much of Europe. Again it was an economic historian who produced the most influential publication on the subject, namely Moses Finley's "*The Ancient Economy*", (1973, re-issued in 1999). Finley suggested that the ancient economy was rurally based with land rents and taxes forming the basis of social status, further arguing that the elite land owners failed to invest their wealth in industry, leading to technological stagnation and small-scale production. Finley argued that poor transportation restricted long-distance trade to luxury goods, concluding that cities exploited the countryside by taxation and rents, rather than existing through the sale of urban produced goods to the rural hinterlands; his ideas became known as '*the consumer-city',* a theme which has been widely debated ever since.

2.1.3 Post-processual archaeology

Post-processual archaeology developed from the 1980s onwards, out of a growing awareness that attempts to analyse archaeological data using anthropological theories had proved less useful than processual archaeologists had anticipated (Trigger 2006, 481-2). Post-processual archaeology sought to understand societies from within, and this movement can be seen as encompassing various strands of thought including structuralism, which sees culture as being governed by rules analogous to those of language (Johnson 2010, 94-5), cognitive archaeology which examines the development of cognition in early hominids (Johnson 2010, 99), and Marxist archaeology which examines the role of conflict and contradiction as causes of social change (Johnson 2010, 156-7). Since the 1990s there has been continuing diversification of theoretical viewpoints, an example being the application of Darwinian ideas of evolution, through selective pressure, to the study of culture (Trigger 2006, 486); in addition, studies have developed examining the archaeological evidence for gender, ethnicity and age, themes which cut across all theoretical schools (Johnson 2010, 137).

An indication of the variety of viewpoints resultant from modern theoretical approaches can be seen with regard to interpretations of Romanization. Millett's (1990) influential publication on the Romanization of Britain represented a major revision of earlier view-points, arguing that the response to Rome was variable due to the diverse nature of pre-existing Iron Age society, and the differing levels of military presence across the province. Millett has subsequently been criticised both for over emphasising the role of native elites in the process of Romanization, and for underplaying the role of the state (Mattingly 2004, 6-7); the politics of individual emperors and provincial governors clearly affected interactions with conquered peoples, while the imposition of Roman law and taxation must have had a profound effect upon society. Other researchers such as Pitts and Perring (2006) have emphasised the importance of the nature of pre-existing Iron Age societies and political systems on subsequent relationships with Rome, arguing that the response of native communities to Rome varied according to their own patterns of patronage and affiliation. The process of Romanization, once thought of in terms of a one-way, top-down transformation, is now discussed using terms such as cultural assimilation and hybridization (Champion 2004, 214-15). Cultural variability within the Roman Empire has also been recognised; in the case of Britain the 'Roman culture' which was introduced came largely from the provinces of northern and western Europe rather than directly from Rome (Mattingly 2004, 6). It has also been noted that the adoption of Roman traits would have been variable across society, dependent upon the social and legal status of individuals, their employment, gender, wealth, religion and ethnicity (Funari 2002, 239).

There has been an equally wide-ranging revision of the role of the army within the Empire, and what was once seen simply as a military-machine enabling imperial expansion is now discussed in terms of its economic and social influences. The impact of the army upon the process of urbanisation has been examined, both through analysis of the donation of gifts of civic buildings by military personnel to communities across Britain (Blagg 1990, 18-20), and in terms of stimulating the development of settlements adjacent to military bases (Millett 1990, 75). That many such settlements declined if troops were withdrawn has been used to indicate the army's critical role in stimulating economic demand (Davies 2002, 190-4). Archaeological evidence has been used to suggest that the influence of the army on various aspects of Romanization was limited, and that in the case of religion (Mattingly 2011, 228-30), diet (Davies 2002, 171) material culture (Willis 1996, 218), art and the use of epigraphy (Millett 1990, 110, 112), the army remained largely distinct from the civilian population, suggesting that its Romanizing influence was limited. Epigraphic evidence suggests that soldiers largely married the daughters of other military personnel, leading to the creation of military families disassociated from the surrounding communities (Scheidel 2007, 423), again suggesting that the Romanizing influence of the army may have been limited.

Many of the earlier economic theories relating to the Roman economy concentrated on the core area of the empire, civilian supply networks, and the relationship of towns to hinterlands, ignoring the fact that the army consumed a major part of the Empire's economic production (Stallibrass and Thomas 2008, 146). The important economic role of the army is now recognised and has been addressed in a number of publications, such as a volume of papers edited by Erdkamp (2002). Opposing views have been taken regarding the effect that provisioning the military had on British agriculture, with some authors seeing a stimulating effect (Greene 1986, 125-6; Mattingly 2006, 220; Kehne 2007, 326), and others arguing that the provision of food for the army could have been easily achieved without major changes in the volume of agricultural production (Millett 1990, 57). An interesting slant on the question of army food supplies is Gerrard's (2008) analysis of the seemingly illogical distribution pattern of Black Burnished Ware pottery from Dorset. This study concluded that this pottery was used as containers for the supply of salt to the military in the Hadrian's Wall area, but noted that it was impossible to determine whether this was through direct military exploitation, or via a military supply contract. The role of the army in direct industrial production has also been examined, notably in relation to metal extraction and production (Millett 1995, 86), quarrying (Davies 2002, 185-6), and tile production (Collingwood and Wright 1992, 125-207; Collingwood and Wright 1993, 1-25).

The post-processual discussion of the Roman economy has to a large extent concentrated upon the inter-relationships of towns to their hinterlands, but there has been a recognition that no one model can fully explain these complex social and economic relationships, resulting in a wide range of differing interpretations of the archaeological evidence. Earlier theories relating to the development of towns were criticised for concentrating upon economic functions while failing to recognise that many other factors played a part, including their role as centres of fashion, entertainment and recreation, and their political function as administrative centres for tax gathering. This has resulted in alternative models for the functions of cities being proposed. Thus, Hopkins (1980) emphasised the role of taxation in the creation of monetized economies, suggesting that the imposition of monetary taxes forced farmers to sell their surpluses to urban communities, to obtain the cash necessary for the payment of taxes; Hopkins also emphasised the critical role of towns in administering the taxation system. In contrast, Engels (1990) offered an alternative *service-cit*y model, which was based on the exchange of peasant surpluses for urban goods and services, with cities also providing for the needs of visiting traders and travellers, while Whittaker (1990) proposed that the foundation and growth of civitates in Western Europe was related to political/administrative needs and social functions rather than to economic considerations.

Analysis of the ever-increasing volume of archaeologically derived data has led to a re-assessment of the scale of the Roman economy. Thus, Greene (1986) concluded that the sophistication of the empire in terms of military power, the volume of building-works and coinage, the wide range of goods available, and the extensive trade networks seen could not have been the product of a simple agriculturally based economy. There has also been a post-processual revision of the social aspects of the economy. Scheidel and Friesen (2009) have contradicted Finley's earlier suggestion that a small elite controlled ancient finance, arguing that both the numerous middle classes and the military could stimulate economic demand in their own right. Other authors, including Robinson (2005) and Parkins (1997) have suggested that, contrary to Finley's views, upper class households were involved with a range of urban commercial enterprises, to generate the cash incomes necessary for the acquisition of political power. The idea that the Roman period was one of technological stagnation has also been re-assessed, particularly in regards to agriculture (Greene 1986, 76-7), the construction industry (Saller 2001, 583) and tegulae production (Warry 2006), with all three authors concluding that the period was not as static in terms of innovations as Finley suggested.

Post-processual thought has clearly generated a wide range of theoretical interpretations relating to Roman history, and the current state of archaeological theory has been compared to a complex mosaic in which there is no overall consensus on theoretical perspectives (Gamble 2001, 42).

2.2 Archaeological theory in relation to the present study

The main focus of the study is an analysis of the production and use of tile during the Roman period in York, as seen through chronological and spatial variations; the results are related to the issues of Romanization, the role of the army and the economic relationship of the town to its hinterland, as outlined in 2.1.3 above.

Roman tile from York and its environs

The introduction of classical architectural forms, including the use of tile, represented a highly visible symbol of the classical lifestyle, and therefore of Romanization. The building industry would also have reflected political decisions; the upgrade of York's status to that of a provincial capital and *colonia* in the early third century was a deliberate political choice, which may have been reflected in building campaigns within the civilian settlements of York. Likewise, the presence of the Imperial household in York, in both the early third and early fourth centuries, may have resulted in politically sponsored building campaigns. The search for identity among ancient populations as seen through cultural activities such as architecture has been a major theme in recent studies of the Roman period (reviewed by Pitts 2007), and in the case of York three groups can be seen as having potential influence over architectural choices: firstly the army; secondly high status individuals relating to the provincial government and/or Imperial household; and thirdly the civilian population of York. A chronological and spatial analysis of the tile is used to determine the date at which tile first appeared within Roman deposits in the civilian settlements of York. This analysis aims to determine the speed with which Romanized buildings appeared, and to assess if there is any evidence for politically motivated building campaigns in the early third or fourth centuries. Later Roman deposits are examined to determine whether, in common with other parts of Britain, the use of tile declined, and the reasons for any such change are discussed.

The study examines tile production from an economic standpoint. The production of tile was a major economic activity in its own right, but also formed a part of the larger building industry; then, as now, the building industry was a good indicator of the strength of an economy, with periods of economic prosperity being reflected in new buildings and economic slumps being indicated by lower levels of building activity or dereliction. A chronological study of the tile in York aims to determine the levels of investment in both tile production and new building campaigns. The results are compared to research on the closely related pottery industry in York, to assess whether there was a collapse in the production of tile, mirroring the demise of the Ebor Ware pottery industry. Given York's status as a legionary fort, coupled with known legionary tile production, the study assesses whether legionary tile production was mainly linked to military needs, or was aimed at supplying the needs of both the fortress and nearby civilian settlements.

The use of tile in the fortress, the *colonia* and the environs, is examined to determine whether supplies to each area were discrete, or whether the army was also supplying the civilian markets of the adjacent town and hinterland. Evidence of civilian production is reviewed to determine the relative economic importance of the military and civilian industries. The spatial distribution of legionary stamped tiles is examined, as this offers the potential to study the economic influence of the army as a supplier of building materials to civilian settlements; it should, however, be noted that this can only relate to the earlier Roman period as the practice of stamping tiles declined from the mid-third century onwards (Darvill and McWhirr 1984, 245-6).

The study also examines the tile in terms of the development of forms, to determine whether there is any evidence of technological changes to tile manufacture or its use. This has implications for changes in building techniques, particularly to the method of roofing buildings, the research potential of which has been highlighted by Warry (2006).

3 Summary of the history of Roman York

A legionary fortress was constructed in York in the late first century AD, and while the generally accepted foundation date is AD 71 (RCHM 1962, xxix), it is possible that there was some military activity predating the establishment of the permanent fortress (Hall 1997, 389-10). York was an excellent strategic choice for the fortress: it was on elevated ground raising it above flooding levels; it was close to the glacial moraine which had been used as a land route across the Vale of York since the Mesolithic; the site was defended on two sides by the rivers Ouse and Foss; the river Ouse was accessible from the sea via the Humber enabling supply by ship; and the site lay on the boundary of the lands held by the Parisi and the Brigantes enabling control of both tribes (Ottaway 1999, 137). The deliberate development of sites in boundary areas is seen elsewhere in Britain, the other three *coloniae* all being examples of liminal settlements. The pre-existing late Roman Iron Age site of Camulodunum, which was targeted in the initial conquest of Britain and then developed first as a legionary fort and then as Britain's first *colonia*, lay at the boundary of two tribal areas (Pitts and Perring 2006, 191-2) making it a logical choice for the control of two tribes. The later first century colonies of Gloucester and Lincoln were close to the limits of the settled zone of the province at the time of their foundation (Fulford 1999, 179) thereby providing useful military reserves against potentially hostile neighbours. The area surrounding York was clearly already settled, as there are a number of Iron Age farmsteads and field systems within 5km of the fortress, including Lingcroft Farm, Rawcliffe Moor (Roskams 1999, 49-50), and Heslington East (Antoni et al. 2009). There is some evidence for pre-existing native settlement in central York. There were a number of ditches interpreted as being of Iron Age date at the site of St Leonard's Hospital in the north-eastern corner of the fortress (Hunter-Mann 2011, 14), and a ditch and associated fence line thought to be of Iron Age date were found at 3 Little Stonegate, also in the area of the fortress (Macnab 2001, 34).

The fortress was founded by the Legio IX Hispana, and activity relating to the early fortress in York comprised a ditch and associated rampart with wooden towers (Monaghan 1997, 837), together with the initial temporary encampment of tents and timber buildings (Hall 1997, 395). There was presumably a *territorium* around the fortress which was exploited for supplies, but its size is unknown (Ottaway 1993, 40). It has been stated (RCHM 1962, xxx) that Agricola undertook a major re-planning of the fortress between AD 79-85, constructing new clay and turf ramparts with timber interval towers, and internal timber-framed buildings with shingle roofs. Monaghan (1997, 837), however, interpreted this building activity as part of a rolling programme of repairs, stating that there is no clear evidence of a major Agricolan re-planning.

During their occupation of York the Legio IX constructed various stone buildings, including a *principia* (Phillips and Heywood 1995, 35-7), a legionary bath-house, an interval tower, the eastern fortress corner tower (Ottaway 1996, 207, 291) and the south-eastern fortress gate, as evidenced by a dedication stone dating to AD 107-8 (RCHM 1962, 111). Despite this rebuilding programme, timber buildings were still present within the fortress in the early second century (Ottaway 1996, 291). While it has been stated that the defences were largely of timber and earth at this stage (Ottaway 1996, 292), recent research into the timber piles beneath the Multangular Tower, at the western corner of the fortress, have led Hunter-Mann (2011, 20-22) to conclude that the south-western fortress walling was constructed no later than AD 110, far earlier than previously supposed (see p43).

Military kilns established by the Legio IX (which remained in use until the mid-third century) were located outside the eastern corner of the fortress (see p57-60), and occupation on the northern bank of the river Ouse included a timber grain-warehouse which presumably related to military provisioning (Brinklow et al. 1986, 16-17). It is thought that the main legionary cemetery at this time was located to the north-west of the fortress at Clifton Fields, though few remains survive (Monaghan 1997, 853).

Relatively little evidence of civilian activity relating to the period of Legio IX occupation has been recovered, some timber structures being known north-west of the fortress (Brinklow et al. 1986, 53), but little sign of activity on land to the south of the Foss or north-east of the fortress (Ottaway 2011, 192, 236). The area south-west of the river Ouse was dominated by the road from the fortress to Tadcaster (*Calcaria*), which was associated with a timber building of late first century date, and a bath-house associated with Legio IX stamped tiles (Ottaway 1999, 141).

The Legio IX was replaced by the Legio VI c. AD 120, and this legion was based in York for the remainder of the Roman occupation (Ottaway 1993, 11). A large portion of the legion was probably absent from York c. AD 120-60 when they were involved with the construction of Hadrian's Wall and the Antonine Wall. This partial absence is reflected in the fortress, where there is relatively little evidence for rebuilding, although stone buildings were constructed in the Bedern area from AD 150-160 (Ottaway 1996, 159). A number of construction projects were begun in the fortress after AD 160, including the replacement of timber barrack blocks in stone (Ottaway 1996, 210-11), remodelling of the defences (Ottaway 1999, 141), and adaptation of the sewer associated with the legionary bath-house c. AD 170 (Whitwell 1976, 23). The rebuilding of the fortress in stone was largely complete by AD 200 (Roskams 1999, 60).

There is evidence for the development of mid-second century civilian settlements to the south-west of the Ouse (Ottaway 1993, 73). New drainage ditches, streets, a water-supply and a major stone building were present at Wellington Row (Ottaway 1999, 141-5). Timber buildings at 24-30 Tanner Row incorporated re-used timbers that probably originated from the fortress, which was being heavily rebuilt at the time (Ottaway 1999, 142). While evidence of manufacturing was present at 24-30 Tanner Row, the military nature of the goods produced (leather tents and weaponry), have led Whyman (2001, 195) to conclude that this settlement was under direct military control, with production being geared to the needs of the military. There is clear evidence of commercial activity in the settlement at this time, including the remains of a warehouse, and of the importation of foodstuffs in the form of crabs and herring from the Yorkshire coast, and figs, grapes, olives, wine and pottery from other provinces of the empire (Ottaway 1993, 84-5).

The Legio VI was removed to Gaul in AD 197 to fight for Clodius Albinus in a conflict for imperial power, but was defeated by Septimius Severus, after which it returned to York (Monaghan 1997, 842). From AD 209-11 Septimius Severus undertook military campaigns in northern Britain and, on his death at York in AD 211, power passed to his son Caracalla (Ottaway 1993, 11). The presence of the Imperial household in York is generally presumed to have acted as a major economic stimulus. York was established as the capital of the province of Britannia Inferior in the early third century (Sheppard Frere 1967, 166-7), and was raised to the rank of a *municipium* and then *colonia* by AD 237 (Ottaway 1993, 64). It is unclear whether the granting of *colonia* status was accompanied by the settlement of a colony of veterans in the town, but it has been suggested that the presence of former soldiers associated with Severus (who was from North Africa) may explain the appearance of African-styled pottery in York in the early third century, the evidence for which is reviewed by Monaghan (1997, 872).

There is archaeological evidence for a major building campaign on the south-western bank of the river Ouse at this stage, which Whyman (2001, 199-202) links to the granting of *colonia* status. The Tanner Row area was re-organised, with earlier timber structures being replaced by a new stone building of sufficient size to be a public building (Ottaway 1999, 142), while at 1-9 Micklegate a substantial baths was built c. AD 225 (Monaghan 1997, 1102). An early third century terracing operation at Bishophill (Ottaway 1999, 143), was associated with hypocausted buildings (Carver et al. 1978, 38). Other buildings included baths complexes and temples to Serapis, the emperors' numen and Mithras (RCHM 1962, 54-7, 116, 119-21). It is thought probable that the *colonia* was walled, with the medieval city walls following the line of earlier Roman walling beneath, though conclusive evidence of this has only been seen on the north-western side of the *colonia* (Ottaway 1999, 145). Increasing population levels were reflected in the growth of cemeteries surrounding the *colonia*, which contain tombstones indicative of a cosmopolitan population (Monaghan 1997, 842).

The area between the river Ouse and the fortress was re-planned in the late second or early third century, and Ottaway (1999, 140) suggests that this may have accompanied a change of legal status for the area. New roads and buildings were constructed, including a bath-house, temples to the Imperial Cult and Hercules, and a large (possibly public) building with Ionic columns (RCHM 1962, 59, 119). It is unclear if the settlement on the northern bank of the river Ouse was part of the *colonia*; a dedication to Hercules by two men who may have been magistrates or members of a college of priests is known from this area, but although they were linked to York, it is unclear if they were connected to the *colonia* (RCHM 1962, 159). In 1986 the re-used coffin of a *decurion* was found in the Fishergate area between the rivers Ouse and Foss, which may suggest that the area north-east of the river Ouse was considered part of the *colonia* (Kemp and Graves 1996, 237-8). It is unclear what effect the granting of *colonia* status had on the surrounding area. Whyman (2001, 203-5) has suggested that the creation of the *colonia* was accompanied by the granting of land to veterans of Severus' army in the areas to the east of York (given that the area around the *colonia* was probably already dedicated to military provisioning), leading to the increasingly Romanised landscape of third century Yorkshire.

In AD 260 Britain was part of the breakaway empire of the Gallic provinces, which were recaptured in AD 274 by the emperor Aurelian, Britain rebelling again c. AD 286-296 with the British legions again supporting the losing side (Ottaway 1993, 96, 101). There was localised degeneration within the fortress at this time including dark-earth at 1-5 Aldwark (Ottaway 1996, 131), together with the disuse of the legionary bath building and blocking of its sewer (Monaghan 1997, 845).

The emperor Constantius Chlorus visited York in AD 306, and on his death his son Constantine I was proclaimed emperor in York (RCHM 1962, xxxiv). There is evidence of rebuilding in the fortress at this stage, with a new basilica superstructure with tile band decoration in the *principia*, while Barracks 1 and 3 were refitted; in addition, evidence of intense occupation was present at the legionary baths and barracks in Davygate (Phillips and Heywood 1995, 7). The surviving walling on the south-western side of the fortress has been stylistically dated to the late third to early fourth centuries (RCHM 1962, xxxiii), with the suggestion that this work may have been commissioned by Constantius (Sumpter and Coll, 1977, 89). As noted above (see p40) Hunter-Mann has recently suggested a much earlier date for this work.

By AD 314 there was a bishop in York (Ottaway 1993, 108), though archaeological evidence for Christianity is slight, comprising just two artefacts, a tegula with a Chi Rho graffito found beneath York Minster (Collingwood and Wright 1993, 142) and a bone openwork casket inscription S[OR]OR AVE VIVAS INDEO (Hail sister may you live in

God), which was found in 1901 in a coffin containing otherwise pagan grave goods (RCHM 1962, 135).

Despite the political upheavals of the late third century, affluent housing of late third or early fourth century date was present in the *colonia* (RCHM 1962, 53, 57; Ramm 1976, 39-44), on the northern bank of the river Ouse (RCHM 1962, 59), close to the eastern corner of the fortress (Brinklow et al. 1986, 40), to the north-east of the fortress (RCHM 1962, 65), and to the south-east of the *colonia* (Brinklow et al. 1986, 57). The development of elaborate housing in York reflects the appearance of villa like buildings in fourth century towns elsewhere in Britain (De la Bédoyère 1991, 149). There is little evidence for manufacturing in the *colonia* at this stage, suggesting that the town was surviving as an administrative centre (Ottaway 1999, 147). The military kilns to the south-east of the fortress were systematically cleared in the mid-late third century with the area being used for settlement during the later third and fourth centuries (Monaghan 1997, 845). Some internal fortress roads were resurfaced in the early fourth century (Ottaway 1996, 181, 295), suggesting that there was a functioning military presence, though it may have been a small one (Monaghan 1997, 847).

The mid-fourth to early fifth centuries marks the decline of Roman Britain. The political situation with constant rebellions, incursions by barbarians and civil wars, weakened the western empire beyond repair, and left Britain increasingly isolated. The number of troops stationed in Britain by the late Roman period is unclear (Millett 1990, 215-16), but occupation in the fortress of late fourth century date is evidenced by the insertion of a hypocaust in the centurion's house of Barrack 2 (Phillips and Heywood 1995, 116). The traditional date for the end of Roman Britain is AD 410 (Ottaway 1993, 111), but a sub-Roman culture continued in many parts of Britain, even if its precise nature is unclear (Millett 1990, 217). From the mid-fourth century evidence of decay in the *retentura* of the fortress (the portion housing the barracks and stores) is indicated by the accumulation of dark earths in some areas and by the partial demolition and robbing of some buildings (Ottaway 1996, 131, 159-60, 295).

From the mid-fourth century there was also a change in the character of the civilian settlements around York (Ottaway 1999, 147). Within the *colonia*, buildings fell into dereliction (Monaghan 1997, 1102, 1116; Carver et al. 1978, 50), and in some cases stone buildings were replaced by smaller timber structures (Monaghan 1997, 1115). Similar timber structures encroached onto the main road leading south-west through the *colonia* (Ottaway 1999, 148), while dark-earth accumulated in parts of the *colonia* (Monaghan 1997, 1116-17). Although there is abundant fourth century pottery on some sites it is unclear if this represents a substantial surviving population in the *colonia* or the breakdown of civic organisation leading to rubbish disposal within derelict buildings (Ottaway 1999, 147). The robbing and re-use of earlier sarcophagi may also indicate a breakdown in civil order (Monaghan 1997, 854).

Contraction of the occupied area is suggested by the presence of late Roman burials in the settlement on the north bank of the river Ouse at Coppergate (Ottaway 2011, 214-17) and at Hungate (P. Connelly pers. comm.). The last known activity seen in the extramural areas was at suburban villas at Clementhorpe and 21-33 Aldwark (Monaghan 1997, 850). There is little evidence of late third or early fourth century activity to either the north-west of the fortress or to the south of the Foss (Ottaway 2011, 159, 263). Monaghan (1997, 847) suggests that the lack of pottery dating to AD 360-410 on most extramural sites, coupled with a lack of pits and dumps of this period, is indicative of large scale abandonment of the extra-mural areas.

The nature of occupation in fifth century York is difficult to determine due to a lack of datable artefacts. However, the so-called Anglian tower on the north-western side of the fortress is most likely of fifth century date; in addition, wooden buildings were present at 24-30 Tanner Row and Clementhorpe which may be post-Roman, though these were difficult to date conclusively (Phillips and Heywood 1995, 9). There is a range of interpretations as to the nature of York in the immediate post-Roman period. Ottaway (1999, 148-9) has argued that by the mid-fifth century AD York was largely depopulated, seeing the presence of late fifth to early sixth century Anglian style cemeteries in Heworth and The Mount, just outside the fortress and *colonia* respectively, as representing the continuity of sacred associations rather than the continuity of settlement. In contrast, Monaghan (1997, 850) suggested that the presence of late fourth century, possibly fifth century pottery, at interval tower SW6, and on one stretch of the north-western fortress wall, may indicate that the fortress endured in a much reduced form into the fifth century. This is also suggested by continued use of a barracks at 3 Little Stonegate until the fifth century (Macnab 2001, 46-7). Phillips and Heywood (1995, 9) have suggested that York may have continued to function as some sort of administrative or ecclesiastical centre into the fifth and sixth centuries. An extensive deposit of pig bones (from young and suckling-pigs) in the immediate post-Roman horizons beneath York Minster has been interpreted as the result of aristocratic feasting, taking place in what had been the centre of Roman power in the north, an act designed to cement cohesion among a dispersed ruling class (Roskams 1996, 283-4). The volume of pig bones is certainly indicative of large surpluses being available for consumption, and therefore of agricultural activity in the vicinity (Roskams 1996, 283-4). Gerrard (2007, 305-6) interpreted this deposit as a deliberate attempt to connect to the Roman past, by using the former seat of Roman power for the consumption of pork, a food which was strongly associated with a Roman diet. Carver (in Phillips and Heywood 1995, 194-5), summarising the archaeological evidence from excavations beneath York Minster proposed three alternative models for late Roman York: the first being that there was no fifth to eighth century activity beyond pillaging derelict buildings, some cultivation and stray losses of pottery and artefacts; the second model suggesting no early Anglian activity, but the re-establishment of the area in the ninth-tenth centuries; while the third model proposed continuous activity.

It is clear that some Roman buildings remained standing for a considerable time, with excavations beneath York Minster suggest that the *principia* remained standing in the ninth century. Though written records are sparse, Alcuin wrote of the grant of lofty walls to St Cuthbert in AD 685 and talked of a great west gate in the town. The first Christian King of Northumbria, Edwin, was baptised in York in 627, while the Viking capture of York in 866-7 was a devastating blow to the kingdom of Northumbria (Tweddle et al. 1999, 115, 119), suggesting that York was an important centre of royal power from at least the early seventh to late ninth centuries. William of Malmesbury writing in the twelfth century also noted that York showed traces of its former Roman elegance (Phillips and Heywood 1995, 9, 69).

4 The production and use of Roman tile

4.1 The production of tile in Roman Britain

The use of ceramics for building purposes was introduced to Britain by the Romans, and a great deal of information relating to the production and use of tile in the Roman period has been derived from the study of over two thousand stamped tiles from Britain (catalogued in Collingwood and Wright 1992 and 1993). The stamped tiles have yielded evidence of military production relating to the legions, auxiliaries and the navy, together with municipal, imperial and civilian production. Tile stamps alone cannot, however, provide a full picture of production and use, as many tiles were never stamped.

Tile was produced in Britain within twenty years of Claudius' invasion, the earliest evidence of production being a kiln dating to AD 50-60 at Colchester, and the earliest known stamped tiles dating to the reign of Nero, AD 54-68, from Silchester and a nearby site at Little London (Greenaway 1981, 290). Late first century tiles are known at several sites in south-east England including examples pre-dating a major fire at Verulamium, caused by the Boudiccan rebellion, which occurred in AD 61, tile pre-dating AD 65 from Eccles, and tiles interpreted as Neronian and early Flavian from Fishbourne (McWhirr and Viner 1978, 360). It is also possible that stamped municipal tiles from London may be of late-first century date (McWhirr 1982, 34).

The date at which tile production ceased in Britain is more difficult to determine. Military stamps linked to specific emperors show that production by the Legio II continued until AD 222-35, possibly as late as AD 269-71, while the Legio VI was still producing tiles until AD 238-44, and the Legio XX was producing tiles in AD 213, possibly as late as AD 269-71, though this later date is less certain; in addition, many of the auxiliary stamps are of third century date (Collingwood and Wright 1992, 125, 196). From the mid-third century onwards the practice of stamping tiles declined in Britain, and the use of stamps also declined in other ceramic industries, such as the Oxfordshire potteries (Darvill and McWhirr 1984, 245-6). Despite the lack of clearly datable stamps it has been suggested that tile production at the military sites of York, Chester, and possibly Caerleon, continued until the fourth century (Collingwood and Wright 1992, 125), though the present study has uncovered little evidence for tile production in York from the mid-third century onwards. Fourth century production has been shown for kiln sites at Arbury in Warwickshire and Crookhorn in Hampshire (Warry 2006, 120), while fourth century construction using tile has been seen at a number of sites including Farningham in Kent (Collingwood and Wright 1993, 60), Batten Hanger in Sussex, Maiden Castle in Dorset, Sparsholt in Hampshire and Wantage in Oxfordshire (Warry 2006, 154-61).

Stone became increasingly popular for building purposes from the mid-second century onwards (Perring 2002, 120); in the early third century stone was used for roofing at Caernarfon (Grimes 1930, 44), Chester (Ward 1998, 65) and Gloucester (Heighway and Parker 1982, 31). In fourth century Cirencester stone was preferred for roofing tiles and for channelled hypocausts (McWhirr and Viner 1978, 371), stone pilae were also used in the fourth century villa at Chedworth (Bethell 2006, 12), and stone was used for fourth century roofing at Exeter (Betts and Foot 1994, 32). A substantial house in the *vicus* at Malton dating to c. AD 300 had stone pilae (Wenham1974, 38), and at Lincoln stone replaced tile for roofing in the fourth century (Perring 2002, 120). Although stone roofing became more widespread across south-east England in the later Roman period, ceramic tile was still commonly used (Perring 2002, 120). A similar shift to the use of stone tiles may have occurred in York, where a late Roman building at 21-33 Aldwark had a stone roof (Brinklow et al. 1986, 44-5). It is impossible to know if the increased use of stone was in response to a declining tile industry, or was the cause of its decline by reducing the need for ceramic products. The increasing use of stone must have resulted in buildings which varied in appearance regionally, dependent upon the types of stone available for use.

4.1.1 Military production

Clearly in such a heavily militarised province as Britain, the various branches of the military acted as both major producers and consumers of tile. Military production would logically be the earliest seen in Britain, unfortunately, it is impossible to prove that the military were producing their own tiles in the mid-first century since the practice of stamping military tiles did not commence until the late first century at the earliest, more probably the early second century (McWhirr 1979b, 254-6). No stamped tiles are known for either the Legio XIV Gemina or the Legio II Adiutrix, both of which were involved with the conquest of Britain, but which were withdrawn in AD 70 and AD 86-7 respectively (McWhirr 1979b, 254-5). The Legio IX did not stamp its' tiles while in Lincoln, but only after it moved to York in AD 71 (McWhirr 1979b, 254-5). Similarly the Legio II Augusta did not stamp tiles while in Exeter, but only after it moved to Caerleon, and even here the earliest possible examples date to AD 90-100 (Warry 2010, 127). The Legio XX began to stamp tiles after it was moved to Chester c. AD 87, though there is little clear dating evidence to precisely date the commencement of stamping by the legion (Collingwood and Wright 1992, 125). The earliest known stamped auxiliary tiles in Britain are from Slack, and these date to c. AD 90 (Hassall 1979, 264). It is unclear whether the practice of stamping tiles was in some way connected with the movement of the legions to their permanent legionary bases, or whether the practice simply represents the army gradually adopting a well-established civilian practice.

The location of the Legio II tileries at Caerleon and Carlisle is unknown (Collingwood and Wright 1992, 128), but both the Legio IX and Legio VI at York had kilns close to the legionary fortress (Betts 1985, 121-2) though these sites have not been fully excavated. The tilery of the Legio XX was at Holt, 12.5km to the south of the legionary fortress at Chester, but with excellent river and road links to the fortress. The twenty acre site had clay pits, and buildings that included a workmen's barracks, baths, a domestic house, workshops, a double-flue kiln, a drying shed with a heated hypocaust room and attached workshop, a kiln-plant comprising a row of six single-flue rectangular kilns, three of which were for tile and three for pottery production, and two later single-flue pottery kilns (Grimes 1930). This site is known to have produced antefixes bearing seven differing Legio XX designs, only three of which have been seen in Chester, an additional antefix type from the same series found in Chester was almost certainly made at Holt, but was not found during the excavations at the site (Toynbee 1964, 428-9).

There is one early civilian stamp from Caerleon which may suggest that the Legio II purchased tiles from civilians prior to establishing its' own kilns. The Legio XX began to use tile produced by non-military personnel from the end of the first century, and it has been suggested that the Legio XX sub-contracted out all tile production from c. AD 130 onwards (Warry 2010, 145). A Legio XX stamped tile from Holt has the additional letters SVB LOGO PR interpreted as 'under Logus principis'; as the name Logus was popular among freedmen it is unlikely that this man was a soldier (Collingwood and Wright 1992, 193), and it has been suggested that the Holt tilery had been sub-let or sold off to a contractor (Warry 2010, 137). The leasing-out of a military kiln site is also known from a tile stamp in Dalmatia (Warry 2010, 139). Production at Holt may have ceased by AD 150, to be replaced by tiles and pottery produced for the Legio XX by civilians at a site at Tarbock (Swan and Philpott 2000, 56).

The distribution of legionary tiles is largely limited to military sites, indicating that production was primarily for the army's own needs rather than for commercial gain. There is no evidence of the legions supplying tiles to one another, but they did supply auxiliary forts. For example, Legio IX tiles are known from Castleford (Warry 2010, 145), and Legio II tiles are known from Aberyscir (Hassall 1979, 261). A similar link between legionary tiles and auxiliary sites has been noted in Dalmatia (Wilkes 1979, 67).

Several auxiliary tileries are known, some of which were clearly major enterprises, an example being the nine kilns present at Brampton (McWhirr 1979a, 104-7). Auxiliary tileries present a different pattern of supply to that seen on legionary sites, as illustrated by the Grimescar tilery which was operated by the Cohors IIII Breucorum, and supplied not only their fort at Slack, but also forts used by other auxiliary units at Manchester and Castleshaw (Collingwood and Wright 1992, 196). The fort at Slack has produced over a hundred examples of Cohors IIII Breucorum tiles, but has also yielded one Legio IX tile and two Legio VI tiles from York, while the fort at Castleford has tiles of the Cohors IIII Gallorum and the Cohors III Breucorum, together with Legio IX tile (Warry 2010, 145). This suggests that auxiliary forts drew supplies from multiple sources as required.

The Roman navy, the *Classis Britannica*, also produced tiles for the buildings at its various bases, and although the precise location of their kilns is unknown, petrological analysis suggests manufacturing was based both in the central Weald and near Boulogne in France (Peacock 1977, 239). There are 119 known naval stamp dies, which is a larger number than for any one of the legions in Britain, nine of these stamps are on French manufactured tiles, the remainder being on British manufactured tiles (Collingwood and Wright 1992, 127; Collingwood and Wright 1993, 3). Four of the sites which have produced naval tiles are inland in the Weald area, three of which were iron working sites, while the fourth was probably an inland port in Roman times; the association between naval tiles and iron working sites has given rise to the suggestion that the navy controlled iron production in this area or was responsible for the distribution of iron to military sites (Brodribb 1979a, 141). Classis Britannica tiles have also been found in London and Betts (pers. comm.) suggests that they were transported there as deliberate cargo rather than as ballast.

Little is known of how the labour at military tileries was organised. A *magistri figlinarum* in charge of sixty men is recorded from continental Europe (Hassall 1979, 262), and a work-list on a wooden tablet from Vindolanda details that men from the ninth cohort of Batavians were sent to work at the kilns, while others were sent to dig clay (Millett 1995, 79). A second century tile from Holt which has both a Legio XX stamp and a graffito by an auxiliary soldier from the first cohort of Sunici based at Caernarfon (Warry 2010, 139), shows that auxiliary units sometimes sent men to work at the legionary tile centres under the supervision of the legionary tile-master. It has been suggested that the large variety of legionary stamp-dies for the Legio VI is the result of each cohort within a legion having its own die, with the dies being in use concurrently (Warry 2010, 127, 132).

There are a limited number of examples of military tiles from civilian sites in Britain, including from the civilian settlement adjacent to the fortress at Caerleon (Wilson and Wright 1965, 225), in the *colonia* at York, a Legio IX tile from Aldborough (Wright 1978, 37), and Legio XX tiles from Silchester (Collingwood and Wright 1992, 181). Occasional supply to settlements adjacent to military sites seems logical and may even represent recycling. In the case of Aldborough the settlement was built as a political act to serve as the *civitas* capital of the Brigantes, which may suggest military involvement, while the tiles at Silchester have been interpreted as state construction of a baths complex under the emperor Hadrian, using military labour (Warry 2010, 143).

4.1.2 Municipal and imperial production

The only known municipal tileries in Britain are at London and Gloucester, which seem to have commenced operation c. AD 75 (Betts 1995, 222) and the early second century respectively (Heighway and Parker 1982, 28-31). The municipal tilery for London was at Brockley Hill (*Sulloniacis*) 22km north-west of London, which had excellent road links to the capital in the form of Watling Street (Betts 1995, 215). Production at the site was limited to the period AD 75 to AD 120-25, and can be directly linked with the need for tile generated by a massive public building campaign that began shortly after AD 70 (Betts 1995, 207, 222). There is also evidence that some municipal tiles were produced in central London (I. Betts pers. comm.). The municipal tilery at Gloucester was located close to the northern walls of the *colonia*, and while the bulk of the output was clearly intended for use within the *colonia*, municipal tiles have also been recovered from three sites to the immediate east of the *colonia*, from the nearby villas at Hucclecote, Dryhill, Ifold and Frocester, and one outlier from Kenchester, Herefordshire, 45km to the north-west of Gloucester (Collingwood and Wright 1993, 41-55). While this could indicate that the villas and suburban sites had an official link to the town, perhaps lying in the *territorium* of the *colonia* (Clifford 1955, 68), this was unlikely to be the case for Kenchester. The tile distribution could equally suggest that products of the municipal tilery were sometimes sold on the open market, or that salvaged material from Gloucester was occasionally sold on for use elsewhere (Darvill and McWhirr 1984, 248).

A few stamped tiles naming Nero have been found at Silchester and a nearby tilery site at Little London, and it has been suggested that these tiles were products of an imperial estate (Collingwood and Wright 1993, 26). There are also some tiles stamped IMP for 'imperial' from the Carlisle area, which may represent imperial production (Collingwood and Wright 1993, 26), however, these include examples from the military tilery at Scalesceugh (Tomlin and Hassall 2006, 475), which may suggest that they were of military origin rather than being linked to an Imperial estate.

4.1.3 Civilian production

Civilian producers had been stamping tiles in Italy since the Late Republican period, though whether this was to act an advertisement, to monitor quality or to prevent theft is unclear (Collingwood and Wright 1992, 125). While civilian tile production might be thought of as following on from military production in Britain, the earliest known civilian tiles, stamped with the personal name RTVSCVS, were made c. AD 75 for the Legio II at Caerleon, prior to the establishment of the legionary kiln (Collingwood and Wright 1993, 82). This suggests that civilian tileries were established in Britain by the late first century, though clearly in the case of Caerleon this was to supply the needs of the army.

Many differing stamp dies are interpreted as being those of civilian manufacturers, but in the majority of cases the stamps are seen on only a few examples, with a limited geographical range. The exceptions are Lincoln which has yielded a group of around forty stamped tiles (Collingwood and Wright 1993, 56) and Gloucestershire which has produced substantial numbers of stamped tiles in a wide variety of designs which have a date range of c. AD 100 to the mid-third century (Darvill 1979, 313).

The majority of civilian tile stamps in Britain comprise letters interpreted as a *tria nomina* of either the tile maker or tilery owner (Wiseman 1979, 221-30). In the case of a series of tiles from Gloucester stamped TPF followed by an additional letter A, B, C or P (Collingwood and Wright 1993, 56), or the Lincoln series of tiles stamped LVL followed by the letter A, D, E or P (Bogaers 1977, 275-7), it has been suggested that the additional letter may stand for individual workshops within a tilery owned by one person. Alternatively, given that it was common for slaves to adopt the first two names of their former master on manumission, it is possible that the first two letters represent the former owner of a group of manumitted slaves, with the third/fourth letters representing the slave's own name, while a third interpretation is that these stamps represent members of the same family distinguished only by their cognomen (McWhirr and Viner 1978, 366-7).

There is evidence for the use of slaves in civilian tile production, with tiles stamped IVC.DIGNI being interpreted as 'Iucundus slave of Dignus' (Wiseman 1979, 225), while a tile from Greetwell, Lincolnshire, has a graffito LIBIIRIISTO interpreted as 'let him be free', perhaps implying that the maker was a slave (Collingwood and Wright 1993, 140). In Italy a slave is known from tile stamps who, on manumission, became the foreman and finally the owner of a tilery (McWhirr and Viner 1978, 367). A series of stamps found on several sites in London is interpreted as meaning 'tile (kilns) of Decimus M…Val… and Decimus M…P…' with both men being freedmen (Collingwood and Wright 1993, 61). Names mentioned in graffiti on tiles show a high proportion of Celtic as opposed to Latin names (Tomlin 1979, 238), suggesting native workers. It has been suggested on the basis of epigraphic evidence that the Viducius named on stamped tiles from Tarbock, which were clearly made for the Legio XX, may have been a member of a family supplying ceramics to the military over several generations (Swan and Philpott 2000, 56).

Given the presence of so many stamped tiles, Gloucestershire has the most studied civilian tile industry in Britain, and there were clearly differing levels of production. The stamps can be divided into several groups, of which those stamped LHS or TPF followed by A, B, C or P, together with those stamped TPLF and TCM have wide distribution patterns, while those stamped ARVERI, VCA or VLA, LLH and LLQ have smaller distribution patterns (McWhirr and Viner 1978, 368-71). By far the largest tilery in the area, indeed in Britain, is Minety 10km south-east of Cirencester, which had at least ten kilns together with stone buildings interpreted as workshops and living quarters (McWhirr 1979a, 102). The Minety site covered a larger area than the extensive legionary kiln site at Holt, but was very different in terms of layout, with the kilns at Minety being spread over a wide area rather than being arranged in a kiln-plant as at Holt. Stamped tiles in LHS fabric 1 and TPF fabric 1 have been found at Minety (Collingwood and Wright 1993, 64 and 74) but petrological analysis suggests the tiles stamped TPFA/B/C/P were also produced at the site (Darvill and McWhirr 1984, 255). The irregular layout of the site, coupled with the presence of both LHS and TPF tile stamps, implies that at least two different producers were present at the site. The various TPF tiles were traded over a 50km wide area centred on Cirencester (McWhirr and Viner 1978, 370), while the LHS tiles were even more widespread, ranging from Cirencester to Silchester, with one outlier from Kenchester in Herefordshire (Darvill 1979, 315, 328). The presence of nearby Ermine Street undoubtedly helped with the sale and distribution of tile from Minety (Darvill and McWhirr 1984, 253).

On the basis of fabric analysis it has been suggested that the TPLF and ARVERI tiles were produced from a single source of clay, possibly with a production centre located on the outskirts of Cirencester (Collingwood and Wright 1993, 57, 78). The distribution pattern of these tiles is noticeably more restricted than the Minety products, perhaps suggesting a smaller scale enterprise. Tiles with these stamps were traded over a 20km radius, with the addition of one or two outlying sites that may have been supplied using water transport (Darvill and McWhirr 1984, 250).

It is clear that peripatetic production was responsible for supplying some of the tiles in the Gloucestershire region. For example, TPF fabric 2 tiles are only found at the site of Hucclecote villa and seem to have originated there, implying that a manufacturer from Minety travelled to the villa and established a kiln or clamp at the site, in order to produce the tiles required for a major phase of construction at the villa (Darvill 1979, 319). Presumably the volume of tile required for the building works justified the construction of a kiln at the site. The widespread distribution of the TCM stamped tiles on sites from Warwickshire to Gloucestershire may also suggest peripatetic production (McWhirr and Viner 1978, 370).

Tiles stamped VCA or VLA, from Gloucestershire are present over a restricted geographical area (McWhirr and Viner 1978, 370), which may suggest that they relate to production for a single estate. The LLQ and LLH stamped tiles are restricted to Gloucester and Cirencester respectively, with one outlier for the LLQ tiles, suggesting that these tileries were small-scale producers located close to their respective markets.

4.1.4 Models for tile production

Peacock (1979) suggested that tile production could be subdivided into a series of types: the first category is household production designed to supply the needs of a family; the second type is small rural brickyards which have to be close to both raw materials and their market in order to be commercially viable; larger nucleated brickyard complexes occur where several producers congregate to take advantage of excellent supplies of raw materials and good communication links, to make the transport of products to markets affordable; estate production is designed to supply the demands of an estate, though products could be sold on for profit; and municipal production is controlled by civic authorities. Peacock (1979, 8-9) also pointed out that most modern commercial brickworks have two kilns, so that while one is being fired the other can be unloaded/loaded, thereby enabling continuous production. Only six civilian tileries in Roman Britain had multiple kilns (McWhirr 1979a, 104-7), which may suggest that most sites were designed for intermittent rather than continuous production. Peacock (1979, 8) noted that the majority of civilian tileries were located away from the main centres of population, suggesting that most were estate kilns designed to meet intermittent requirements.

Darvill and McWhirr (1984) have suggested an alternative model for tile production based on the study of tile stamps, though there is considerable overlap with Peacock's categories. Darvill and McWhirr's levels of production are military and municipal, district production supplying the short term needs of major towns, clustered industry where groups of producers come together at a site to take advantage of good supplies of raw materials, peripatetic manufacture supplying one-off-demand at a site, and finally, estate production to supply the demands of an individual land-owner.

While evidence can be found of tile production matching each of the categories suggested by both Peacock and Darvill and McWhirr, it is clear that the pattern of manufacture and use was considerably more complex. Thus, in the case of the military several systems of production are known, including direct military production, purchase of products from civilian manufacturers, and the leasing out of military kilns to civilians; in addition, production and supply for auxiliary forts clearly differed from that of the legions in terms of scale, continuity, and the distribution patterns seen. The study of Italian tile stamps has shown that land owners leased out tileries, which was a lucrative business involving senatorial families (Warry 2006, 122). Neither Peacock's nor Darvill and McWhirr's models take into account the presence of specialist producers trading over long distances, this has been suggested on the basis of fabric analysis for relief-patterned box flue tiles, which were traded over distances of 100km (Warry 2010, 140). The influence of the availability of prodigious quantities of clay and fuel may also have been underestimated in terms of kiln location and duration.

Because of their weight there has been a tendency to assume that tiles were always produced near to the point of consumption so as to reduce transportation costs, but this was clearly not always the case. A tile group recognised by distinctive calcareous clay and the round-topped flanges of the tegulae is known from various sites across southern England including Exeter and London, with a known distribution of over 400km (I. Betts pers. comm.), though the location of the tilery is unknown. These tiles must have been transported around the south coast by ship, and are present in sufficient quantity in London to suggest that they were deliberately imported rather than occurring as a result of movement as ballast (Betts and Foot 1994, 22, 27, 32). In third century London tiles were imported from Harrold in Bedfordshire some 84km away (Betts 1987, 28). Long distance trade in tile is seen elsewhere in the Empire; by the first century AD tiles from Imperial brick factories in Dalmatia were being shipped across the Adriatic and along the Dalmatian coast, with a small proportion travelling by road; in addition, roughly a third of the brick stamps seen in Dalmatia seem to originate in north-east Italy, representing further evidence of trade by sea (Wilkes 1979, 69). Bricks were also shipped from North Africa to Rome (Betts 1985, 20). It is also clear that other building materials were traded over considerable distances, with Forest of Dean stone tiles being used for roofing in Cirencester, and Swithland slate from sites to the west of Leicester being traded over 80km from their source (McWhirr and Viner 1978, 371). Clearly building materials were sometimes traded over considerable distances.

4.2 Production of tile in Roman York

4.2.1 The Legio IX

The Legio IX was stationed in York from AD 71 to c. AD 120, when it was redeployed away from York (Collingwood and Wright 1992, 125). The Legio IX stamps date to AD

71 at the earliest, but may be slightly later, and continued in use until the legion left York. Sixteen stamp-dies are known for the Legio IX, most with the number nine in the form IX, but a few stamp-dies from the Hadrian's Wall area post-dating AD 120 have the nine in the form VIIII (Collingwood and Wright 1992, 168-74). The Legio IX stamps are fewer in number than for other legions, because they left Britain within 50 years of the practice of stamping being adopted (Collingwood and Wright 1992, 127).

The Legio IX is known to have produced tiles and pottery in York, and although no kilns have been located the tilery is known to have been in the vicinity of St Cuthbert's church, Peasholme Green, approximately 180m south-east of the fortress. Tiles with the legionary stamp were uncovered under the north aisle of the church prior to 1818 and again in 1836, and these were interpreted at the time by the excavator Hargrove as being indicative of a production site (King 1973, 213). Excavations in the 1970s in gardens bordered by St Cuthbert's churchyard and the city walls uncovered half a ton of tile and pottery, in three heaps, including sherds of vitrified kiln wall and kiln furniture (King 1975, 213). Nine of the tiles had Legio IX stamps, and there was a graffito on one of the tiles which read OTTO…COM, presumably the name of the maker (Collingwood and Wright 1993, 127). The pottery from the site is a form known as York Legionary ware, or Ebor Ware, and adjoining sherds of pottery were found in the differing dumps, implying that all the material had originated over a short space of time; it has been suggested that these large dumps may represent the Legio VI clearing out the Legio IX kilns, and dumping the material into an earlier clay pit (Betts 1985, 121). Although tile wasters were present at the site there is no mention of pottery wasters in King's report to confirm that pottery was made in the same kilns as the tile.

Stamped Legio IX tiles have been found on other military sites in the vicinity (Castleford, Malton and Templeborough), and on civilian sites including the *colonia* at York, Aldborough (the Brigantian *civitas* capital), Old Wintringham (Humberside), and further afield from Hilly Wood, Bainton in Northamptonshire. All match stamp-dies from York with the exception of the two dies from Malton which are unknown in York (Collingwood and Wright 1992, 168-74). The only known stamped voussoirs in Britain relate to the Legio IX (Collingwood and Wright 1992, 127).

It has been suggested that the relative lack of first century military tiles is because most military buildings at this stage were of timber and could have been roofed with thatch or shingles, with the few buildings that required tiles, notably bath houses, representing limited commissions (Collingwood and Wright 1992, 125). Later remodelling of the early fortress in stone must have generated a demand for tile stimulating production by the Legio IX.

4.2.2 The Legio VI

The Legio VI arrived in York c. AD 120 and it had adopted the practice of stamping tiles in Lower Germany prior to its arrival in Britain. There are ninety-four known stamp-dies for the legion, which is the largest number for any legion in Britain (Collingwood and Wright 1992, 148). The Legio VI tile stamps have many nomenclatures relating to imperial titles (Hassall 1979, 262); the legion already had the titles *victrix* and *pia fidelis* on arrival in Britain, and numerous tile stamps reflect this with variations in the lettering including the forms LEGIONIVI, LEGVIV, LEG·VI·V, [...]I·V, LEG·VI·V[.], LEGVIV, LEG·VIVI, LEG·VI·VIC, LEGVIVIC[..], [...]VIVIC, [...]VI·VIC, [...]V·P, LEG·VI·VP, LEVI·V·P·F, LEVIV·P͡F, LEG·VI·V·P͡F, [...]IVPF, [...]VP͡[.]. LEG·VI·V·P͡F, LEGVIV[...], LEGVIVPF, [...]VIPF, LEG VI VIC PF, [...]VICPF, LEGVIVICTPF and LEGVIVIT·PF (Collingwood and Wright 1992, 148-166). York has produced tiles stamped [..]GVI VIC BPF, while at Carpow in Scotland there are tiles stamped LEG·VI·VIC·B·P·F. with the letter B representing the title *Britannica,* which could relate either to Commodus who took the title in AD 184, or to Septimius Severus who took the title with his sons in AD 210. Collingwood and Wright (1992, 148) favour the AD 210 identification which seems logical given that the tiles in question were from Carpow in Scotland where Severus campaigned, but it has been argued on the basis of the cutaway forms of these tiles that the identification with Commodus is the more likely (Warry 2010, 141). The legion was granted the title *Antoniniana* by Caracalla in AD 212, which is seen on a tile from York stamped [...]VIC·ΛNT, while the title *Severiana* granted by Severus Alexander between AD 222-5, is seen in stamp lettering LEG·VISEV, [...]VISE͡VP͡F, [...]VISVP and LEGVIVƧΛ on stamps from York (Collingwood and Wright 1992, 148, 155, 162). The last known dated tiles relate to the Emperor Gordian III, AD 238-244, who gave the legion the title *Gordiana,* which is seen on tiles from York stamped LEG·VIG[..], LEGVIGOR, [...]GOR , LEG·VIGOR (Collingwood and Wright 1992, 156). It has been suggested by Collingwood and Wright (1992, 125) that production of unstamped tiles by the legion may have continued into the fourth century, but they present no supporting evidence.

The Legio VI tilery has not been found, but a road of probable mid-second century date at 21-33 Aldwark incorporated tile wasters, kiln debris and two overfired tiles with Legio VI stamps, suggesting that the kiln was located somewhere nearby, placing it slightly to the north-west of the earlier Legio IX kilns (Betts 1985, 122). Finds in the Peasholme Green area also indicate the presence of kilns; deposits of waste Ebor Ware pottery and tile at the Adams' Hydraulics site, interpreted as being of early third century date, imply manufacture nearby. Charcoal and ash deposits 0.5m thick, including sherds of kiln structure, were revealed by augering on a site at Peasholme Green, and these were interpreted as the deliberate dumping of kiln-derived material, perhaps resultant from a major clearance exercise in the area (Swan and McBride 2002, 183, 191-2). Since only thirteen of the ninety-four differing dies used by the Legio VI were present on the Peasholme Green site, it has been argued that production in the area was intermittent, and that the legion may have had other tileries sited elsewhere (Swan and McBride 2002, 183, 191-2). A number of tiles with Legio VI stamps at New Earswick found in 1926 were interpreted as the site of a legionary kiln, but the lack of wasters casts doubt on this interpretation (Betts 1985, 122-3).

4.2.3 Civilian production

There is some evidence for civilian tile production in York with five civilian stamped tiles present in the fortress and *colonia* (Collingwood and Wright 1993, 55-8, 68, 72). A tile from the Yorkshire Museum collection was stamped AGR[...] in an ansate frame with the G being inverted. A tile stamped AGRIPA was found in excavations undertaken by YAT in 1981 at Rougier Street, and a second civilian stamp from this site, found in a late second century context, bore the letters MVCOA or MVCVA in an ansate frame (context dating from the site archive and Monaghan 1997, 1107). The presence of ansate panels on two of these stamps is unusual, as this design was rarely seen outside military contexts (Warry 2006, 138). An incuse stamp bearing the letters AV was found in 1931 at the legionary baths in the fortress. A fifth civilian tile stamp, found in 1966 on the site of the Prudential Insurance buildings on Blossom Street, bears the letters TITVS [...] (Collingwood and Wright 1993, 72).

Although no clear evidence of a civilian tile production site has been excavated in the vicinity of York, a civilian pottery with two circular kilns, which dated from the late first to mid-late second century, has been excavated at Apple Tree Farm, Heworth, 3km north-east of the fortress (Lawton 1993, 4-8). The precise nature of the Apple Tree Farm site is debated; the presence of mortaria stamps with ansate panels and of Legio IX pottery forms, have been used to suggest a military connection for the site (Lawton 1993, 7). Against this, mortaria stamps were present from two potters, Vitalis and Mercator, which lacked ansate panels (Lawton 1993, 7), suggesting that they were civilian manufacturers, and Monaghan (1997, 1142) has argued that the pottery produced at the site was of a strongly civilian character.

Lawton makes no mention of the production of tile at the site, and the fact that the kilns were circular suggests that they were for pottery rather than tile manufacture, as Romano-British tile kilns were always square or rectangular (McWhirr 1979a, 98). Swan and McBride (2002, 194) stated that no legionary stamped tiles were known from this site, but other authors (Monaghan 1997, 1142; Roskams 1999, 61) state that two Legio VI tiles were present, though Roskams noted that it was unclear if these tiles were from the kiln site or a nearby building.

One of the ansate civilian tile stamps from York contained the letters AGR[...] with the letter G upside down, a similar stamp, also with an ansate panel bearing the letters AGRIPP, with an upside down G and the first P reversed, is known from mortaria made at Apple Tree Farm (Lawton 1993, 7). Ansate panels were equally uncommon among civilian tilers and mortaria potters (Dickinson and Hartley 1971, 133-6). The links between the stamps may therefore suggest that both tiles and mortaria were produced by a single manufacturer at the Apple Tree Farm site, but given the limited scale of the excavation, no clear evidence of tile production was recovered. Links between tile and mortaria production have been noted elsewhere, Swan (1984, 98) records that slow fired objects like tile and mortaria were often fired together on the continent.

4.3 The use of ceramic building material

Tile are known from sites as early as the second century BC, such as the basilica of Pompeii, but tiles were not the dominant building material used in Roman architecture at that time (Sear 1982, 76). The earliest large-scale brick building in Rome was the *Castra praetoria* built by Tiberius in AD 21-3 (Adam 1994, 145). Arguably the greatest stimulation to the development of the use of tile in architecture was the Great Fire of Rome in AD 64, which resulted in a remarkable building boom. Tile, which could be manufactured far more quickly and cheaply than quarried stone, was the favoured material for the rebuilding programme. Tile remained the dominant building material in Rome from then onwards, with the overwhelming bulk of buildings in the city being built of brick faced concrete walls, with the reign of Hadrian representing the peak period of tile production (Bloch 1941, 4).

Tile has some advantages over stone for construction, it can easily be made to predetermined sizes and shapes to suit specific building needs, and it can withstand considerable changes in temperature, which could cause stone to fracture (Webster 1979, 287). The ability to easily mould clay into differing forms made it of particular use for items where the carving of stone would be time consuming, such as for drains (Perring 2002, 109). Tile could also be made anywhere with a suitable clay source, which is usually more widespread than supplies of suitable building stone. Tile could also be used to augment walling of lower quality stone, as at Silchester, where tiles were used to re-enforce a wall footing made of the locally available flint, which is a far from ideal building stone (Perring 2002, 109).

While in Italy entire buildings were often constructed of brick faced walls, *opus testaceum*, such as Trajan's Markets in Rome (Sear 1982, 161), this was not the case in Britain, where the larger public buildings were constructed primarily of stone, with the majority of smaller buildings being of timber (Webster 1979, 285). For example, tile was not used in the walls of the palace at Fishbourne, though it was used for the roofing, flooring and for the specialised tiles required for the bath-house (Webster

1979, 287). The preference for stone for Britain's public buildings was presumably due to plentiful locally available supplies over much of the country. There are, however, very few examples of tile walls in the south-east of England, despite the lack of naturally available stone in the area, which might suggest that the preference for stone was a question of taste (Williams 1971, 177).

The use of horizontal tile bonding courses, two to three tiles thick, at regular intervals within stone-faced rubble core walls, appeared in Roman Gaul prior to the conquest of Britain (Perring 2002, 108). Similar bonding courses are seen in Britain on public buildings such as the baths at Jewry Wall in Leicester (de la Bédoyère 2002, 22), but they were also used on domestic structures in the second and third centuries, and are typical of third century fortification walls, such as those of London dating to c. AD 200 (Blagg 1979, 280). Tile bonding courses helped to even off walls and dry off lifts while work was on-going (Perring 2002, 109), but they may also have had a decorative purpose (Blagg 1979, 276). It has been noted that such bonding courses may have inadvertently introduced fault lines into buildings (Perring 2002, 109).

The decorative properties of tile were often exploited in walling. For example, most of the architectural details, including a blind arcade of bricks above a row of clerestory windows in a fourth century facade at Meonstoke, were executed in red brick, separated by thick bands of white mortar (de la Bédoyère 2002, 60); in addition, columns of segmental brick are known from Verulamium, and decorative brickwork was also seen at fourth century Caerleon (Blagg 1979, 279-80).

The most extensive use of tile in Britain was for roofing, but no ancient roofs have survived in Britain, indeed they are rare anywhere, consequently relatively little is known of their construction. Roofing tiles are particularly vulnerable to breakage; at Fishbourne Palace it has been calculated that 43,000 tegulae would have been required for the roof, but only three complete examples were found, while a national survey of tile in Britain recorded only 620 complete tegulae, insufficient to roof a small bath-house (Brodribb 1989, 12). Ceramic tile was used as a roofing material soon after the conquest and appeared on pre-Boudiccan timber framed buildings at Colchester (Perring 2002, 120). Not all buildings had tiled roofs, and it is assumed that thatch was commonly used on lower status Roman buildings. A collapsed thatch roof has tentatively been identified in London (Perring 2002, 120). Tile roofs in Britain seem to have used both tegulae and imbrices, and there is no conclusive evidence for imbrex-only roofs, made by alternating overlapping rows of imbrices facing up and down, which are known from Gaul (Warry 2006, 108-9). (Imbrex are defined on p78). The use of tiles of different colours on the same roof has been noted at Fishbourne and in London red and yellow tiles were used (Perring 2002, 121), at Lullingstone, Kent red tiles interspersed with yellow tiles were used (De la Bédoyère 1991, 26), and at Piddington villa where blue imbrices and cream tegulae (defined on p79) were used for decorative effect, there is also evidence at Piddington of the use of a red wash or slip on some of the tegulae and finials (Ward 1999, 15, 19).

Ancient roofs are generally assumed to have had a pitch of about 20°, which is the angle recommended by the architect Vitruvius (writing in the reign of Augustus), this angle is seen on surviving Roman roofs at Herculaneum, the Maison Carré, the portico of the Pantheon and the Portico of Octavia (Rook 1979a, 295). It also seems to have been the pitch of the collapsed facade of a Roman villa at Redlands Farm in Northamptonshire, which had a tile roof (Warry 2006, 102). It is clear, however, that there was variation in roof pitches in Britain, though this was largely related to the choice of roofing materials, with thatch shingle and stone roofs generally having a steep pitch and tile roofs having a shallow pitch (Perring 2002, 120). At Meonstoke there was a stone tiled roof with a pitch of 47.5° and at Batten Hanger villa, Sussex, there was a roof with a 60° pitch, which was thought to be thatched (Warry 2006, 102).

Tile was extensively used in bath-houses which required specialised tiles for the heating systems. In early bath buildings the transfer of heat through the floor was inefficient, resulting in small tunnel-like buildings designed to reduce heat loss. Advances to heating systems through the use of tile wall-linings improved heat transfer, facilitating the construction of larger more elaborate baths; Seneca writing in the first century AD contrasted the small dark cramped baths of Scipio Africanus' day with those of his own, where both bathing and sunbathing was possible (Rook 1979b, 303, 306). Several types of tiles were used to create a continuous cavity wall within a room, these included the use of flat tiles with projecting lugs (tegulae mammatae, see p79) fixed to the wall with iron clamps or nails, flat tiles with flanges at the corners (half-box flue tiles), or hollow square sectioned tiles (box flues). The earliest surviving example of the use of box flues to line an entire wall is the Central Baths in Pompeii which were under construction in AD 79 (Rook 1992, 16). An alternative to the use of tiles to transfer heat through walls was to line the room with tufa, as at Griggs Bridge or Richborough (Rook 1979b, 305). It is not certain if the hot air from hypocausts also passed from the wall-linings and through vaulted roofs. For example, the section of hollow voussoir vaulting at Bath clearly shows the cavities blocked by transverse flat tiles (Rook 1979b, 303), which might suggest that the primary function in this case was to reduce the weight of the roof. By the first century BC clay pipes were used as chimneys to vent gasses, with an example visible at the Central baths in Herculaneum (Rook 2002, 12). It should be noted that not all rooms in baths had hypocausts; a brazier installed in AD 29 was still in use to heat the tepidarium of the Forum Baths in Pompeii in AD 79 (Rook 1979b, 303). Production of flue tiles may have been highly specialised, creating shortages when the tile industry went into decline in Britain. In response to this, the late fourth onwards saw extensive robbing of earlier bath-house tiles, for re-use in later hypocaust systems (Webster 1979, 287). Thus, late second century relief-patterned tiles made in Harrold, Bedfordshire, were found in the late third to fourth century bath-house at Brixworth, suggesting re-use, while other relief-patterned tiles were re-used in a fourth century bath-house at Cobham, Surrey (Betts et al. 1994, 51-52).

5 Methodology

5.1 The dataset

A total of 8.11 metric tonnes of tile was analysed, this comprised 7.7 tonnes of tile from 215 archaeological excavations undertaken by YAT since 1973 (listed in Appendix 2), and 0.4 tonnes from excavations at Heslington East 2008-11 undertaken by the Archaeology Department of the University of York, directed by Dr C. Neal. The size of the study area, a 4km radius from the centre of York, is purely pragmatic, the overwhelming bulk of YAT excavations having taken place within this area. The sherds were recorded to a standard YAT methodology which is described in Appendix 3, together with details of the various computer programmes used for the production of the tables, graphs and figures in the present study.

It is important to note that tile not included in this study comprises the collections of the Yorkshire Museum, the collections of York Minster, tile excavated in York by commercial archaeological units other than YAT, and tile excavated in the city by amateur excavation groups. Some tile from YAT excavations undertaken in the 1970s and early 1980s was transferred to the Yorkshire Museum at the time of excavation, such as that from the major Roman site at Blake Street (YAT project code 1976.5), and this material was not, therefore, included in the present study (though much of this tile was covered by Betts 1985). Any items removed from YAT collections for museum display are also excluded. Finally, any YAT excavations which were on-going on the 30th July 2010, or which have been undertaken since that date, were not included as this was the cut-off point for data-selection for the present study.

5.2 The selection of sites for detailed stratigraphical analysis

A large proportion of the tile analysed is from excavations that have not been fully published, though for most sites some form of archive report or grey-literature report exists detailing the stratigraphic sequence. For many excavations predating the early 1990s the archives mainly comprise paper records, with little computerised data available. It would have been impossible within the time frame of the present study to go through all 215 site archives in order to determine the phasing information for each of the contexts bearing tile; in addition, for many smaller sites detailed pottery dating is unavailable, reducing their research potential. The decision was therefore taken to select a smaller number of sites for detailed stratigraphic analysis. These were to be representative of the fortress, the *colonia*, the environs to the south-west of the *colonia* and the environs to the south-east, east and north-west of the fortress (Appendices 8-13). Ideally the sites selected for detailed analysis needed to fulfil the following criteria:

1) To have yielded a substantial quantity of tile from stratified Roman deposits.

2) To have a continuous sequence of deposits dating from the entire period of Roman occupation, to enable analysis of the chronological changes to the tile.

3) To have undergone sufficient post-excavation analysis for both accurate phasing and detailed pottery dating to be available.

While it was possible to select sites within both the fortress and *colonia* for such analysis, no single site in the environs matched all three of the criteria listed above. In order to have sufficient tile for analysis, therefore, four groups of smaller sites were chosen to the south-east, east and north-west of the fortress, and to the south-west of the *colonia*. The sites selected are summarised in Table 1, with the locations depicted on Figure 3 (with the exception of Wentworth House, which lies slightly beyond the limits of this figure, and its location is given on Figure 140). Collectively the sites selected for detailed stratigraphic analysis yielded 2,371,416g of tile, representing 29.2 percent of the overall total. All the sites selected for analysis have either been published in full, or have detailed assessment reports, and all have detailed pottery dating available. Given that strong links between pottery and tile production are known to have existed in York (Swan and McBride 2002, 190-1), the tile from the selected sites has been analysed in relation to the phases of pottery production previously identified by Monaghan (1997, 837-50).

Table 1a. The sites selected for detailed stratigraphic analysis		
Site name	Date Range	Reason for selection
The site of St Leonard's Hospital 1 on Figure 3	c. AD 71 to 5th century	Selected to represent the fortress. A complete sequence through the fortress defences and associated internal structures, with abundant tile. Detailed in Appendix 8.
Leedhams Garage and Wellington Row 2 on Figure 3	c. AD 71 to 5th century	Selected to represent the *colonia*. The largest YAT Roman site, with abundant tile, detailed phasing and pottery dating available. Features included part of the Roman road to Tadcaster, a side street and major stone building. Detailed in Appendix 9.
14-20 Blossom Street, 28-40 Blossom Street , 35-41 Blossom Street 3-5 on Figure 3	Possibly as early as AD 71-100, mainly c. AD 120-5th century	A group of sites representative of the area to the south-west of the *colonia*, with evidence of occupation covering the entire Roman period. The sites were to either side of the Roman road to Tadcaster and included evidence of agriculture, disposal of rubbish (presumably from the *colonia*) and burials. Detailed in Appendix 10.

Table 1b. The sites selected for detailed stratigraphic analysis		
Site name	Date Range	Reason for selection
22 Piccadilly, 38 Piccadilly, York Castle Car Park, 41 Piccadilly, 50 Piccadilly, Dixon Lane 6-11 on Figure 3	c. AD 71 to 5th century	A group of sites representative of the area to the south-east of the fortress. The area was dominated by the River Foss, with deposits comprising river bank activity, cobble surfaces, buildings and dumps. Detailed in Appendix 11.
21-33 Aldwark, 36 Aldwark, Adam's Hydraulics, 2 St Maurice's Road, County Hospital Monkgate, 40-48 Monkgate 12-17 on Figure 3	c. AD 71 to 5th century	A group of sites representative of the area to the north-east and east of the fortress. An area associated with dumping of legionary kiln waste in the early Roman period, it was developed for residential purposes in the third century, with high status houses at two of the selected sites. Detailed in Appendix 12.
45-57 Gillygate, 26-28 Marygate, 108-110 Bootham, Wentworth House 18-20 on Figure 3 (for location of Wentworth House see Figure 140)	AD 120 to 5th century	A group of sites representative of the area to the north-west of the fortress. No activity prior to AD 120 was present. The sites were dominated by the Roman road leading to Catterick. Characterised by ditches, pits, building foundations, and burials at two of the sites examined. Detailed in Appendix 13.

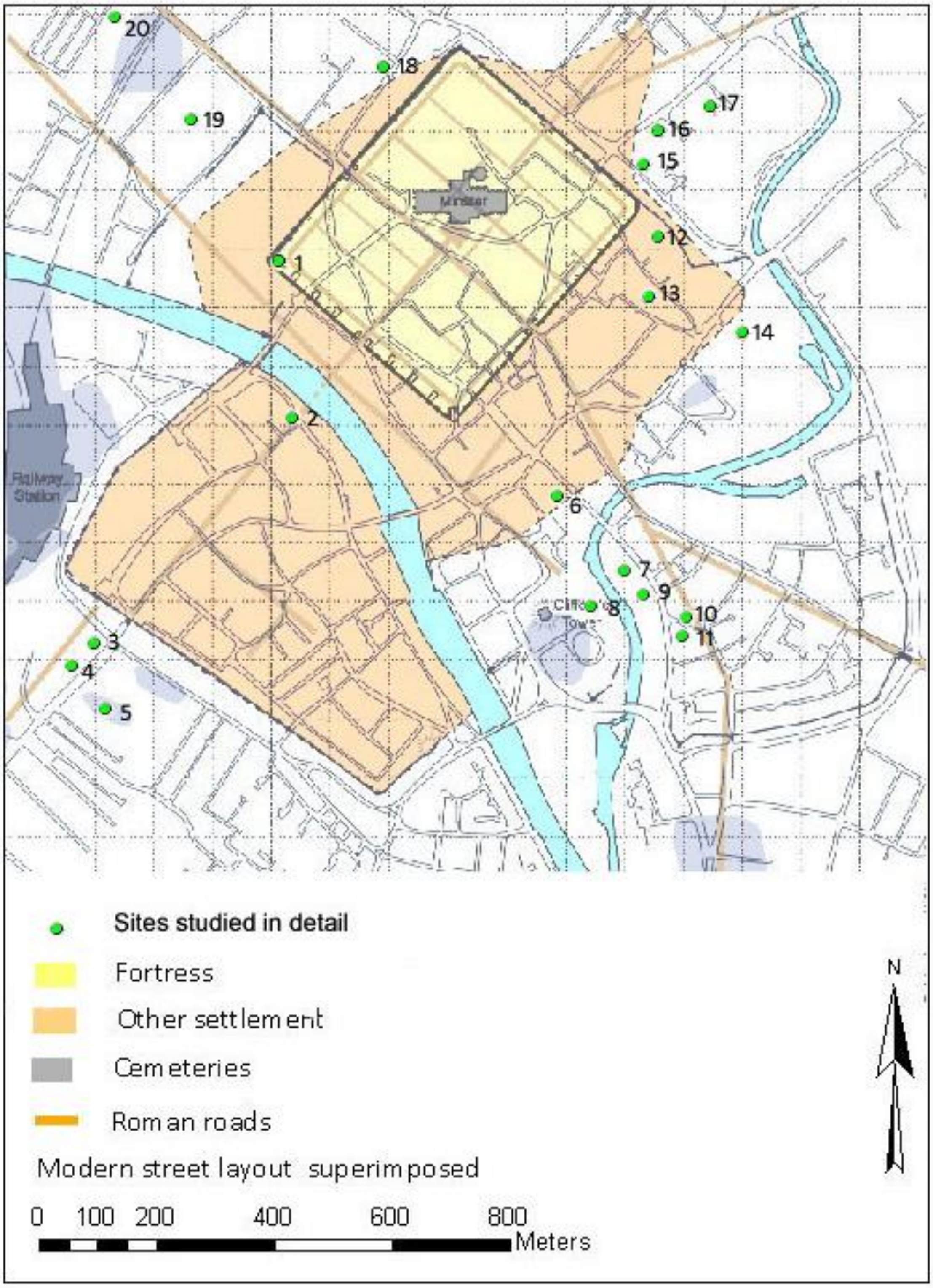


Figure 3. The location of the sites subjected to detailed stratigraphic analysis ©YAT, using underlying © Crown Copyright data Ordnance Survey Licence Number 100018343). For key to locations see Table 1.

Other groups of smaller sites were considered for detailed stratigraphical analysis. In the case of Dringhouses the YAT archives for seventeen excavations and watching briefs were examined (YAT project codes 1980.1041, 1981.1032, 1982.1004, 1983.1020, 1985.1042, 1989.12, 1989.31, 1989.1009, 1992.1015, 1999.29, 305, 386, 489, 526, 529, 830 and 1135) but collectively these sites yielded only 214 sherds (39,515g) of tile, which was insufficient for meaningful analysis. A group of six sites in the vicinity of Paragon Street/Fawcett Street (YAT project codes 1987.27, 1989.8, 1989.16, 1999.174, 601 and 858) were also considered, but these collectively yielded only 143 sherds (24,305g) of tile, while six sites in the Bishopthorpe Road area (YAT site codes 1986.5, 1988.9, 1989.14, 585, 1131 and 1229) yielded just 61 sherds (7,140g of tile). These groupings did not therefore present sufficient tile for detailed stratigraphic analysis. It had been hoped that the University of York's excavations at Heslington East could be examined from a stratigraphic point of view, but the post-excavation analysis for the site was insufficiently complete at the time of writing for this to be undertaken, though such analysis will form the basis of a future publication.

5.3 Problems inherent to the data and issues relating to interpretation

Arguably the greatest problem with the dataset was the fragmentary nature of the tile, which was due to its post-depositional history, with most of the tile originating from deeply stratified urban sites, where the Roman buildings had collapsed or been robbed, with the resultant tile being constantly re-deposited and broken into ever smaller sherds. Despite in excess of 36,000 sherds being recorded, only 158 tiles had complete length measurements, 246 tiles had complete breadth measurements, and 145 tiles had both a complete surviving length and breadth. For some forms no examples with complete dimensions were present. The lack of tiles with complete surviving length or breadth dimensions hampers any attempts to determine typical dimensions for most forms, and whether these varied over time (though sufficient thickness dimensions were present to enable some comparisons of thickness over time for some forms).

It can be argued that the tile examined is not representative of York as a whole, given that it comes from excavations which represent only a small fraction of the total area of the city; in addition, the excavations are dependent upon the location of redevelopment within the city, which is far from evenly spread. Against this, Roskams (1999, 47) has pointed out that the sheer number of excavations in the town might overcome any problems of representativeness.

The potential of tile to aid with the dating of specific Roman contexts on archaeological excavations is limited given that the various forms of tile introduced to Britain by the Romans remained in use throughout the Roman occupation, in contrast with other artefacts such as pottery where individual forms have more limited date ranges. Tegulae represent one of the few forms of tile with design variables, namely the size of the upper cutaways, and the shape and size of the lower cutaways. Recent research into tegulae (Warry 2006, 61) compared cutaway forms to legionary stamps, which resulted in the creation of a typology consisting of four dated groups. Unfortunately, only two tegulae in the present study had both a cutaway and a legionary stamp, limiting the potential of this study to confirm Warry's typology.

Monaghan (1997, 833) noted that, with the exception of the raising of the first fortress rampart c. AD 71, York does not have any city-wide sequence of construction, or clear horizons within the city, which can be assigned to historical events (such as deposits relating to the fires caused by the Boudiccan rebellion seen in Colchester or London); the presence of city-wide horizons in York would undoubtedly have made the study easier.

Very little of the tile in Roman deposits is *in situ*. Taking the site of St Leonards Hospital as an example, only 0.0002 percent of the tile from Roman deposits was from structural remains, while at Blossom Street only 3.3 percent of the tile was *in situ.* The lack of *in situ* tiles makes it difficult to clarify their date and to develop dated typologies for the tile forms seen.

While the study aims to analyse the chronological and spatial variations in the use of tile, it should be noted that analysis of such patterns is complicated by a number of factors. Firstly, spatial distributions are inevitably heavily distorted by the Roman attitude to the disposal of rubbish, which (until at least the fourth century) was routinely cleared out of, and dumped beyond, the limits of settled areas (Monaghan 1997, 147). This is confirmed by bio-archaeological evidence for conditions in Roman domestic buildings, which is often lacking, suggestive of organised cleaning and waste disposal (Dobney et al. 1999, 18). The dumping of such rubbish complicates distribution patterns in the immediate hinterlands of the fortress and *colonia*. It would also seem that rubbish was simply tipped alongside the main roads, rather than being buried in pits (Monaghan 1997, 839), the subsequent disturbance and spreading of the tipped waste means that it has less potential for the dating of artefacts than do pit-fills, which offer the potential of tightly dated groups of artefacts. Spatial and chronological patterning is further obscured by the presence of residual tile; the deposits excavated in the centre of present-day York are from complex sites, with anything up to 6m in depth of stratigraphy present, and levels of residuality on such sites are usually very high, creating a confusing picture. Furthermore, while tile built into walls or hypocaust systems offers good potential for dating, in the case of roof tile there would logically be a time lag between the use of the tile on a building, and its final deposition once the roof was repaired or became derelict, thereby limiting the dating potential of roofing tile within deposits.

It should be noted that individual sherds of tile from excavations in York, including the excavations at Heslington East, were recorded in relation to the context from which they were recovered rather than being recorded three-dimensionally, simply because far too much tile is recovered to make such recording practicable on site. The rare examples of tile recorded three-dimensionally were from within walling, but such tiles were usually left *in situ*, resulting in virtually no three-dimensionally recorded tile being available for examination in the present study. Context plans exist for most of the tile-bearing deposits, and in theory it would be possible to calculate a central coordinate for each tile-bearing context, but in practice a great deal of time would be required to achieve such a goal, as thousands of plans would have to be retrieved from the YAT archives, digitised in relation to the Ordnance Survey National Grid, and the resultant coordinates would need adding to the tile database. Such work could not be undertaken within the time limits for the present study. The tile is therefore plotted on the various distribution maps, on the basis of a central coordinate for the excavation from which it was recovered.

A further problem relates to sampling policies on site, there is often a tendency with tile to only bring a small selection off-site, usually comprising some of the largest sherds or any sherds deemed of interest, such as stamped tiles. Such policies result in skewed collections. Conversely, the sherd count on major sites excavated from the late 1980s to early 1990s was greater, due to extensive programmes of environmental sample sieving, which resulted in an increase in the number of small sherds recovered. Comparisons of these sites to other smaller or older sites, with less extensive sieving programmes, should therefore be treated with caution.

While every effort has been made to examine all the tiles in the YAT collections it is possible that some sherds have been missed. Artefacts catalogued by YAT are recorded either as 'Bulk Finds' or as 'Small Finds', the difference being that bulk finds such as tile, pottery, or animal bone, are grouped and bagged by the context from which they came, while the small finds are recorded individually. In theory, all tiles should have been recorded as bulk finds, but in practice sherds seen as 'interesting', such as those with a legionary stamp or dog's paw print were often recorded as small finds, and entered on the YAT database as such. Every effort has been made to track down such items by running queries on the small finds database to look for fired clay artefacts, and then re-recording any relevant sherds on the bulk finds database, it is however, possible that a few sherds may have escaped detection. It should also be noted that it is easy to mistake curving forms of tile such as chimney sherds, pipes and imbrices as pottery, while decoration on small sherds of antefix may also have led to misidentification as pottery, and it is possible therefore that there may be further sherds of these forms of tile within the YAT pottery collections.

The tile has been recorded by two people, from the mid-1980s to 1999 the tile from many, but not all of YAT's excavations, was assessed by S. Garside-Neville, while from 2000-2004 the tile was fully recorded by S. Garside-Neville and/or J. M. McComish, and since 2004 the tile has been recorded by J. M. McComish (including a major review of all the tile held in the YAT collections, detailed in Appendix 1). Given that two people have been involved in recording the tile there is the potential for inter-observer differences, particularly with the allocation of fabric types. It is hoped that this represents a minimal problem for the present study, given that S. Garside-Neville trained J. M. McComish in the recording of tile.

5.4 The format of the dissertation text

Some tables were too large to fit onto an A4 format and are therefore split over two or more pages, but kept in portrait format. Throughout the appendices an empty cell in a table indicates that no sherds were present.

The site location plans are based upon YAT report plans, which are in turn based upon map data from the Ordnance Survey, used by YAT under Licence number 100018343.

Two of the principal reference works for the present study Betts (1985) and Warry (2006) have tegulae defined in groups numbered A-C and A-D respectively. To avoid confusion, therefore, a superscript $^{\text{Betts}}$ or a superscript $^{\text{Warry}}$ has been added where necessary to clearly distinguish between the two authors.

It should be noted that the individual sherds are recorded in grams, and this unit of measurement therefore appeared in the Excel table upon which the study was based. Grams have therefore been used as the unit of measurement throughout the text.

6 Results

Descriptive accounts of the various forms, their method of manufacture, the fabrics and the surface marks present, together with the stratigraphic data for the sites selected for detailed study, are given in Appendices 4-13; in the interest of brevity this information is not repeated here, but is referenced throughout the text. There is, however, a brief summary of the forms and fabrics present in section 6.1, to set the results and discussion in context.

6.1 The tile forms and fabrics

The various forms of tile present are defined in Table 2. Where possible there is a photograph of each form using an example from the present study, though in some cases it was necessary to use the authors' own photographs, those of YAT, or published examples, as the tile in the study was too fragmented. Detailed descriptions of the forms are given in Appendix 4.1.

Table 2a. Brief descriptions of the forms of tile present

Form	Photograph	Description
Antefix	 	Decorative tiles to infill the basal end of a column of imbrices, or the ends of the ridge line of the roof. Tile from 37 Gillygate York, photograph © YAT Antefix from York. Illustration from RCHM 1962 Plate 39

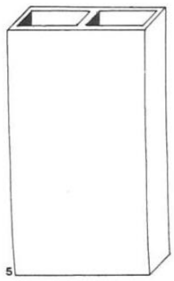
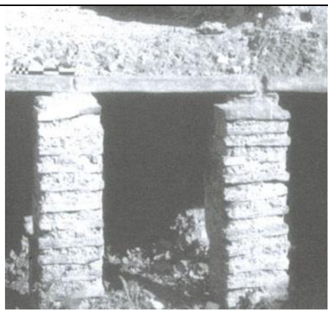
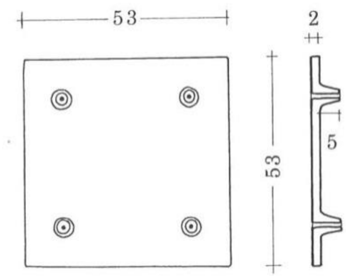
Table 2b. Brief descriptions of the forms of tile present		
Bessalis		Bricks eight Roman inches square (197mm square). Tile from Heslington East.
Chimney		A tapering cylinder pierced by tiers of vents, used in association with heating systems. Chimney, Malton Museum
Box flue		Box flues are hollow rectangular prisms usually pierced by vents on two sides. Used to conduct heat through walls. Flue at Chedworth villa
Relief patterned box flue		Box flues with roller impressed keying on the non-vented sides. Tile from County Hospital, photograph © YAT
Double box flue		A partitioned box flue, used to conduct heat through walling. Illustration from Brodribb 1989, 76.

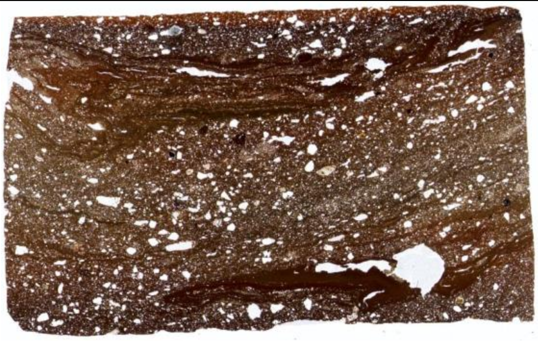
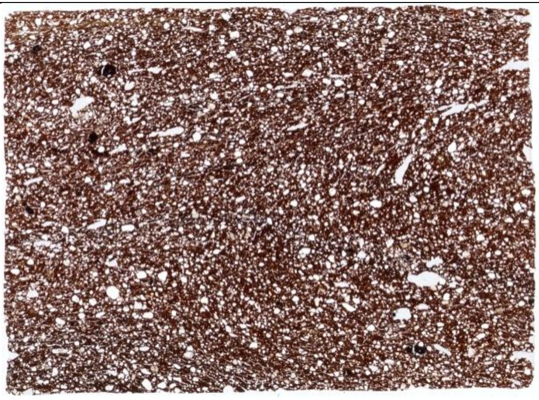
Table 2c. Brief descriptions of the forms of tile present		
Opus spicatum	Too fragmentary to merit photography	Small bricks placed on their stretchers in a floor.
Imbrex		Hollow half cylinders which taper inwards at the top. Used on roofing to cap adjoining tegulae. Tile from Heslington East.
Lydion		Rectangular bricks 1 x 1.5 Roman feet in size (297mm by 444mm). Tile from Heslington East.
Parietalis		Notched and keyed tiles used to line the inside of a room. Unstratified tile from YAT collections. Photograph © YAT
Pedalis		Bricks one Roman foot square (295.7mm square). Usually square, sometimes circular. Basal brick in photograph. Tile from Heslington East. Photograph © YAT
Pipes		Hollow tubes of varying designs for movement of water, or to reduce the weight of vaulting. Vaulting pipe from 12-18 Swinegate. Photograph © YAT

Table 2d. Brief descriptions of the forms of tile present		
Sesquipedalis		Bricks one and a half Roman feet square (444mm square). The tiles above the pilae in the photo. Illustration from Adam 2007, 268
Tegula		Rectangular roof tiles with lateral flanges. Tegula in Chester Museum
Tegula mammata		Flat tiles with lugs, to act as dry linings for walls. Illustration from Adam 2007, 268
Tessera		Small cubic blocks of cut stone, glass or tile used in mosaic and tessellated floors. Mosaic at Chedworth Villa
Voussoir		Wedge shaped bricks used in arches. Voussoirs, Modesto's bakery, Pompeii

A number of sherds were unusual and represent valuable additions to the corpus of tiles known nationally. There was a sherd of double-box flue; these are known from other sites in Britain, but are always rare (Brodribb 1989, 76-7). A sherd of relief-patterned flue tile matching a design previously recorded in Hertfordshire, Bedfordshire and London (Die Type 2, Betts et al. 1994, 65-6, 74) represents the first example of a relief-patterned flue tile in Northern England (Betts et al. 1994, 26-8). A group of short flues without vents from the Heslington East site were also unusual; these were associated with a kiln structure and may represent tiles commissioned for a specific purpose. An exceptionally short imbrex was also present at the Heslington East site. A flue tile with a signature in the present study is unusual, as virtually none are known nationally (Brodribb 1989, 101-2). The four sherds of tegula mammata in the study represent the first examples of such tiles from York. Tiles of this type are rare outside the south-east of England (Brodribb 1989, 148-9), and equally rare within the study representing only 0.034 percent of the tile examined. There were also twenty-one tiles of unusual size or shape (detailed in appendix 4.1.9). A new Legio VI tile stamp-die was present (see p343-4), together with a number of signatures not previously recorded in York (see p334-8). Two of the tegulae have splashes of glaze, which is highly unusual (see p240). All the tiles seen were manufactured to standard Roman methods, and though the average dimensions varied slightly from those of Brodribb's (1989) national survey, the degree of variation was often small and differed from form-to-form (see 131-3).

A total of nineteen tile fabrics (fabrics R1-R19) were recorded on the basis of identification using a x10 hand lens. The fabrics are described in full on p286-91, and the range of fabrics is illustrated here by R7 and R10 (Table 3), which were the least well sorted and the most carefully sorted fabrics respectively. Thin section analysis (Finlay, 2011) placed the nineteen fabrics into just five groups (see p319) showing that there was remarkably little variation in tile fabrics. Finlay (2011) compared three of the fabrics to clay samples taken from excavations at Hungate (close to the site of the legionary kilns in the Aldwark/Peasholme Green area), and this showed that the clay and tile fabrics were remarkably similar, suggesting that the Hungate area was a possible clay source for the manufacture of tiles at the legionary kilns.

Table 3. Fabrics R7 and R10 descriptions

R7 Light red fabric with reduced pale grey cores. Poorly sorted, rare vesicles, moderate quartz content with the quartz mainly sub-angular though 20% is angular quartz. Calcite precipitation into vesicles, occasional clay pellets and grog. Streakier and less well sorted than the other fabrics.	
R10 Light red fabric. Well sorted, moderate vesicles, very frequent quartz content, with the quartz round to sub-angular. Rare calcite precipitation into air pockets. This fabric, together with fabric R11, is the most carefully sorted of all the fabrics in the series.	

6.2 Chronological variations in tile production and use

6.2.1 Roofing tile size

Betts (1985, 168-70) and Warry (2006, 51) both observed a decrease in roofing tile size over time. While the highly fragmented nature of the tile in the study meant that too few lengths and breadths survived to determine whether a similar pattern was present, there was certainly evidence for a thinning of roofing tile over time (Figure 4), this decrease was particularly marked in the case of the tegulae, which reduced in thickness by 36 percent. The average thickness of Legio IX stamped imbrices was greater than that of Legio VI imbrices (see p178) again suggesting a reduction of thickness over time.

This thinning of the roofing tiles over time has implications for production costs, as thinner tiles would require less clay for manufacture and could be fired more quickly, thereby reducing fuel consumption; in addition, transportation costs of the finished product would be cheaper, due to the reduced weight of the tiles. Thinner tiles would also affect roof design, with the reduction of weight enabling the use of lighter supporting timberwork, again reducing the costs of raw-materials and therefore overall construction costs. The downside would be tiles which were less durable. This picture of architectural development challenges the notion, suggested by Finley (1999, xxi-xxii), that the Roman period was largely static in terms of technological advances.

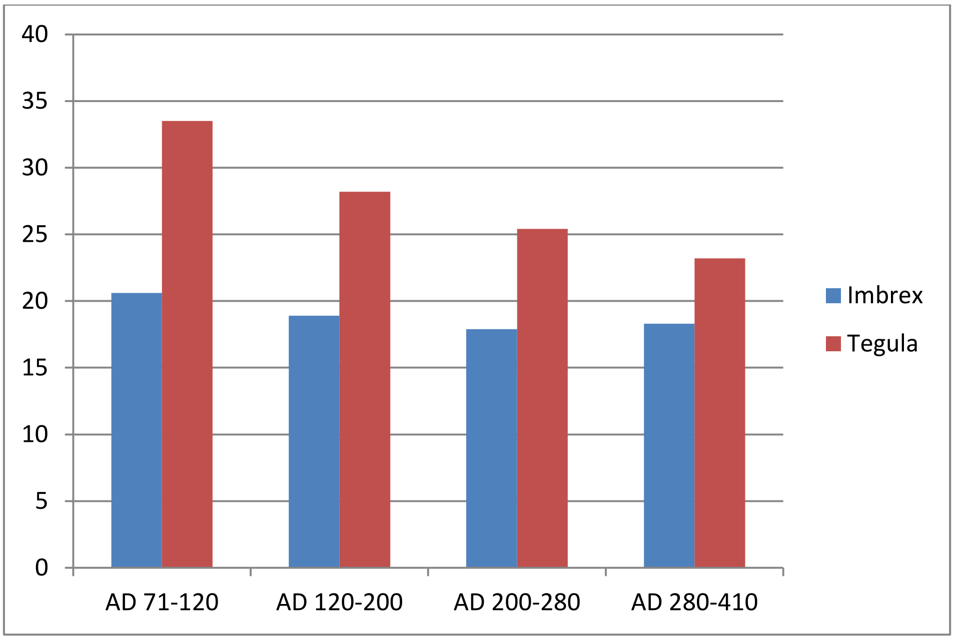


Figure 4. The average thickness of roofing tile in mm in relation to date, for the sites selected for detailed stratigraphic analysis in Appendices 8-13 (associated data in Tables 35-6).

Given the reduction in tegula thickness over time, a comparison was made between tegula thickness and lower cutaways, to determine whether there was any chronological variation in the cutaway forms seen. The Group B^{Warry} lower cutaways were by far the commonest form observed, with lesser numbers of Group A^{Warry} and Group C^{Warry} cutaways (Table 4), though there were sufficient numbers of each type to enable a comparison. The Group A^{Warry} cutaways were on average the thickest tiles, followed by the Group B^{Warry} cutaways, with the Group C^{Warry} cutaways being the thinnest (Figure 5). A comparison of tegula flange heights in relation to lower cutaways showed that the flanges associated with the Group A^{Warry} cutaways were the largest, then the Group B^{Warry} cutaways, with the Group C^{Warry} cutaways having the smallest flanges (Figure 6). Given that there is a thinning of the tiles over time, and assuming that flange height is in proportion to tegula size, the data suggests that the Group A^{Warry} cutaways were the largest and therefore the earliest tiles, then the Group B^{Warry} cutaways, with the Group C^{Warry} cutaways being the thinnest and therefore the most recent. It is, however, impossible to assign specific dates to each cutaway type as there is a considerable overlap between the thicknesses seen for any given group.

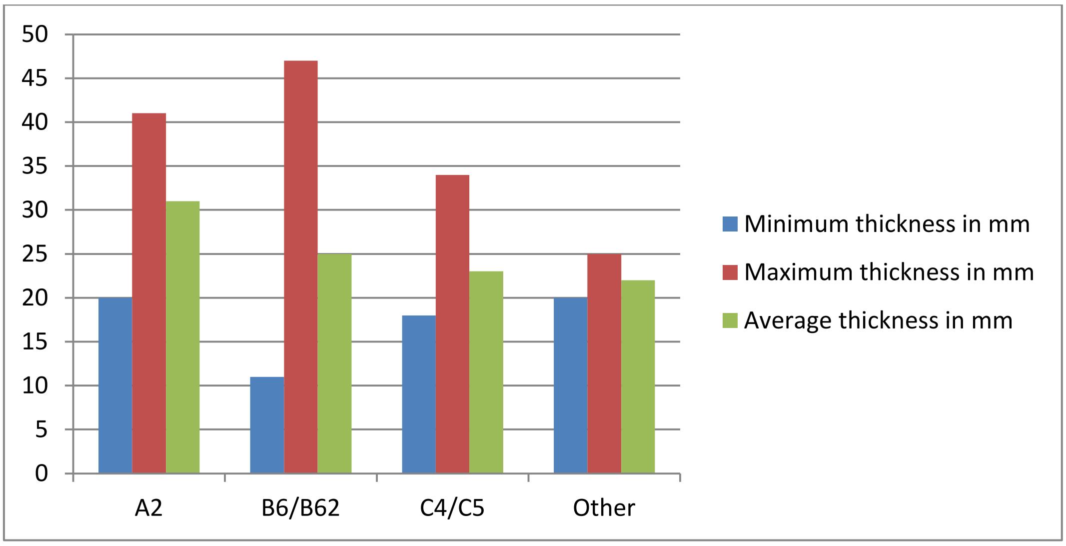


Figure 5. Maximum, minimum and average thickness of tegulae in mm in relation to lower cutaway forms (associated data in Table 29).

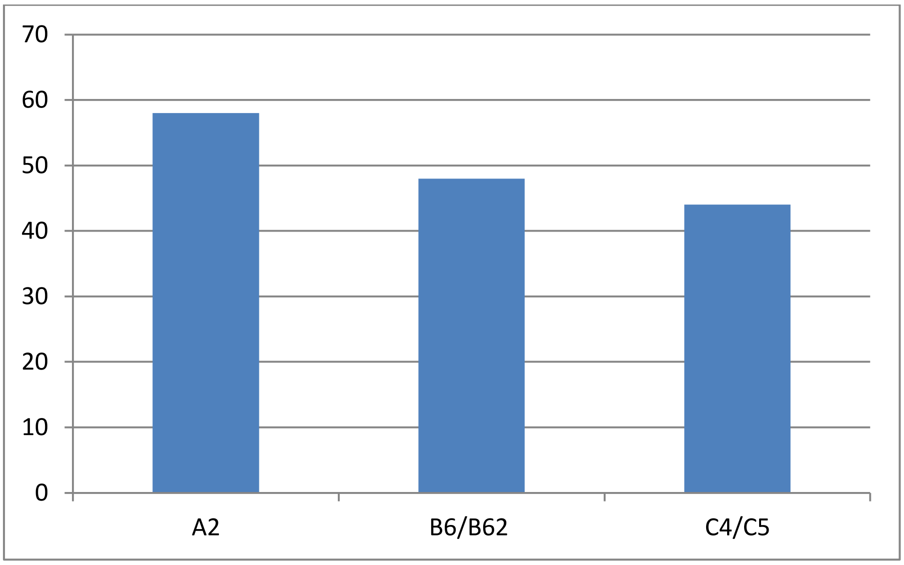


Figure 6. The average flange height in mm in relation to lower cutaway types (associated data in Table 30).

Table 4. Lower cutaway forms as a percentage of the total		
Cutaway form	Number of examples	Number of examples as a percentage of the total
A2	48	9.5
B6	412	81.6
B62	2	0.4
C4	9	1.8
C5	30	5.9
Other	4	0.8

6.2.2 Fabrics

Analysis of the chronological change in fabrics (as defined on p286-291) concentrated upon fabrics R1-R3, R5-R11 and R15, as the sherd counts for the remaining fabrics were too low to enable any analysis (see Table 46). The fabrics were examined in terms of the volume present among the phased tile, and in relation to lower cutaway forms, tegulae thickness and legionary stamps (see p314-8). Most fabrics were present throughout the Roman period, though in differing proportions. Fabrics R2, R5 and R9 were commonest in deposits of first to second century date, while fabrics R1, R3 and R8 were slightly later, then fabric R11, with fabrics R6 and R10 being commonest in deposits of second to third century date. Fabrics R7 and R15 seemed to be evenly spread across all periods. It is, however, impossible to determine how the patterns seen were affected by re-use and re-deposition, as opposed to reflecting the date of production.

Fabrics R9, R10 and R11 represent by far the dominant fabrics in the study accounting for 61.5 percent of all tile (see Table 48). Of these, fabrics R9 and R10 are from a single fabric group (Group 3), and the suggested dates for these fabrics imply that R10 represents a later replacement of R9. Fabric R9 is distinctive in being highly fired to a dark red colour, while fabrics R10-R11 are less highly fired, being of light red-orange colour. Given the suggested dates for these fabrics, this may imply that tiles were more highly fired in the first century of Roman occupation in York, with firing levels reducing thereafter. This reduction in firing temperatures has implications for production, as less fuel would be needed for firing, making production cheaper and more efficient.

It may also suggest that the desired colour of roofing tile changed over time, which has implications for the appearance of the city-scape, with the dark red roofs of R9 being replaced by lighter red-orange colours. The range of colours seen in fabric Group 5, is also of interest, as the dominant two fabrics in this group, R6 and R11, were fired to a light grey-red and a light red respectively, and given that there is little chronological difference between R6 and R11, it is possible that they represent a single fabric being fired differentially to achieve a variety of colours for decorative purposes. The use of differently coloured tiles has been noted on other sites in Britain (Perring 2002, 121; Ward 1999, 15, 19).

6.2.3 The presence of nail-holes on tegulae

Warry (2006, 103) has suggested that legionary tegulae were not generally nailed to roofs prior to AD 200 and that the proportion of nail-holes increased over time, and he suggested that the practice of nailing tegulae to the roof may have been necessitated by an increase in roof pitch in the later Roman period to better suit the British climate.

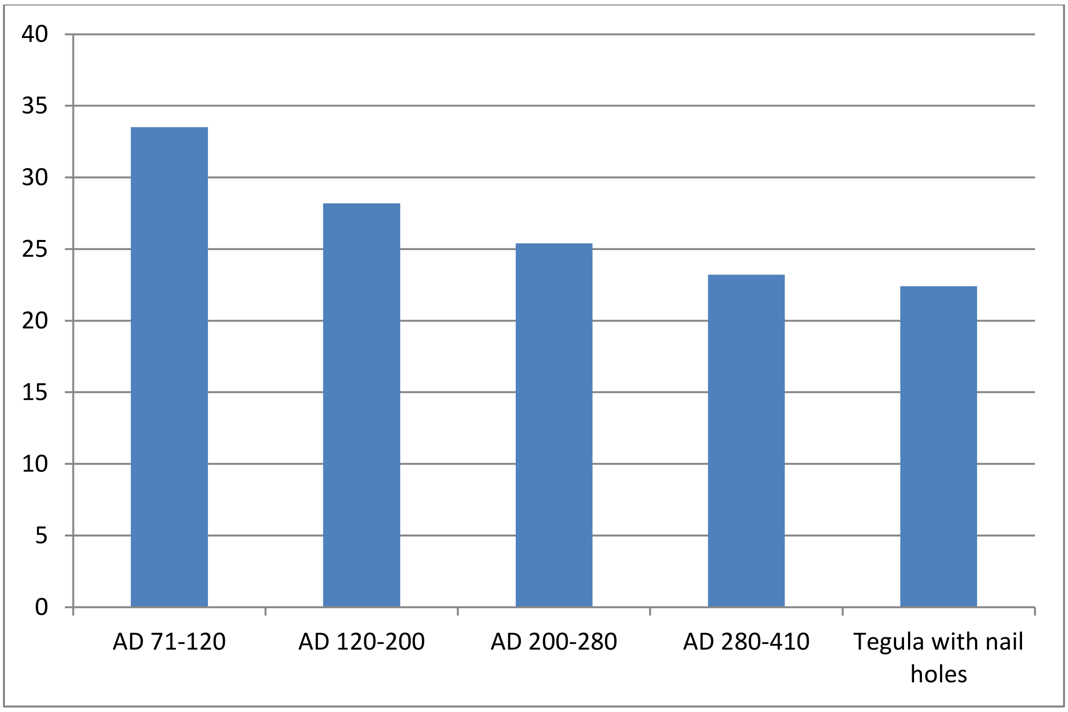


Figure 7. The average thickness of tegulae in mm by phase, and the average thickness of tegulae with nail-holes. The associated sherd count is given on Table 37).

The small number of tegulae with nail holes present (eighteen examples) confirms Warry's observation that nail holes are rare on military tiles (military production dominated in York). The average thickness of these eighteen sherds is consistent with tegulae from later Roman contexts (Figure 7), but given the problems of residuality (seven of the sherds in question were in post-Roman contexts) it is impossible to state with certainty that the tegulae with nail-holes are of late Roman date. The number of examples is so small it would suggest that only the basal row of tegulae were nailed to roofs. There are insufficient examples to indicate the presence of any steeply pitched roofs where all the tegulae were nailed in place.

6.2.4 Tile production in relation to pottery production

The present study confirms the strong links between the production of tile and Ebor Ware pottery. Both legions are assumed to have produced tiles and Ebor Ware pottery in kilns located to the south-east of the fortress (see p57-60), though it should be noted no kilns have been located or excavated, merely dumps of kiln waste. The precise date at which tile production commenced is uncertain, and although fragments of tile were incorporated into the first fortress rampart at the St Leonard's Hospital site there were problems of contamination with the contexts concerned (see p367). The pattern of pottery deposition suggests that there was a period of decline from AD 120-160, between the departure of the Legio IX and full occupation of the fortress by the Legio VI (Monaghan 1997, 871). It has been argued that the kiln site at Apple Tree Farm in Heworth may relate to this period, with production passing into the hands of civilians with strong military connections, possibly veterans. Although there was no direct evidence of a tile kiln at Apple Tree Farm it is possible, given the strong similarities between stamps from the site and a civilian tile stamp from York, that tile was produced at this site (see p61).

The production of Ebor Ware pottery had ceased by AD 280, possibly as early as AD 250 (Monaghan (1997, 865). Tile stamps from the reign of Gordian III (AD 238-244) show that tile was produced in York until at least the mid-third century, but the demise of the practice of stamping from the mid-third century makes it very difficult to determine whether any tile was produced after that time. The development of the

Aldwark area as a residential suburb in the later third century (Brinklow et al. 1986, 40) does, however, suggest that the legionary kilns in the area had gone out of use. Pottery may have been produced in the Lawrence Street area of York after AD 225 (Monaghan 1997, 874), but there is no conclusive evidence of tile production, in the form of tile kilns or wasters, in the immediate hinterland of York at this time.

The pattern of tile production was strikingly different to that of pottery from the late third century onwards. The void in the pottery market created by the demise of Ebor Ware was filled by coarse wares produced in rural locations to the north and east of York (Monaghan 1997, 865-9). In contrast there is no evidence from the tile fabrics of the importation of tile into York from these areas (see p282), suggesting that tile production did not develop alongside pottery production in these rural locations. It is possible that by this date stone had largely replaced tile in building works thereby reducing the market for tile. In contrast pottery remained an everyday necessity for the storage and preparation of food, and for the transportation of goods, resulting in continued production, albeit in different locations to those of preceding periods.

6.2.5 Tile in relation to city wide chronological development

The following conclusions are based largely on the presence of legionary stamps which offer potential for dating. The stamps in the study were examined in conjunction with those catalogued by Collingwood and Wright (1992) in order to obtain as full a picture as possible.

The stamps suggest that tile roofing was relatively rare in York in the period of Legio IX occupation i.e. AD 71-120 (see p354), with only the *principia* and the legionary bath-house in Swinegate yielding sufficient tiles to clearly suggest tile roofs (see p263, p351). There was no clear evidence from the stamped tiles (see p354) for tiled roofs outside the fortress during the period of Legio IX occupation. The only possible exception is a bath-house found in 1852 on Fetter Lane, to the south-west of the river Ouse, which had a floor of Legio IX stamped tiles (RCHM 1962, 52), and such a building would probably have also had a tiled roof. Why there should be a bath-house on the opposing side of the river Ouse from the fortress is unclear, especially given that there was a legionary bath-house inside the fortress. One possibility is that the Fetter Lane bath-house was in fact of a far later date, incorporating re-used tiles, this is highly possible given that the area south-west of the river Ouse did not develop, structurally at least, until the later second or early third century, and because the re-use of bath-house tiles is widely known from the late Roman period (see p65 and p354). The presence of a Legio IX stamped tile at 42-50 Tadcaster Road, Dringhouses, may suggest that this settlement, 3km to the south-west of the *colonia*, originated in the late first or early second century, though Ottaway (2011, 363) dates this settlement to the late second century, suggesting that the tile was re-used.

Large numbers of Legio VI stamped tiles are present in York, reflecting the lengthy period of occupation of this legion. Within the fortress, the 137 stamped tiles recovered from investigations beneath York Minster relate to the construction of stone barracks in the area after AD 120, and to subsequent roof repairs (see p351). The presence of Legio VI stamped tiles suggests that new roofs were present at the Swinegate bath-house, barracks at 3 Little Stonegate and on a building at Purey Cust (see p232). Warry (2010, 127, 132) has argued that the wide variety of Legio VI stamp dies seen may have been due to each cohort having its own die, but the idea of a rolling repair programme suggested by Monaghan (1997, 837) may offer an alternative explanation. If tile was required in small batches for specific repairs, or small-scale building projects, production may have been intermittent, with a new die being cut for each batch of tile, hence the multiplicity of Legio VI stamps. The Group B^{Warry} lower cutaways also showed wide variance in thickness (Figure 5), which might support the idea of tile being produced intermittently, with not just a new stamp, but also a new mould being made for each batch of tile produced.

The stamped tiles, coupled with the volume of tile sherds present, suggest that the period AD 150-180 saw development beyond the limits of the fortress. In the area to the south-west of the river Ouse tiled roofs were present at Wellington Row, 5 Rougier Street, 24-30 Tanner Row, 1-9 Micklegate and George Hudson Street (see p93, p232 and p265-6). In the case of 24-30 Tanner Row the buildings concerned were of timber rather than stone. The pottery dating for the earliest buildings on these sites ranged from AD 150-175 (Monaghan 1997, 1102, 1106-9; McComish 2001, 34).

The early-third century saw the Imperial household present in York in AD 211, and the raising of the status of the area south-west of the river Ouse first to a *municipium* then a *colonia* by AD 237 (Ottaway 1993, 11, 64), both of which have been taken as major economic stimuli. There is abundant evidence for a major building campaign in the newly created *colonia*, and in the area between the fortress and the rivers Ouse and Foss (see p42-3). At least one major building of this date at 1-9 Micklegate may have had a tiled roof (see p267), but the decreasing volume of tile dumped in the Blossom Street area to the south-west of the *colonia* from the third century onward, despite the extensive dumping of pottery in the area at this date, suggests an overall decline in the use of tile (see p404).

The Imperial household was present in York for a second time in AD 306. The early fourth century saw the redevelopment of the *principia* area, including a new basilica, though it is impossible to determine whether this work was commissioned by the Imperial household. There was also redevelopment of both the legionary bath-house and the barracks in Davygate (Phillips and Heywood 1995, 7). It is clear that stone had largely replaced tile in construction projects by this date (see Appendix 4.2.3). Given that the legionary kilns had been out of operation for roughly fifty years by this time, and that there is little evidence for late Roman tile production, it would suggest that all the tiles within these structures were re-used. Re-use of tiles has been suggested for the tiles from the hypocaust of the legionary bath-house (RCHM 1962, 43) and the tiles on the new basilica roof (Phillips and Heywood 1995, 40).

Relatively little evidence of structural activity of later fourth century or early fifth century date has been recovered from York, but barrack 2, beneath York Minster, was adapted into something resembling a villa, the alterations including the insertion of a drain and hypocaust into one room (Phillips and Heywood 1995, 35). Each of the seven surviving hypocaust pilae comprised a square basal bessalis with circular bessales above, but it is impossible to know if these represent re-used or newly manufactured tiles, but given the lack of evidence for tile manufacture after the mid-third century, re-use seems the more likely suggestion. Whyman's (2001, 292-3) re-interpretation of the Wellington Row site has suggested that there was extensive remodelling of the major building on the site between AD 388-402, but no tile was associated with this.

6.2.6 The date at which tile production ceased in York

Collingwood and Wright (1992, 125) have suggested that legionary tile production may have continued in York into the fourth century, though no supporting evidence for later third century or fourth century production is noted. The present study contradicts this view, suggesting that legionary production ceased in the mid-late third century with evidence from the Aldwark area indicating that the military kilns to the south-east of the fortress were systematically cleared sometime after AD 238-44 (the date of the last tile stamps from York), with the Aldwark area subsequently being used for settlement (Monaghan 1997, 1068). There is no evidence for any other legionary tile kilns in the study. Why military tile production stopped is unclear, possibly the use of stone tiles may have become more economic, or it may have resulted from reduced levels of manpower in the fortress.

The demise of legionary production in the mid-late third century must have had a significant effect on buildings in York and its environs, either civilian production would have to increase to compensate for the loss of the military kilns, or tile would have to be re-used from presumably ever-dwindling supplies, alternatively other methods of roofing would be required.

The presence of a late Roman tile industry is difficult to prove as the practice of stamping declined from the mid-third century onwards, there are therefore no stamps to confirm the presence of later Roman tile production; in addition, a wide range of fabrics were used throughout the Roman period, so neither individual fabrics nor the range of fabrics present can be used to indicate date. Furthermore while imbrices 11-14mm thick and tegulae 11-20mm thick seem to post-date AD 120, roofing tiles of these thicknesses were present throughout the remainder of the Roman period, so thickness cannot be used as a clear indicator of date for any given sherd. There was a group of underfired clay blocks of unusual size and shape at 28-40 Blossom Street, dating to AD 200-280, and there was a group of abnormally short flue tiles without vents of late fourth century date at the Heslington East site. All these items were of such poor quality and unusual design it is possible that they represent later attempts at civilian production. It is also possible that four tegulae with unusual lower cutaways may represent later production: in terms of thickness these four tiles would seem to be of later date (Figure 5) and their non-standard forms may suggest that they were not of legionary production, which tended to be tightly controlled. They could, however, equally represent manufacturing errors. It should be noted that the fabrics used in the production of all these potentially civilian manufactured tiles were of local origin, and they do not represent the importation of tiles from elsewhere. These tiles are so few in number that, if they do indeed represent late third century to fourth century civilian manufactured tiles, production must have been on a very small-scale.

As noted above there is some evidence of re-use of earlier tiles in later Roman structures in York, notably in the early fourth century legionary bath-house and on the fourth century fortress basilica roof. In terms of building materials there is evidence for a shift from the use of tile to that of stone for roofing in York after the mid-third century (see Appendix 4.2.3), suggesting that the demise in tile production led to a fundamental change in the type of roofing material used in the city.

6.3 Spatial variations across the study area

When considering the spatial distribution of the various forms of tile it is important to remember that the pattern seen is dependent upon the location of the archaeological excavations in the study, which have been concentrated in the historic core of the city, namely the fortress area, the *colonia*, and the area between the fortress and the rivers Ouse and Foss, with far less excavation elsewhere. This may have created a misleading picture of the distribution of Roman tile. Despite this limitation various spatial patterns relating to the use of tile can be determined.

6.3.1 The distribution of military tiles

It is clear that military production was dominant in York: 99 percent of all legible tile stamps from York were military (Table 5), and at least 90.7 percent of all fabrics were definitely related to military manufacture (Table 6), though it should be noted that it would be difficult to distinguish unstamped civilian and military tiles if similar clay sources were used. While the overwhelming majority of legionary stamped-tiles were associated with the fortress, they were also widespread in both the *colonia* and the environs (Table 5). The presence of 161 legionary stamps beyond the confines of the fortress raises the question of whether the army supplied civilian areas. At least fifty-seven of these stamped tiles were from sites where dumping had taken place, or they represent casual losses on sites with no Roman structures present, or they were tiles re-used in tile tombs. The remaining ninety-six legionary stamps were from sixteen sites with known Roman structures from which the tiles could have originated, and most of these were found within the fortress, *colonia* or within 800m of the fortress or *colonia,* with only two examples being known in the wider study area.

Whyman (2001, 195) has suggested, on the basis of the artefacts from the 24-30 Tanner Row site, that the area to the south-west of the river Ouse was largely geared to the production of military goods for the Legio VI in the mid-second century, and may therefore have been under the direct control of the military. If the area was under the control of the Legio VI, it may also have been under the control of the Legio IX during their preceding period of occupation.

Table 5. Sherd count for stamped tiles in relation to zone from both the present study and Collingwood and Wright (1992, 149-174)

	Overall	Fortress	*Colonia*	Environs
Legio IX	76	33	23	20
Legio VI	249	159	45	45
Illegible	27	4	9	14
Civilian	4	1	3	
Total	356	197	80	79

The tile in the study lends support to Whyman's argument. The 24-30 Tanner Row site yielded an exceptionally large number of legionary stamped tiles. There were eleven Legio IX tiles which were clearly dumped in the area, as no structures were present on the site prior to AD 120, when the legion departed from York. Timber buildings were constructed here c. AD 160, and the presence of twelve Legio VI stamped tiles at the site may suggest that these buildings were roofed with military tiles. It has also been noted that the 24-30 Tanner Row timber buildings incorporated re-used timbers that probably originated from the fortress, which was being heavily rebuilt at the time (Ottaway 1999, 142). The presence of military dumping in the area, followed by its use for buildings constructed with military tiles and timbers of military origin, coupled with the production of goods for the Legio VI on the site, are certainly suggestive of strong military connections, and possibly of direct military involvement in the construction of the timber buildings at the site.

Table 6. Stamp dies in relation to fabric

Fabric	Legio IX	Legio VI	Illegible	Number of stamped tiles as a % of the total number of stamps	Fabric as a percentage of the total excavated
R1	1	1		2	5
R2	1		1	2	3.9
R3	1	2		3	7
R6		3	1	4	5.7
R7	1		1	2	1.5
R8	1			1	2.5
R9	22	23	19	63.4	24.6
R10		6	3	8.9	24.9
R11	1	7	3	10.9	11.5
R13		1		1	0.1
R14		1		1	0.7
R15	1			1	3.3

It is possible to suggest that this zone of military control extended beyond the 24-30 Tanner Row site, to other nearby sites. The sites at Wellington Row, 5 Rougier Street and George Hudson Street all exhibit a similar pattern, having Legio IX tiles resultant from dumping, together with Legio VI tiles associated with substantial stone buildings constructed from AD 120-160 (Monaghan 1997, 1106-8). The building at Wellington Row was of exceptional size, while the building at 5 Rougier Street was interpreted by Monaghan (1997, 1107) as being a public building, and the building at George Hudson Street was sufficiently elaborate to have a hypocaust (McComish 2001, 34). That such elaborate buildings were associated with Legio VI tiles may indicate direct military involvement in their construction, perhaps suggesting that this remained a military controlled zone until at least c. AD160. The area between the fortress and the rivers

Ouse and Foss may also have been a military zone up to the mid-third century. Cool et al. (1999, 156-7) have suggested that the 16-22 Coppergate site was used by the Legio VI in the late second to mid-third centuries for the production of window glass. The legionary kilns were also sited to the immediate south-east of the fortress, and these remained in production until the mid-third century. The presence of these industries may suggest that the area between the fortress and the River Foss was a military industrial zone. Again this idea can be supported by the tile. The 16-22 Coppergate site yielded twenty legionary stamped tiles (four for the Legio IX, seven for the Legio VI and nine illegible military stamps) while a nearby site at 28-29 High Ousegate also had a Legio VI tile. The presence of so many legionary stamped tiles confirms a strong military presence, if not control of, the area.

Looking at the wider study area there are military stamped tiles at just two sites, 42-50 Tadcaster Road, Dringhouses, 3km to the south-west of the *colonia*, and at Heslington East 3km to the south-east of the fortress. In the case of Dringhouses the evidence consists of one Legio IX stamp and one illegible legionary stamp from the 42-50 Tadcaster Road site, while RCHM (1962, 107) lists a tile-lined tomb with Legio VI stamps in Dringhouses. At Heslington East there was one Legio VI stamp present, and there was a tally mark, which is an exceptionally unusual find for a civilian site (Warry 2006, 91, 140) and may therefore imply military connections.

It has been argued that the *territorium* of Gloucester is indicated by the presence of tiles from the municipal tilery (Rivet 1964, 139), if a similar argument is used here, it would suggest that York's *territorium* would have been at least 3km in size around the southern half of the study area, though the extent to the north is unknown. Against this, the tiles in the study pre-dated the structures at the two sites concerned (a Legio IX tile pre-dating AD 120 on a site dating to the late second century in the case of Dringhouses, and a Legio VI tile dating to the mid-third century at the latest on a largely fourth century settlement in the case of Heslington East) and the tiles may simply therefore indicate the re-use of earlier stocks of tile. Hurst (1999, 127) has pointed out that the use of stamped tiles to determine a *territorium* is unreliable, given that tiles can be moved away from their original locations.

6.3.2 The distribution of civilian stamped tiles

There is very little direct evidence of civilian tile manufacture in York. A graffito on a tile found in 1737, thought to be from the Clifton area north-west of the fortress, read POLIO COLEGIO FELICTER 'Polio to the guild, good luck' (Collingwood and Wright 1993, 128). As this sherd is now lost it is impossible to determine if the inscription was made on wet clay, which would imply that the person making the tile wrote the graffito, and this could possibly, therefore, indicate the existence of a tilers guild. Alternatively, if the graffito was scratched onto an already fired tile the guild referred to could represent some other trade.

There are five known civilian tile stamps from York (Collingwood and Wright 1993, 56-72). One was from the fortress, though this sherd was re-used and may have originated elsewhere, three sherds were from the *colonia*, and the find spot of the fifth tile is unknown. The design of two of the civilian stamps, incorporating ansate panels, suggests a link between civilian production and the military, and between tile producers and mortaria producers at the Apple Tree Farm site (see p61); it is impossible to determine whether the use of the ansate represents civilians copying a common military design, or whether the men concerned were ex-soldiers who went into business as tile and mortaria producers on retirement from the army.

As noted above (see p90) there were small numbers of later Roman tiles at both 28-40 Blossom Street and Heslington East that were so badly made, and of such unusual size, that it is difficult to regard these tiles as being of military origin, given that legionary tiles were of consistently high quality. If this is evidence of later civilian production it would seem to suggest that tile was made for specific requirements, but that quality control was somewhat lacking.

While the small number of civilian stamps seems to imply that civilian manufacture represented a negligible proportion of total production in York, this picture may be misleading. If civilians had stamped their tiles with the same frequency as the military, it might be expected that multiple examples of any given civilian stamp would have been recovered archaeologically, especially given the volume of material excavated in York. All five civilian stamps in York are, however, one-offs in terms of their design, which may imply that civilians were less likely to stamp their tiles. If this was the case, civilian production in York may have been under-estimated on the basis of the stamp evidence. A similar pattern is seen in London, where most civilian stamps occur as single examples (I. Betts pers. comm.).

6.3.3 The distribution of antefixes

Only two antefixes were seen in the present study, one from 16-22 Coppergate and one from the County Hospital site, both sites being in the immediate environs of the fortress. A further fourteen antefixes from six sites are, however, known from York (Figure 8). Taking the antefixes as a whole, one was recovered from beneath York Minster in the heart of the fortress, there were five examples from the immediate environs of the fortress at 31-37 Gillygate, Hungate, County Hospital and 16-22 Coppergate, a further three antefixes were from the *colonia*, one being from Priory Street, one from near the railway arch in the city walls, and one from Wellington Row, while the original location of the remaining examples is unknown.

The two differing designs of antefix in the present study (Figure 9), both depicting parts of female heads, are identical to examples previously recorded in York (illustrated in Table 2a above). The first design is known from County Hospital, Hungate and 31-37 Gillygate, all of which presumably represent material dumped from the fortress. The second design (RCHM 1962, Plate 39, 21f) is from 16-22 Coppergate and this may represent dumping from the fortress, or could have originated from stone buildings on the site. It is not clear how these designs relate to the example from York Minster, as this sherd was inadequately published, with no reference to the RCHM typology (Phillips and Heywood 1995, 685). One of the two designs in the study has also been recorded in the *colonia* (RCHM 1962, 114), though it is unclear from RCHM which one. The presence of an identical design in both the fortress and *colonia*, hints at a city-wide building campaign, though the date of this campaign is uncertain as the sherds at County Hospital and 16-22 Coppergate were not closely stratified.

The pentagonal shape of the antefixes suggests that they were designed for use on the ridge line, rather than on the eaves of buildings (Blagg 1979, 279), and the rarity of antefixes in York suggests that the form was little used.

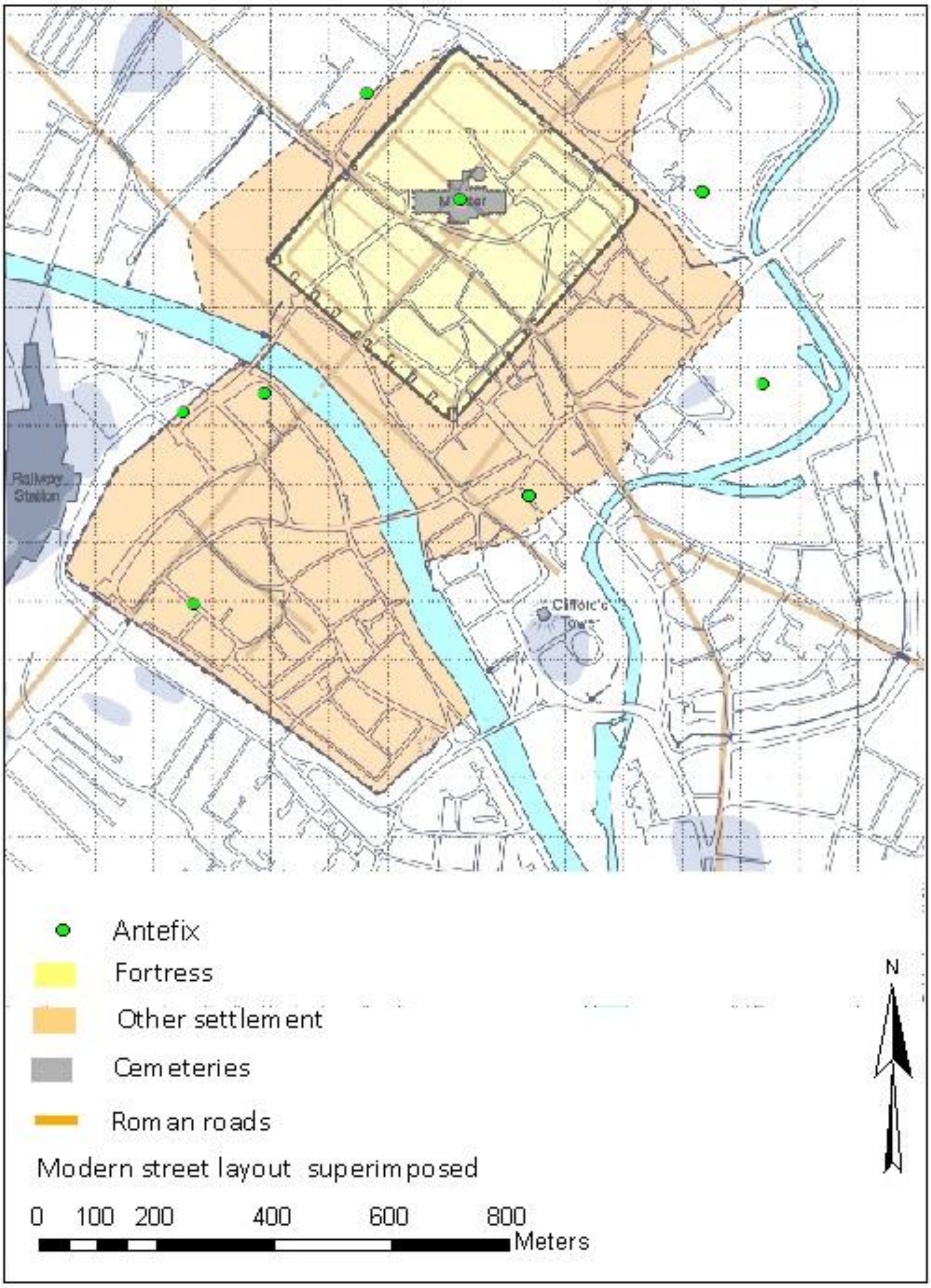


Figure 8. The location of antefix in York

Figure 9. Antefix sherds from the present study, © YAT

6.3.4 Relief-patterned flue tile

Relief-patterned flue tiles date from the late first to late second centuries, and their distinctive designs, coupled with analysis of their fabrics, have enabled the production of detailed distribution patterns (Betts et al. 1994). Relief-patterned tiles were made from the same clays as other types of tiles, suggesting that they were produced alongside other forms of tile, and there is no evidence to suggest that kilns were set up specifically for their manufacture (Betts et al. 1994, 17, 52). The only kiln sites known to have produced relief-patterned tile were civilian, and were predominantly in southern England, the most northerly being in Oxfordshire (Betts et al. 1994, 16). The example in the present study is Die Type 2 (Betts et al. 1994, 53) and was from the County Hospital site just outside the fortress. It is extremely unusual in terms of its distribution, not only because examples of this die have only previously been seen in the Hertfordshire/Buckinghamshire area and in London, but also because it represents the most northerly example, by far, of a relief-patterned tile in England (Betts et al. 1994, Table 1).

There are two possible explanations for the presence of this tile. Either it was imported from southern England or the die was brought to York and used in civilian production here. The size of the sherd made identification of the fabric uncertain, so it could have originated outside York. If the York example represents movement of a finished product, the tile concerned would have been transported 300km, but it is perfectly possible that the tile could have been transported by sea, via London, where examples of this die are known. It has been shown (Betts et al. 1994, 20-21) that the die in question was present on two differing tile fabrics, suggesting that it was used at two differing tileries. The York example could therefore represent movement of the die to a third location, being a rare example of civilian manufactured tile in York. Against this, it has to be said that the presence of one relief-patterned sherd is hardly suggestive of production in York. The only way to clarify the origin of this sherd, and therefore its meaning in terms of tile production, would be a direct comparison to examples from London, but that lies beyond the scope of the present study.

6.3.5 Variations in tile use across the study area

While the fortress obtained its tile from the legionary kilns, the question arises as to how the *colonia* and environs were supplied with tile. This has been examined by concentrating on sites with Roman structures, the following categories of site therefore being excluded: sites where tile was the result of dumping; sites with no Roman structures; tile occurring residually on sites where Roman deposits were not reached during excavation, as this tile could have originated elsewhere; tile from cemeteries; tile occurring in association with rampart dumps; and tile from watching briefs or sewer/cable trenches as such remains are difficult to interpret. This process of exclusion left thirty-five sites with excavated Roman structures, but the sherd counts on the majority of these sites were far too low to enable any analysis, with only twelve sites having sherd counts of over 100 (Table 7). These twelve sites were examined for the presence of legionary stamps, signatures, fabrics known to be associated with legionary stamps (fabrics R1-R3, R6-R11 and R13-15), and fabrics which have not previously been associated with legionary stamps (fabrics R4-R5, R12 and R16-R19). It is clear from Table 7 that there were no significant differences between the zones of the study area in terms of the presence of signatures, stamps and fabrics. The similarities between tiles in the varying zones show that military tiles were used in all areas of York, including the *colonia* and environs.

Table 7. Selected sites with Roman structures in relation to stamps, signatures and fabrics (F = Fortress, C = *Colonia*, E = Environs, Yes = sherds present)						
Site name	Zone	Sherd count	Legionary stamps	Signatures	Fabrics R1-R3, R6-R11, R13-15	Fabrics R4-R5, R12, R16-R19
1-5 Davygate and 9 Little Stonegate	F	119		Yes	Yes	R17
Purey Cust	F	308	Yes	Yes	Yes	R4, R17
Rear of 3 Little Stonegate	F	379		Yes	Yes	R15
12-18 Swinegate	F	2626	Yes	Yes	Yes	R5, R12, R16, R18.
George Hudson Street	C	174	Yes		Yes	R18
5 Rougier Street	C	1037	Yes	Yes	Yes	R5, R16, R18
1-9 Micklegate	C	3999	Yes	Yes	Yes	R5, R12, R16-17, R19
24-30 Tanner Row	C	5941	Yes	Yes	Yes	R4-5, R12, R16-19
Leedhams/Wellington Row	C	7498	Yes	Yes	Yes	R4-5. R12, R16-19
2 St. Maurice's Road	E	112		Yes	Yes	R16
42-50 Tadcaster Road, Dringhouses	E	175	Yes	Yes	Yes	R5
Heslington East, University of York	E	2116	Yes	Yes	Yes	R12, R18

In terms of tile sizes only bessales, flue tiles, imbrices and tegulae had sufficient examples to enable any comparison of dimensions across the zones of the study area. The bessales were on average broadest and thickest in the fortress and smallest in the environs (Figure 10), while both the flue tiles (Table 8) and imbrices (Figure 11) were thickest in the fortress and thinnest in the environs (though it should be noted that in all cases the differences in size were small, being less than 20mm). The tegulae showed a different pattern, with those of the fortress being on average 30mm thicker than those of the environs, and 43mm thicker than those of the *colonia*. The tiles in the fortress were clearly larger on average than those of the *colonia* and environs. While this could suggest differential supply, it is also possible, given that roofing tile decreased in size over time, that this is simply a reflection of the date at which the bulk of construction took place in the various zones.

The distribution of bessales, chimney, flue, parietalis, Lydion, pedalis, pipe, bricks of unusual shape, and sesquipedales were largely associated with sites known to have hypocausts or bath-houses present (see Appendix 4.3), and it can be argued that groupings of such tiles represent key indicators that hypocausts were present, even if no direct structural evidence is recovered (see p259). In contrast, tegulae and imbrices were abundant in all areas, showing that tile roofs were widespread, irrespective of the legal status of the area concerned.

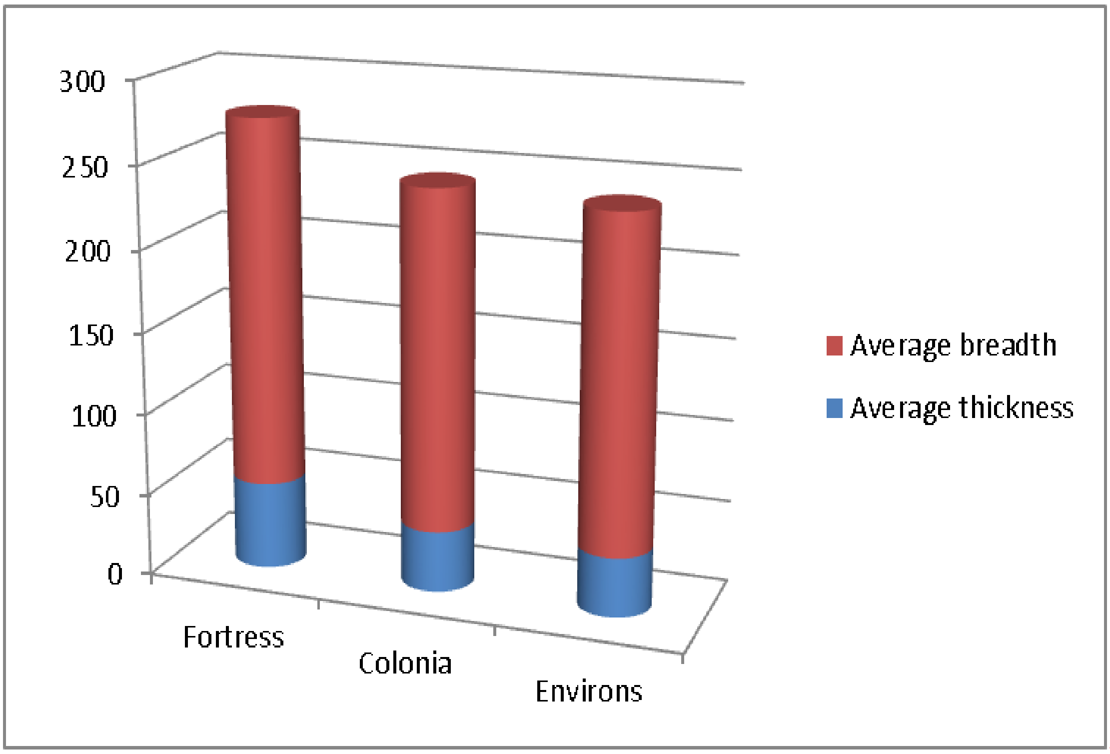


Figure 10. The average breadth and thickness of bessales in mm in relation to zone.

Table 8. The average thickness of flue tile by zone			
	Fortress	*Colonia*	Environs
Average thickness	22.64	19.29	18.2
Sherd count	380	595	298

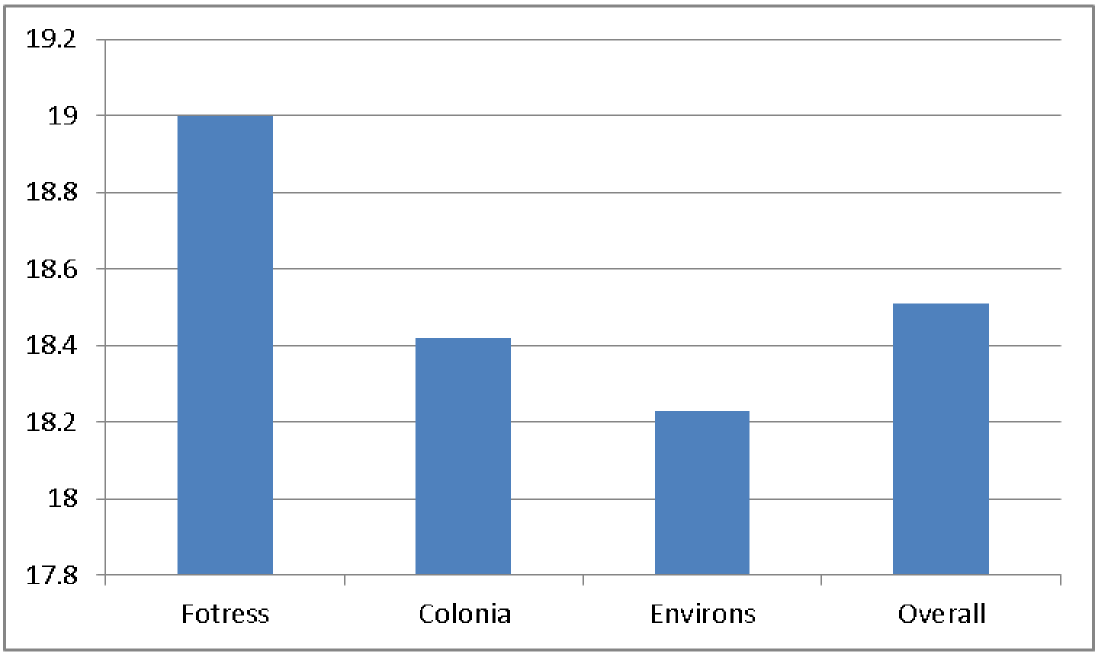


Figure 11. The average thickness of imbrices in mm in each zone compared to the average thickness of imbrices for the study area as a whole (the associated sherd count is given in Table 18).

7 Discussion and conclusions

As noted above (see p36) the study aimed to examine the chronological and spatial variations in the use of tile in York in relation to three key issues of archaeological theory, namely the speed and depth with which the process of Romanization occurred, the role played by the army both economically and culturally, and the nature of the Roman economy in York as seen through patterns of tile-supply between the town and its hinterland.

The analysis of the tile presented a number of interpretative difficulties (see 5.3), but it is the imbalance in the volume of excavation between the city centre and the environs that has proved the most problematical aspect of the data: the relative lack of excavation in the latter zone has severely hampered any discussion of either the economic relationships of the town to its immediate hinterland, or the nature of the process of Romanization in the vicinity of York. Despite the limitations imposed by the data, the study can contribute to all three areas of research.

7.1 Romanization

It is impossible to assess the initial impact that the introduction of classical architecture had on the indigenous population in the immediate hinterland of the fortress, as very few sites of late Iron Age/early Roman date have been excavated in the study area (see p39). The Heslington East site offers potential to analyse structural development in this period, and it is hoped that future research into this site will cast light on the question of whether the native building tradition survived or was replaced by Romanized structures, and the speed with which this process occurred.

The use of classical architectural forms represents an important element of the process of Romanization. Tile was a key building material, with tile-banded stone walls, bath houses with their specialised tiles, and low-pitched tiled roofs, all being characteristic of Roman architecture. It is clear from the tile in the study, however, that Roman York was very different from the classical ideal in terms of its architecture. This can be illustrated by roofing tiles, which were the dominant identifiable forms in the study: tiled roofs were rare prior to AD 100, and tile roofing only seems to have been the norm in the period AD 100-180, after which time the production of roofing tile declined sharply, coming to an end in the mid-third century. For the last 160 years of the Roman occupation, therefore, roofs must have been clad with stone, thatch, shingles, or possibly re-used tiles. Given that stone and thatch are better suited to steeply pitched roofs, this suggests that later Roman roofs in York were far steeper than the classical pitch of twenty degrees, showing divergence from the cultural norm.

This rejection of the classically styled tile roof could have been caused by any number of reasons. For example, it is possible that the staffing level in the fortress had been reduced and there were simply insufficient soldiers present to manufacture tiles, though it should be noted that as the number of troops in late Roman York is unknown this may not have been the case. Alternatively, it is possible that the manufacture of stone roofing tiles in west Yorkshire was such a successful industry that it out-competed the tile industry. Stone may also have been seen as a superior roofing material, with recognition that the steeper pitch of a stone roof was better suited to the British climate, being more efficient at shedding rainwater. It is also possible that the choice of stone over tile was due to increasing regionalisation in terms of sourcing resources, a similar shift being seen in later Roman pottery. Whether the reasons for abandoning tile roofs were pragmatic or aesthetic, clearly for much of its history, the roof-scape of York would have been very different from that of a classical Mediterranean settlement.

The chronological changes seen in the sizes of tile, and in firing temperatures (see 6.2.1 and 6.2.2), together with the switch to the use of stone in the later Roman period also show that Roman culture was not as static as is often supposed, but rather showed considerable technological change and adaptation over time.

Very few sites in the study had surviving walling above foundation level, but the evidence suggests that such walling was either timber-framed, stone, or stone with tile bands, conforming to the patterns seen elsewhere in Britain. There was no evidence for *opus testaceum* walling, which shows a significant divergence from the pattern seen in central Italy, where walling of this type dominated from the late first century onwards (see p62). The use of timber-framing and stone walling in York, as compared with the use of concrete and brick in central Italy, suggests that the architectural influence of building fashions seen in Rome was of limited effect in Britain, clearly indicating that the Roman Empire was not monolithic in terms of culture. This variation in architectural norms may have been the result of architectural styles being introduced to Britain from the provinces in which the army had previously been stationed, rather than coming directly from Rome. It could also be that the choice of walling type was purely pragmatic, making the best use of readily available resources.

There is a striking difference between the production and use of tile in the York area, and that of the more Romanized areas of southern Britain; the absence of any significant civilian tile industry in York shows that a true market for tile never developed, in contrast to the civilian tile industries which flourished in areas such as Lincoln or Gloucestershire (Collingwood and Wright 1993, 56). The difference suggests that there was less demand for tile among civilian communities in the York area than in southern Britain, hinting that the indigenous population initially rejected a Romanized lifestyle. There is certainly very little evidence for the development of towns or villas in the region prior to the mid-third century (Whyman 2001, 360), suggesting that Romanization occurred slowly. By the time the process of Romanization developed in the region, tile had largely been replaced by stone for building purposes, which may explain the absence of a later Roman tile industry in the York area.

7.2 The role of the army/state

It is clear from the present study that the army dominated tile production in York from the time of the conquest until the mid-third century, and that tile was produced primarily for the needs of the army and state. In this respect tile production closely matches that of Ebor Ware pottery which has an equally restricted distribution pattern, linked to military requirements (Monaghan 1997, 874-5). The tile evidence would also seem to confirm both Whyman's (2001, 195) suggestion that the area south-west of the Ouse was under military control until at least the mid-second century, and Cool et al. (1999, 147) suggestion that a zone of military control existed between the fortress and river Foss until the mid-third century (see p93-4).

While the primary motive for military tile-production was the needs of the army, the study suggests that military tiles were also used to supply the requirements of building campaigns in the area to the south-west of the Ouse. Whyman (2001, 199-202) has suggested that the buildings in question represent state-sponsored development to accompany the founding of the *colonia* as a political and administrative centre. That York seems to have developed for political reasons, rather than growing organically, would suggest that in cultural terms the influence of the army in the early Roman period was limited, despite its large-scale presence, as it did not encourage the growth of a Romanized settlement, with its associated architecture, including tile.

There was clearly a fundamental change in the nature of Roman occupation from the mid-third century onwards, reflecting the terminal decline of the empire; the collapse of the tile industry in York represents one element of the widespread changes occurring in later Roman society. As noted above (see p90), the reasons for the collapse of the tile industry are unknown, but it may be linked in some way to the growing preference for the use of stone as a building material, which was seen both in the fortress (Phillips and Heywood 1995, 198) and in the civilian areas (see Appendix 4.2.3). The change from the use of ceramic tile to stone for roofing represents a shift away from military self-sufficiency in terms of supplies. It also raises the question as to how the army obtained its stone tile supplies, whether these were bought from civilian producers, whether they represent the redistribution of the products of state-owned mines, or whether they were obtained as taxes in kind, and such questions are impossible to answer from the archaeological evidence alone.

7.3 The Roman economy of York as seen from the perspective of tile

7.3.1 Modes of tile production

Tile production in York can be split into four groups which can be compared to the models for tile production suggested by Peacock, and Darvill and McWhirr, outlined above (see p55-7).

The first group of tile, which was dominant by far, was military production. This matches the category of 'military and municipal' production suggested by Darvill and

McWhirr (see p56). The creation of a tile industry from scratch to meet military requirements matches the pattern seen elsewhere in Britain, where it was perfectly normal for military units to establish tileries to supply their own needs (see 4.1.1). Military/state self-sufficiency in terms of tile production, though clearly representing a major economic activity, does not represent trade in the true sense, but rather the state organisation of supplies. That military tile supply seems to have been sufficient to meet the need for tile, implies both that there was little demand for the product beyond the fortress and its associated settlement, and that true market-based commercial production never developed on any scale.

The second group of tile comprises a small number of civilian stamped tiles, the quality of which was comparable to military tiles. The production site, or sites, for these tiles is unknown, but the most likely candidate is a site at Apple Tree Farm, 3km north-east of the fortress. Pottery and mortaria were clearly produced at this site by at least two different potters, and similarities between mortaria stamps from the site and a tile stamp found in the *colonia*, suggest that tile may also have been produced at Apple Tree Farm, even though no direct evidence was found at the site. The presence of different producers, making a range of products including pottery, mortaria and possibly tile, at the one location suggests that producers had clustered together to take advantage of suitable clay sources and proximity to consumers. This pattern matches Peacock's model of nucleated production, and has characteristics of Darvill and McWhirr's modes of both district and clustered production (see p56). Production at the Apple Tree Farm site was of limited duration, dating to the early second century, a period when the fortress was not fully occupied and thus presumably to a lull in military production. The resumption of military ceramic production by the Legio VI in the mid-second century caused this civilian industry to collapse, indicating its economic fragility. The presence of the army seems, therefore, to have stifled the development of market-based tile production in the immediate York area.

The third group of tile production in York comprises evidence of tile manufacture in the later Roman period; there was a small group of underfired third century clay blocks from 28-40 Blossom Street, and a small group of flue tiles associated with a late fourth century industrial furnace at Heslington East. These tiles were unusual in terms of their forms and dimensions, and their deplorable quality clearly differed from that of the tiles in groups one and two, suggesting that knowledge of the correct methodology for tile production had been lost. These tiles can be seen as representing sporadic production to meet specific needs, and as such they best match Peacock's mode of 'household production' (see p55-6).

The fourth group of tile comprises a single sherd of relief-patterned flue tile, which matches tiles seen in Hertfordshire, Bedfordshire and London. As mentioned on p99-100 it is possible that a die was brought to York and used in civilian production here, and if this was the case this would fit the model of peripatetic production suggested by Darvill and McWhirr (see p57).

There was no evidence for municipal, rural or estate production as suggested by Peacock, or Darvill and McWhirr. Any municipal needs seem to have been met by the military kilns, making it unnecessary for the *colonia* to produce its own tiles, and therefore no equivalent in York of the municipal tiles of London or Gloucester has been found. The lack of rural and estate production is in contrast with other areas of Britain, and the fact that a rural tile industry did not develop in the York area suggests that there was little demand for tile, in other words civilian markets failed to develop. It should be noted, however, that at Dalton Parlours villa, 21.5km south-west of York, which dates to c. AD 200-370, the tile fabrics suggested two sources of supply, one being York, the second being an unidentified tilery which also supplied Castleford (Wrathmell and Nicholson 1990, 170). It is perfectly possible that this second source of supply at Dalton Parlours was a civilian tilery, and if so, commercial production in the region in the later Roman period may have been under-estimated (I. Betts pers. comm.).

7.3.2 Patterns of supply

It is clear that in terms of the supply of tile, the Roman period can be divided into two distinct parts, the first dating to AD 71 to the mid-third century, and the second from the mid-third century onwards.

Roman tile from York and its environs

Taking the first period the similarity in the tile used in the fortress, *colonia* and environs is clearly indicative of supply being dominated by one production centre, namely the military tileries in the Aldwark/Peasholme Green area (see Table 7). The distribution of legionary stamped tiles in the area of the *colonia* and immediate vicinity of the fortress can be explained by both military dumping and military/state involvement in the construction of buildings in that zone. Very few legionary stamps have been found in the wider study area, with examples only being present at two sites at Dringhouses and Heslington East. It is unclear how military produced tile ended up on these sites and, while it is possible that this was through the sale of military goods to civilians, or that it represents the redistribution of military goods across the *territorium* of the fortress, it is most likely to represent the re-cycling of old military tiles (see p94).

The short-lived civilian pottery at Apple Tree Farm, 3km to the north-east of the fortress, shows that there was an attempt to set up a civilian ceramic industry in York during this period, and the five civilian tile stamps in York must also date to this period, given that the practice of stamping died out in the mid-third century (Darvill and McWhirr 1984, 245-6). Three of these civilian tile stamps were from the area south-west of the Ouse, suggesting that the primary market for such production was not the fortress. A fourth civilian stamped tile sherd, though found in the fortress, was almost certainly re-used and may have originated elsewhere (see p354).

The supply of tile in this period mirrors that of pottery, with both being produced specifically to supply the needs of the army. It has previously been noted that the pottery produced in York had little impact on the surrounding areas (Pitts and Perring 2006, 207), and the distribution of military stamped tiles, both within the study, and as catalogued by Collingwood and Wright (1992, 148-74), would suggest that the same was true for tile. The economy of the region, as seen from the perspective of tile and pottery production would therefore seem to be largely state-led up to the mid-third century, with little evidence for the development of a demand stimulated economy.

One curiosity in terms of supply at this date is the single sherd of relief-patterned box flue tile. As mentioned on p99-100 this sherd may be evidence of the occasional movement of tiles over a long distance, but a single sherd is hardly indicative of regular trade in this type of tile between southern Britain and York.

From the mid-third century onwards production of both tile and Ebor Ware pottery ceased, leading to a fundamental change in patterns of production and supply for both industries. In the case of tile, production seems to have all but ceased in York, with the only possible later Roman tiles being suggestive of localised attempts at production, on nothing like the scale or quality of the earlier Roman period. In contrast, there is abundant evidence of rurally based pottery production in the areas to the north and east of York from the late third century onwards, which has been interpreted as estate-based production (Whyman 2001, 360), or as the development of an existing pottery tradition dating back to the late pre-Roman Iron Age in the area (Evans 1988, 331). Presumably tile was not produced at these rural sites due to a lack of demand for the product. In contrast pottery was still required for the preparation, storage and transportation of foodstuffs, albeit with a fundamental shift in both the location of the kilns and in the aesthetic quality of the end-product.

While it is clear that from the mid-third century onwards the use of stone largely replaced that of ceramic tile, there is also evidence for the robbing and re-use of earlier ceramic tiles, suggesting that re-cycling formed a valuable source of supply in the later Roman period, especially for the specialised tiles needed for bath-houses (see p65 and p354).

7.4 Concluding remarks

7.4.1 The value of the study

The subject of Roman tile from York has been under-researched in comparison with other artefact types, and the present study has gone some way to redressing this situation. The detailed recording of the tile, which formed the background for this study, led to the creation of a searchable database, which in turn enabled the compilation of a full catalogue of the tile. Both the database and catalogue are of value in their own right, representing a useful resource for the future study of Roman tile in York. The cataloguing of the tile also yielded evidence of unusual tile forms, together with previously unrecorded stamps and signatures, all of which represent valuable additions to the national corpus of tile.

By analysing over eight tonnes of tile from 216 sites, the study has attempted to set the tile from individual excavations into a broader context, to better understand the social and economic factors underpinning the production and use of tile in Roman York and its immediate hinterland, although it is fair to say that the nature of such relationships between the fortress and town on the one hand and the peripheries of the study area on the other, remain somewhat obscure, due to the relative lack of tile from excavations beyond the central core of the study area.

It is clear that production and use of tile in Roman York was adaptive, changing to suit the needs of society. The variation in the volume of tile production and use over time was primarily to fulfil the requirements of the military and state and therefore reflected political decisions, while changes in roofing tile size reflect technological changes in production, and there is even a hint of variation in the colour of roofing tiles over time, perhaps suggestive of changing fashions. The change to the use of stone roofing tiles represents both a fundamental shift in building-material supplies in the later Roman period, and possibly also a switch to steeper-pitched roofs, which were better suited to the British climate.

For the period up to the mid-second century the widely debated question of town-hinterland relationships is slightly different in the case of York, being rather a question of fortress-hinterland relationships. The tile evidence suggests that it was primarily state involvement which led to the creation of a town in York. The study has provided evidence to back earlier suggestions that the area between the fortress and the river Foss, and the area to the south-west of the Ouse, were military controlled zones up to the mid-second century and, though a civilian settlement developed south-west of the Ouse from the mid-second century onwards, the tile suggests strong military involvement in this process. The study also suggests that a state-sponsored building campaign, using military produced tiles, occurred in the newly created *colonia*: politics, rather than market forces, were the dominant factor in the development of the *colonia*.

Given that tile production all but ceased in the mid-third century, it cannot contribute to the question of town-hinterland relationships for the later Roman period: a study of stone roofing tile supply would be required to determine the nature of such relationships in terms of building supplies. The use of stone rather than ceramic tile for roofing for the last 160 years of occupation in York suggests that the cultural influence of classical Italian architecture was somewhat limited, and that the Empire was far from monolithic in terms of its architecture. The increasing use of stone for roofing across late Roman Britain (see 4.2.3) must have led to increasingly provincialized architecture, and such provincialism has also been observed in architectural ornamentation in Britain (Blagg 1980, 40), reflecting the heterogeneous nature of Roman identities.

7.4.2 The potential for research

Further work could clearly be undertaken on the data from the present study. Detailed examination of the tile from a number of large-scale excavations undertaken in the late 1980s, notably 12-18 Swinegate/14 Little Stonegate, 1-9 Micklegate, 5 Rougier Street and 24-30 Tanner Row (which collectively account for 47.9 percent of all Roman tile from York), would further clarify the picture of chronological changes in the use of tile across York and lead to a better understanding of the buildings in question. Additional recording could be undertaken on the tegulae flanges and upper cutaways, so as to develop typologies. A comparison of the fabrics in the sherd of relief-patterned tile from York and similar examples from London might help to clarify whether this tile was produced locally or was imported, either way the result is of interest representing either evidence of peripatetic production, or of long-distance exchange. Comparisons of the fabrics of the present study to other sites across Yorkshire could also help to determine supply patterns, particularly between the various military bases in the region, especially for sites which have revealed Legio IX and Legio VI stamped tiles, such as Malton and Castleford.

One site in the study which stands out as having potential for further analysis is the Heslington East site. Not only did this site have the remains of several types of Roman building, and of both tile and stone roofing, but it was also relatively undisturbed in comparison with the sites in the centre of York. It therefore offers the potential to assess the distribution of tile on a context-by-context basis to determine how tile spreads across a landscape after a site has been abandoned.

Ideally the tile collections of York Minster, the Yorkshire Museum, and tiles excavated by commercial archaeological units other than YAT and by amateur excavation groups, should be analysed in relation to the present study, as this would build up as full a picture as possible of the production and use of tile across Roman York.

There is also clearly potential for the publication of the results of this study to fill the void which currently exists relating to the subject of the production and use of Roman tile within York and its hinterland.

Appendices

Appendix 1 Summary of the YAT collection review of 2005

YAT was established in 1972 and since its foundation it has continuously excavated sites within York and its immediate environs, resulting in the accumulation of a large collection of artefacts and ecofacts. By 2005 the artefact collections were housed in a number of locations around York including St Saviour's church, the YAT conservation laboratories in Galmanhoe Lane and at two warehouses in Walmgate and Clifton Moor, all of which were full to capacity, and the decision was therefore taken to undertake a collections review, with the aim of rationalising the material held in order to reduce the storage space required. The review concentrated on the two artefact/ecofact types where it was felt there was the greatest potential for discard, namely tile and environmental soil samples (since the environmental soil samples lie beyond the scope of the present study they are not discussed further here).

The level to which the tile within the YAT artefact collections had been recorded varied. Tile recovered from archaeological projects predating the mid-1980s was largely unrecorded. Many, but by no means all, archaeological projects undertaken since the mid-1980s had been assessed by S. Garside-Neville, with the results recorded on pro-forma sheets and the tile being retained in full for further study. The majority of the recording sheets for this period existed in paper form only, with virtually none of the information being held on a computerised database. The tile excavated from 2000-2004 was fully recorded by S. Garside-Neville and J. M. McComish with only a representative sample from each excavation, typically 20 percent of the original volume, being retained, and the data from these sites had been added to YAT's internal database, named the Integrated Archaeological Data Base (IADB). Since 2005 all the tile excavated by YAT has been recorded by J. M. McComish on a revised pro-forma recording sheet, a representative selection of tile from each site has been retained, and all the information has been entered onto YAT's database.

During 2004 the present author recorded all the previously unrecorded tile in the collections using the methodology described in Appendix 3, and the resultant data was entered into YAT's database. Where tile had already been recorded by S. Garside-Neville the paper records were retrieved from the YAT archives and computerised. By the end of the 2005 collections review all the tile in the YAT collection had been fully recorded, with only a representative portion being retained, this resulted in a substantial reduction in the volume of material requiring storage. In the case of the Roman tile the retained sample comprises 1.4 tonnes while the discarded portion was 6.4 tonnes.

Appendix 2 Sites included in the study

Table 9 list details all the archaeological excavations included in the present study, and they are listed in order of the YAT project codes used on IADB.

Table 9a. The sites included in the present study together with their project codes.	
Project code	Site name
1972.15	Museum Street/Lendal
1972.17	St Maurice's/Newbiggin, Lord Mayor's Walk
1973.5	21-33 Aldwark (St Helen's) (Ebor Brewery)
1973.13	The Bedern, South-west
1973.14	58-59 Skeldergate (Bishophill I)
1973.1001	Marygate
1973.1020	Bondhill Ash I (Outer Ring Road)
1974.12	34 Shambles
1975.3	Ward's, St Sampson's Square, Road
1975.6	9 Blake Street (City Garage)
1976.7	16-22 Coppergate
1976.11	Parliament Street Sewer
1977.1028	3 Stonegate
1978.8	118-26 Walmgate
1978.14	The Bedern, north-east
1981.3	1-2 Tower Street (Castle Garage)
1981.12	5 Rougier Street
1981.18	Trinity Lane Car Park
1981.1034	Mount School, Dalton Terrace
1982.10	County Hospital/Fossbank
1982.19	County Hospital/Monkgate
1982.22	Coppergate/Piccadilly/Castlegate, watching brief
1983.1	36 Aldwark (Police Garage)
1983.2	Skeldergate, City Mills
1983.5	Jewbury
1983.32	General Accident, 24-30 Tanner Row
1983.35	Swinegate (Roman sewer)
1983.43	25 St Saviourgate
1983.45	Judge's Lodging, Lendal
1984.14	City Walls, Tower 8
1985.2	City Walls Walmgate Bar
1985.5	7/9 Aldwark
1985.6	Museum Gardens (IBM)
1985.9	46 - 54 Fishergate (Redfearn National Glass)
1985.12	City Walls, Foss Islands Road
1985.15	City Walls, Tower 13 (Toft's Tower)

Table 9b. The sites included in the present study together with their project codes.	
Project code	Site name
1986.3	Micklegate
1986.5	Clementhorpe/Terry Avenue
1986.8	Assembly Rooms, Blake Street
1986.11	St George's Field
1986.14	Haymarket Car Park, Peasholme Green
1986.22	Purey Cust Nuffield Hospital
1987.1	Coffee Yard
1987.8	Exhibition Square
1987.9	19/29 Bishophill Senior
1987.13	16 Parliament Street
1987.21	22 Piccadilly (ABC Cinema)
1987.24	Leedhams site, Wellington Row
1987.33	76/82 Walmgate
1988.6	St Andrews Church, St Andrewgate
1988.8	1 King's Square
1988.17	1-9 Micklegate [Queens Hotel]
1988.22	2 Coffee Yard
1988.27	Barbican leisure Centre, Paragon Street
1989.1	Albion Wharf, 23-28 Skeldergate
1989.3	Rolyat Works, Cromwell Road
1989.7	Crown Court, York Castle
1989.8	Foss Islands Road / Lawrence Street
1989.14	Cherry Hill Lane, Clementhorpe
1989.16	8-9 Escrick Street
1989.18	Yorkshire Museum lift building
1989.21	35-41 Blossom Street
1989.22	Dundas Street, NEEB HQ
1989.25	112 Micklegate
1989.26	Piccadilly to Stonebow to Davygate Telecom trench
1989.28	12-18 Swinegate
1990.1	14 Little Stonegate & 18 Back Swinegate
1990.3	5-13 Clifford Street
1990.5	King's Square sewer repair
1989.21	35-41 Blossom Street
1989.22	Dundas Street, NEEB HQ
1989.25	112 Micklegate
1989.26	Piccadilly to Stonebow to Davygate Telecom trench
1989.28	12-18 Swinegate
1990.1	14 Little Stonegate & 18 Back Swinegate
1990.3	5-13 Clifford Street
1990.5	King's Square sewer repair
1990.8	23 Clifford Street

Table 9c. The sites included in the present study together with their project codes.	
Project code	Site name
1990.12	St Wilfrid's RC School, Monkgate
1990.13	Adams Hydraulics, Peasholme Green
1990.14	Church Street sewer repair
1990.16	Bishophill Senior Car Park
1990.17	St Georges Field Car Park
1990.20	Swinegate sewer repair 2
1990.24	Tanner Row, Wellington Row [Stakis].
1990.25	20-24 Swinegate
1990.32	City wall, Fishergate - Tower 37
1991.1	26-34 Skeldergate
1991.3	13-17 Coney Street
1991.4	89 The Mount
1991.5	Ideal Laundry, Trinity Lane
1991.9	Carmelite Street
1991.11	14-20 Blossom Street
1991.14	14 Skeldergate
1991.16	84 Piccadilly
1991.21	104-112 Walmgate
1991.29	17-21 Piccadilly [Reynard's Garage]
1992.4	38 Piccadilly
1992.5	York Castle Car Park
1992.8	45-57 Gillygate
1992.9	City walls, Tower 9
1992.10	50 Piccadilly
1992.11	26-28 Marygate
1992.12	2 St. Maurice's Road
1992.16	Holgate Dock, Watson Street
1992.18	41 Piccadilly
1992.1001	Museum Gardens, Railings
1992.5007	Rawcliffe
1993.3	Nicholas Gardens, Lawrence Street
1993.10	North Street , sewer discharge chamber
1993.16	Land to rear of St Andrewgate/Spen Lane
1993.5005	Manor farm, Rawcliffe Lane
1993.5007	Rawcliffe Manor, Manor Lane, York
1993.9	Frontage of 148 Lawrence Street
2000.1	Hungate Development, Trench 1, City Car Park, Dundas Street, York
2000.6	Hungate Development, Trench 20, Property off Garden Place, York
2000.7	Hungate Development, Trench 24, Henlys Garage Forecourt, The Stonebow, York
2000.8	Hungate Development, Trench 8, TAVR Depot, Hungate, York

Table 9d. The sites included in the present study together with their project codes.	
Project code	Site name
2000.9	Hungate Development, Trench 25, Northern Electric Site, Dundas Street, York
2000.12	Hungate Development, Trench 12, Former Derwent Coachworks, Palmer Lane, York
2000.13	Hungate Development, Trench 13, Former Derwent Coachworks, Palmer Lane, York
114	Site of St. Nicholas' Hospital, 148 Lawrence Street, York
161	16-20 Blossom Street, York
209	Blue Bridge Lane
245	The Judges Lodging Hotel, 9 Lendal, York
274	York Castle Car Park, off Tower Street, York
305	52-62 Tadcaster Road, York
321	Merchant Adventurers Hall, Fossgate, York
336	Land off St. Andrewgate/Spen Lane, York
352	40-45 Parliament Street & 3-9 Pavement, York
385	Bootham School, Bootham, York
386	The Starting Gate, 40 Tadcaster Road, York
391	The Old Bus Depot, 17-19 Barbican Road, York
414	47-51 Skeldergate, York
441	Sewer repair adjacent to 47 Goodramgate, York
448	47-55 Tanner Row, York
449	Sewer repair adjacent to 1 Chapter House Street, York
466	Sewer repair adjacent to 81 Low Petergate, York
468	Sewer repair adjacent to 93 Low Petergate, York
489	60 Tadcaster Road, Dringhouses, York
504	Land off Water Lane, Clifton, York
510	1-5 Davygate and 9 Little Stonegate, York
511	County House, Monkgate, York
514	Land off Manor Lane, Rawcliffe, York
518	Property adjacent to 20 Davygate & 9 New Street York
524	George Street/Margaret Street Car Park, York
527	18A-19 Fetter Lane. York
529	26-30 Regency Mews, Tadcaster Road, Dringhouses, York
530	Old Foxtons Garage, Leeman Road, York
532	BHS Store, 44 Coney Street, York
559	Land adjacent to Female Prison, York Castle, Castlegate, York
570	St. Margaret's Church, Walmgate, York
585	292 Bishopthorpe Road, York
591	Holgate Motors, 39 Holgate Road, York
601	Former school canteen, Fawcett Street, York
607	Rear of 3 Little Stonegate, York

Table 9e. The sites included in the present study together with their project codes.	
Project code	Site name
608	13-17 New Street, York
620	St. William’s College, College Street, York
630	47-55 Tanner Row, York
633	Former Old Priory Youth Club, Nunnery Lane, York
635	Former Primitive Methodist Chapel, 3 Little Stonegate, York
638	14 Skeldergate, York
645	Land off Watson Street, St. Pauls Green, Holgate, York
647	Land at The Stonebow, Hungate, Dundas Street, Carmelite Street, Palmer Lane & Garden Place, York
651	2 Clifford Street, York
663	Site of St. Leonard’s Hospital, Museum Street, York
671	NCP Car Park, 64-74 Skeldergate, York
693	Acomb Grange, Grange Lane, Acomb, York
694	1-1A Low Ousegate, York
706	Wentworth House, The Avenue, York
731	St. Peters School, Clifton, York
744	The Ryedale Building, 58-60 Piccadilly, York
770	Electrical Substation & Supply, York Railway HQ, Station Rise, York
771	90 The Mount, York
777	Concrete Works, Leeman Road, York
782	Land off Wigginton Road and the A1237, Clifton Moor, York
785	Land at Huntington South Moor, Monks Cross, York
788	41-49 Walmgate, York
798	Land off Lord Mayors Walk & Clarence Street, College of Ripon & York, York
817	Former Presto Supermarket, George Hudson Street, York
820	Land at 12-13 The Avenue, Clifton, York
834	Site of St. Leonard’s Hospital, Museum Street, York
838	Union Terrace Car Park, Clarence Street, York
854	Former D.C. Cooks site, Lawrence Street, York
858	York City Arms Social Club, Fawcett Street, York
859	Former Victoria House, Micklegate, York
893	13-15 St. Martin's Lane (Bantams Barn), York
1000	Land off Dundas Street, Palmer Lane & Hungate (Hungate Development), York
1006	62-68 Low Petergate, York
1023	127 Lawrence Street, York
1025	Land off Metcalfe Lane, Osbaldwick, York
1048	28-29 High Ousegate, York
1069	University of York, Heslington East Development, York
1074	Tregelles Junior School, Dalton Terrace, York

Table 9f. The sites included in the present study together with their project codes.	
Project code	Site name
1088	Theatre Royal, St. Leonards Place, York
1091	Electricity cable trench, outside Holy Trinity Church, Micklegate, York
1092	Bedford Hotel, 108-110 Bootham, York
1118	The Mount School, Dalton Terrace, York
1131	6 Colenso Street, Clementhorpe, York
1135	Former Starting Gate Pub, 42-50 Tadcaster Road, Dringhouses, York
1140	Land off Navigation Road, York
1196	Former Henlys of York Filling Station, The Stonebow, York
1213	Land at 3 Driffield Terrace, York
1214	Land adjacent to St. Saviours Church, Hungate, York
1229	Terry's site, Bishopthorpe Road, York
1260	St. Mary's Abbey Precinct North, Yorkshire Museum, York
1276	21 Clifton Green, York
1278	23 Ogleforth, York
1283	6 Trentholme Drive, York
1296	House and Son, 4 Ogleforth, York
1307	Land at junction of Dixon Lane and George Street, York
1313	40-48 Monkgate, York
1334	27 Lawrence Street, York
5003	Land adjacent to St. Saviours Church, Hungate, York
5007	St Anthony’s Hall, Aldwark, York
5015	29 The Mount, York
5031	Electricity Sub-station, Silver Street, York
5073	Ambulance Station, Hay Market Car Park, Dundas Street, York
5112	University of York, Heslington East Development, York
5144	Former Stoneplan Yard, Dalton Terrace, York
5145	Waggon and Horses PH, 19 Lawrence Street, York
5244	Sewage attenuation tanks, 28-40 Blossom Street, York
5344	City walls Lord Mayors Walk
HE08	University of York, Heslington East, 2008 Excavation
HE09	University of York, Heslington East, 2009 Excavation
HE10	University of York, Heslington East, 2010 Excavation
HE10	University of York, Heslington East, 2011 Excavation

For brevity the Former Presto Supermarket, George Hudson Street is referred to as George Hudson Street in the text, Land at the junction of Dixon Lane and George Street is referred to as Dixon Lane, and The Former Starting Gate Public House, 42-50 Tadcaster Road, Dringhouses, is referred to as 42-50 Tadcaster Road.

Appendix 3 Recording methodology

3.1 The YAT methodology for recording Roman tile

The tile in the present study was recorded to the following methodology, which is currently in use at YAT. In the interest of brevity the following description relates only to Roman tile and does not include medieval, post-medieval or modern tile excavated by YAT. Material from each excavation is washed and dried, then bagged by context, prior to the individual sherds being recorded in full on a pro-forma recording sheet (Figure 12). Each pro-forma record sheet is used to record the tile from a single archaeological context (that is an individual layer of soil or a construction related deposit). The excavation project code, context number and date of recording are listed at the top of the form, each row of the pro-forma record sheet usually represents a single sherd, though sherds or the same form weighing less than five grams from any given context are usually grouped together and recorded on a single row. The following categories of information are recorded in the relevant column of the pro-forma recording sheet:

Fabric type - The tile is examined by a x10 hand lens and matched to a fabric reference collection held by YAT. A clean surface is required for accurate assessment of the fabric necessitating the breaking off of a small area of each sherd. The Roman fabrics are prefixed by the letter R followed by a number to indicate the fabric concerned, where it is impossible to determine the fabric the sherd is recorded as R0 (this is often used for sherds weighing less than ten grams). Where a highly unusual fabric occurs comprising one or two sherds unique to a particular site, it is termed R99, and a description of the fabric is noted in the comments section. A question mark after a fabric name indicates that too little was present to be entirely sure of the identification.

Form – One of the following list of form names is used: Antefix, Bessalis, Bipedalis, Chimney, Flue, Imbrex, Lydion, Mammata (an abbreviation for tegula mammata), Spicatum (an abbreviation for *opus spicatum*), Other (for any sherds of unusual form), Parietalis, Pedalis, Rbrick (an abbreviation for Roman brick, which is used for all sherds of uncertain form), Tegula, Tessera or Voussoir. A question mark after a form name indicates that too little was present to be entirely sure of the identification of the sherd, thus 'Parietalis?' indicates a sherd that is probably, though not definitely, a parietalis.

Corners – The number of surviving original corners is recorded.

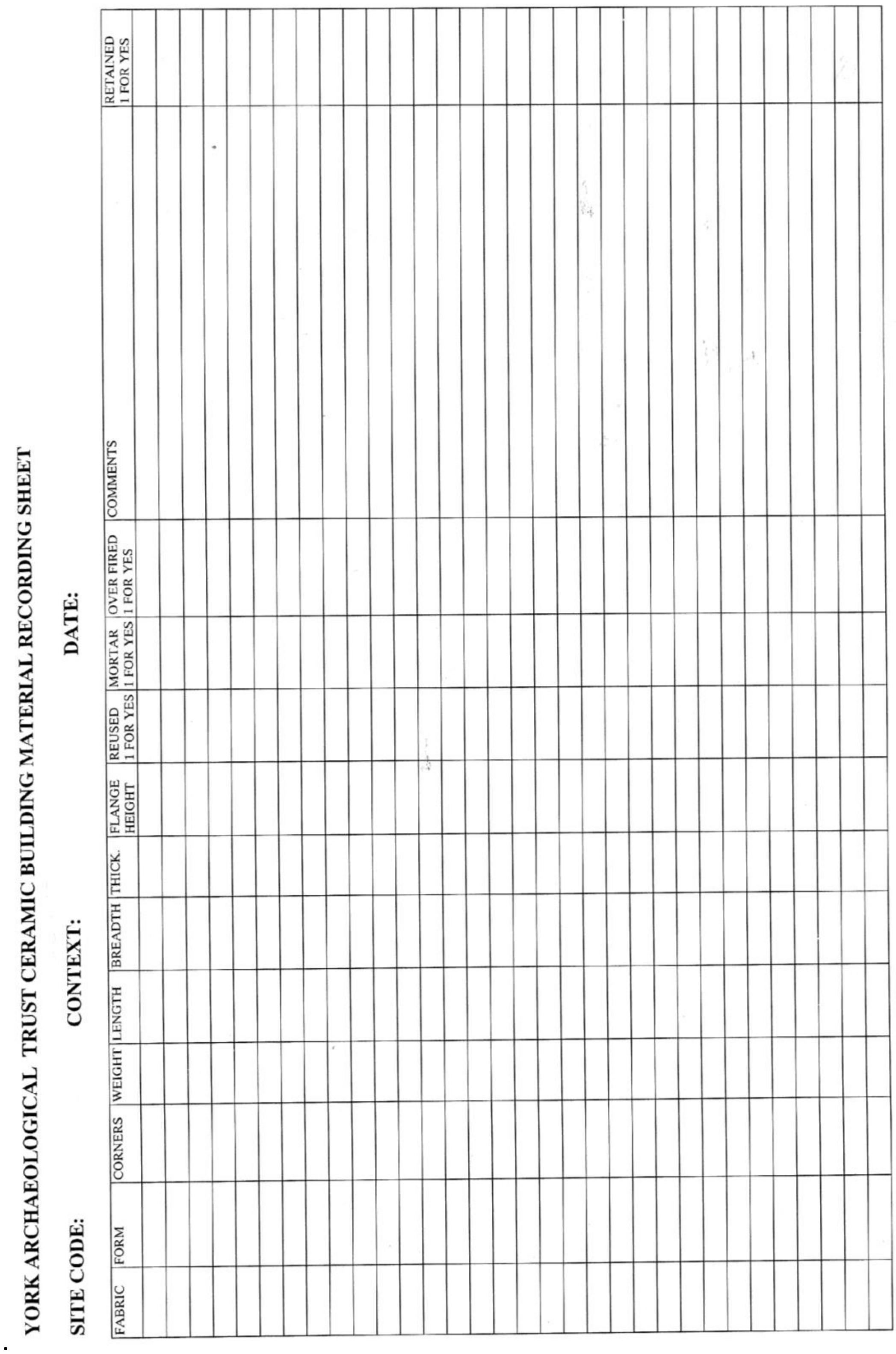
Weight – The weight of the sherd is recorded in grams.

Length/Breadth/Thickness/Flange– A measurement in millimetres is taken if the full dimension is preserved. Within IADB a zero in these columns indicates that the original full dimension did not survive. Flange refers to the flange-height.

Re-used/Mortar/Over-fired – For sherds with clear evidence for re-use either in the form of sooted broken surfaces, or having been shaped into counters/lids, or with mortar on broken surfaces indicating re-use in later structures, or with evidence of over-firing, a '1' is placed in the relevant column. A zero in these columns indicates that there was no clear evidence of re-use, mortar on broken surfaces or over-firing present

Comments – Any other comments relating to the sherd are added as free text. Comments include descriptions of surface marks such as the presence of keying lines and whether these are combed, incised or drawn with the fingers, together with the pattern of combing seen. The presence of animal paw prints, grip marks, hob-nail boot impressions or finger prints is noted, as is the presence of tally marks, batch marks or graffiti together with a description. Signature marks have been recorded in relation to Betts' typology (1985, 192-4) and legionary stamps are recorded in relation to Collingwood and Wright's catalogue (1992, 148-74). Flue tile vent sizes and shapes are noted. Nail-hole shape and dimensions are recorded in the form 'Square hole 10x10mm', or 'Circular hole 11x11mm', but if the entire nail-hole does not survive it is written in the form 'Square hole 11x?mm' where one side survives, or 'Square hole ?x?mm' where no complete dimension survives. The presence of tegula upper cutaways is noted and the lower cutaways are recorded in relation to Warry's typology

(2006, 4). The presence of reduced cores and whether sherds are blown or vitrified is noted.



YORK ARCHAEOLOGICAL TRUST CERAMIC BUILDING MATERIAL RECORDING SHEET

SITE CODE: CONTEXT: DATE:

FABRIC	FORM	CORNERS	WEIGHT	LENGTH	BREADTH	THICK.	FLANGE HEIGHT	REUSED 1 FOR YES	MORTAR 1 FOR YES	OVER FIRED 1 FOR YES	COMMENTS	RETAINED 1 FOR YES

Figure 12. The YAT pro-forma recording sheet for ceramic building material (©YAT)

Retained – A '1' indicates that the sherd was retained while a zero indicates that the sherd was discarded.

A representative selection of the tile from each excavation is retained, and in the case of Roman tile sherds are retained if the fabric is unusual, the form is unusual, if there is a complete breadth or length measurement present, if there is a complete surviving tegula flange, if there is a feature of interest relating to manufacture or use, if there is a legionary/civilian stamp, signature mark, graffito, batch mark or tally mark present, or in order to retain a representative selection of tile from the excavation concerned in terms of both the fabrics and forms present.

The resultant records are entered into YAT's internal database, the Integrated Archaeological Database (IADB), which was devised by YAT's Head of Computing, M. Rains. The records are stored in relation to a project code for the excavation in question, and for many sites excavated prior to 2000 the project code is the museum accession code allocated by the Yorkshire Museum, while for most sites excavated since 2000 an internal YAT four digit code has been allocated. The IADB is currently remotely stored, with Rackspace, USA, and the material is backed up daily to prevent record loss.

3.2 Use of the YAT records for the present study

The YAT data analysed in the present study was extracted from the IADB on July 30th 2010. Since IADB does not have a spell-checking facility, the data was transferred into a Microsoft Excel table and searched for errors, which were then corrected on the original IADB records. Where necessary sherds were re-examined in order to check data, make corrections, or to record additional information which was then added to the IADB.

The tile and a collection of stone roofing tiles from the University of York's excavations at Heslington East, York, 2008-2011, was recorded using the YAT methodology from October to November 2010, and in December 2011, and the resultant records were added to the IADB. The data was checked for errors and any necessary corrections were made. Two assessment reports on the tile from the Heslington East site were prepared (McComish 2010 and McComish 2011) which follow the format used for commercial archaeology projects undertaken by YAT.

Once the Heslington East data had been added to the IADB, the data relating to all Roman tiles was extracted and placed in a Microsoft Excel table. A series of columns for additional information not recorded on the IADB were added into the Excel table, including a primary key column numbering each line of data in a sequence from one to 35,945, a column listing the museum accession code (as this sometimes differs from the project code), and columns giving a central X and Y coordinate for the excavation in question in relation to the national grid. Where form and fabric are uncertain they were originally recorded on the IADB with the form or fabric name followed by a question mark (such as Tegula? or R14?). For ease of data-sorting two new columns were added giving the form and fabric types without the question marks. A column termed 'flange-height' was added giving the difference between the flange height and thickness of the tegula in mm. A column was added giving the zone from which the sherd originated in terms of F for fortress, C for *Colonia* and E for Environs.

As the free-text 'Comments' column of the original data was difficult to search, the information in this column was separated out into a series of new columns on the Microsoft Excel table. Taking each of these new columns in turn, the presence of an upper cutaway was recorded as a 'Y' for yes in the relevant column. The lower cutaways were recorded in relation to Warry's typology (2006, 4) with a question mark used where a lower cutaway was present but the form could not be determined, and 'other' being used for lower cutaways where the form did not match Warry's typology. A column was added to state which legion any tile stamps belonged to, with a number 9 for the Legio IX, a number 6 for the Legio VI, a number 1 for a legionary stamp which was illegible, and a question mark for any stamps which were totally illegible. A column was added where the legionary tile stamps were recorded in relation to Collingwood and Wright's typology (1992, 148-74) with a question mark being used for legionary stamps which were illegible and 'other' being used for stamps that did not match Collingwood and Wright's typology. Signatures were recorded in relation to Betts' typology (1985, 192-4), with a question mark being used for partially preserved signatures where the original design was impossible to determine, and 'other' being used for signatures that did not match Betts' typology. Keying was recorded as combed, incised, finger (for finger-drawn) or stick (for the one example drawn with a stick). Graffiti were described in free text. The presence of pierced holes and their dimensions were recorded in the form 'Hole 10x10mm' where the hole survived intact or 'Hole 10x?mm' where the hole was partially destroyed, and holes which had been pecked or chipped out of the tile after firing were recorded in the form 'Pecked 11x8mm'. A column for firing information contained any combination of the terms blown, overfired, reduced, underfired, vitrified, warped and waster, separated by commas. A column for surface marks contained information on human and animal prints, grass/straw impressions, rain or hail-stone marks, glaze, hob-nail boot impressions and incisions or possible tally marks. A column was added to give the dimensions of large but incomplete sherds, in the form 'in excess of 300x350mm'.

Once all the alterations had been made to the Microsoft Excel table data, it was used for the analysis of the tile in terms of the quantities of the various forms, fabrics and surface marks present, and their relationship to one another and to other variables such as zone.

The data for the sites selected for detailed study was copied into a separate excel table, and the phasing data added on the basis of the archive/publication reports and their associated pottery dating. The phasing was designed to match the periods used by Monaghan (1997) for Roman pottery in York, in order to facilitate comparisons between the pottery and tile industries.

3.3 Use of ArcGIS in the present study

The computer programme ArcGIS version 10 was used for the production of the distribution plots within the study, which was available for the use of students within the Department of Archaeology at the University of York. Two base plots of Roman York in relation to modern features were provided by YAT in jpg format, one showing the entire study area (Figure 1) and one showing the central area of York in more detail (Figure 2). The base plots were inserted into ArcGIS in the correct position on the relevant Ordnance Survey maps, this process involved stretching the jpg images which has caused some loss of detail (as a comparison of Figures 1-2 with Figures 17-18 illustrates), but the resultant distribution plots remain legible. The Microsoft Excel data-table, described in Appendix 3.2 above, containing all the recorded details of the tile was added to the ArcGIS to enable the creation of distribution plots for the various forms and fabrics recorded.

It should be noted that YAT records site national grid reference numbers for the central point of each excavation in a four figure format while ArcGIS requires a six figure format, and to convert the YAT grid references into a suitable format for ArcGIS a '4' was added at the start and a '0' at the end of each of the YAT grid reference numbers.

Appendix 4 Forms of Roman tile

The volume of the various forms is given on Table 10. Due to the highly fragmented nature of the sherds analysed, 60.6 percent of the tile was classified as Rbrick. The dominant and most widespread identifiable forms were tegulae and imbrices which together represented almost a third of the total volume of tile examined. This conforms to the national picture where tegulae and imbrices invariably represent the commonest forms (Warry 2006, 1). Only forty-three sites lacked any evidence for roofing tile, and in all cases these were watching-briefs, small sites which generated few artefacts, or were sites which did not penetrate Roman levels.

The ratio of imbrices to tegulae in the present study, 1.78g of tegula to every 1g of imbrex, is perhaps lower than might have been expected. At Beauport Park 3.7 tons of tegulae and 1.16 tons of imbrices were recovered (Brodribb 1979a, 140) giving a ratio of 3.19g of tegula to every 1g of imbrex. The lower than expected ratio of tegulae to imbrices in the present study can be accounted for by the fragmented nature of the tile, for while the imbrices in the study were distinctive enough to be identified even when severely fragmented, the same was not true of the tegulae, where the only clearly identifiable sherds were portions of flanges or sherds with broken off flanges; many fragments of shattered tegulae will inevitably have been recorded as Rbrick.

An examination of the ratio of tegulae to imbrices on each site of the study area was undertaken, and only four sites had more imbrex than tegula. At Heslington East there was 62,322g of imbrex and 61,885g of tegula; this higher than normal level of imbrices was due to the presence of a stone roof with an imbrex ridge-line, thereby increasing the proportion of imbrices seen. Three other sites had more imbrex than tegula (Land adjacent to St Saviour’s church, Dixon Lane and 1-5 Davygate/Little Stonegate), but the sherd counts for these sites were too low (sixty-seven, seventy-one and forty-eight respectively) to make any valid suggestions as to the types of roofing present. From the observed ratio of tegulae to imbrices, it is clear that none of the sites in the study had sufficient imbrices to be suggestive of imbrex only roofs, confirming Warry’s (2006, 108-9) observation that such roofs were not used in Britain.

Flue tiles were the next most commonly-occurring form in the study representing 4.4 percent of the total volume of tile. Flues are associated with hypocausts, and their comparative rarity in the dataset reflects the small number of hypocausts excavated.

Table 10. The weight in grams of each form, the sherd count and the weight in grams of each form expressed as a percentage of the total weight of tile in the present study

Form	Weight in grams	Sherd count	Weight as a percentage of the total weight
Antefix	250	2	0.003
Bessalis	116525	76	1.435
Chimney	1425	15	0.018
Flue	358642	1345	4.418
Imbrex	916651	5965	11.292
Lydion	26550	6	0.327
Opus spicatum	300	1	0.004
Other	42880	21	0.524
Parietalis	40581	57	0.500
Pedalis	16775	5	0.207
Pipe	28129	468	0.346
Rbrick	4918988	22786	60.597
Sesquipedalis	4650	1	0.057
Tegula	1636129	5101	20.154
Tegula mammata	2750	4	0.034
Tessera	1749	88	0.022
Voussoir	5085	4	0.063

The remaining forms (antefix, bessalis, chimney, Lydion, *opus spicatum*, parietalis, pedalis, pipe, sesquipedalis, tegula mammata, tesserae and voussoir) each accounted for between 0.003 and 1.4 percent of the total volume of tile examined. The rarity of antefix, chimney, parietalis and voussoir in the study conforms to their rarity nationally (Blagg 1979, 277; Brodribb 1989, 31, 58-9, 142). Bessalis, pedalis, pipe and sesquipedalis were primarily associated with hypocausts (Betts 1984, 149; Brodribb 1989, 34, 36, 41, 84) and their comparative rarity in the dataset reflects the small number of hypocausts excavated. The rarity of tesserae in the dataset is a reflection of the low number of tessellated pavements and mosaics excavated. No *opus spicatum* floors were present on the sites in the study, explaining the rarity of such tiles, though floors of this type are known from thirty sites nationally (Brodribb 1989, 142). The four sherds of tegula mammata in the study represent the first examples of such tiles from York; tiles of this type are rare outside the south-east of England (Brodribb 1989, 148-9). Lydion bricks have been recorded on at least 109 different sites across Britain (Brodribb 1989, 42). The number of Lydions in the present study is low, possibly reflecting the fragmented nature of the tile analysed.

Three Roman tile forms (bipedalis, ridge tile and hollow voussoirs) which have been recorded elsewhere in Britain are not present in the dataset, but given that these forms are rare nationally (Brodribb 1989, 41-2; Williams 1971, 184) their absence is unsurprising. It is perfectly possible that these forms were used in York, but due to the highly fragmented nature of the material examined, no definite identifications could be made.

No compete examples are present of antefix, chimney, *opus spicatum*, parietalis, pipe, tegula mammata or voussoir, preventing any comparison of dimensions to material from elsewhere in Britain, and there is no national survey of tesserae sizes against which the results of the present study can be compared. The range and average dimensions of the remaining forms in the present study are listed in Table 11, together with the associated sherd count, and comparative measurements are given from a national survey of tile sizes (Brodribb 1989, 12, 26, 35, 40, 41, 74, 142-3). Table 11 is illustrated on Figure 13.

There was variation between the tile sizes in the present study and those of Brodribb's national survey (1989), but this differed from form to form (Figure 13): the bessales in the study were broader and longer but thinner; the flue tiles were shorter but broader; imbrices were shorter, broader and thinner; Lydions matched the national sizes closely; pedalis were longer but narrower and thinner; sesquipedalis were thinner; and tegula were longer. In the case of the bessalis, pedalis and sesquipedalis the differences were small (Table 11). The flue tiles varied the most from the national average sizes, reflecting the presence of a group of seven abnormally short flues from the Heslington East site, but also the fact that there was no standard size for flue tiles nationally (Brodribb 1989, 74). The tegula were larger than the national average, confirming earlier observations by Betts (1985, 171) that the York tiles were among the largest seen in Britain.

Table 11. The sherd count, range of dimensions and average dimensions in mm of forms in the present study and nationally (national figures taken from Brodribb 1989). H = Height, L = Length, B = Breadth, B1 = Breadth at top of imbrex, B2 = Breadth at base of imbrex, T = Thickness

Form and dimensions		No. of sherds	Size range	Average size	National size range	National average
Bessalis (Square)	L	13	190-235	210.5	170-235	198
	B	66	178-245	207	170-235	198
	T	67	20-70	38	25-90	43
Flue	H	10	131-301	190.7	155-470	366
	L	15	120-301	204.5	130-315	190
	B	22	102-257	159.9	85-280	131
	T	1273	10-36	20	unknown	unknown
Imbrex	L	4	290-441	369.8	360-510	398
	B1	7	138-177	152.1	137-177	135
	B2	3	162-232	198	130-220	176
	T	5625	10-35	18.5	14-30	20
Lydion	L	3	386-410	402	335-480	403
	B	3	270-295	279	230-310	280
	T	6	29-62	42	25-70	41
Pedalis	L	1	305	305	unknown	281
	B	5	260-305	276.4	unknown	281
	T	5	32-62	40	25-70	46
Sesqui-pedalis	L	1	400	400	350-460	405
	T	1	44	44	40-70	52
Tegula	L	2	520	520	310-570	430
	B	5	302-380	342	270-480	330
	T	3631	11-50	24.7	9-35	unknown

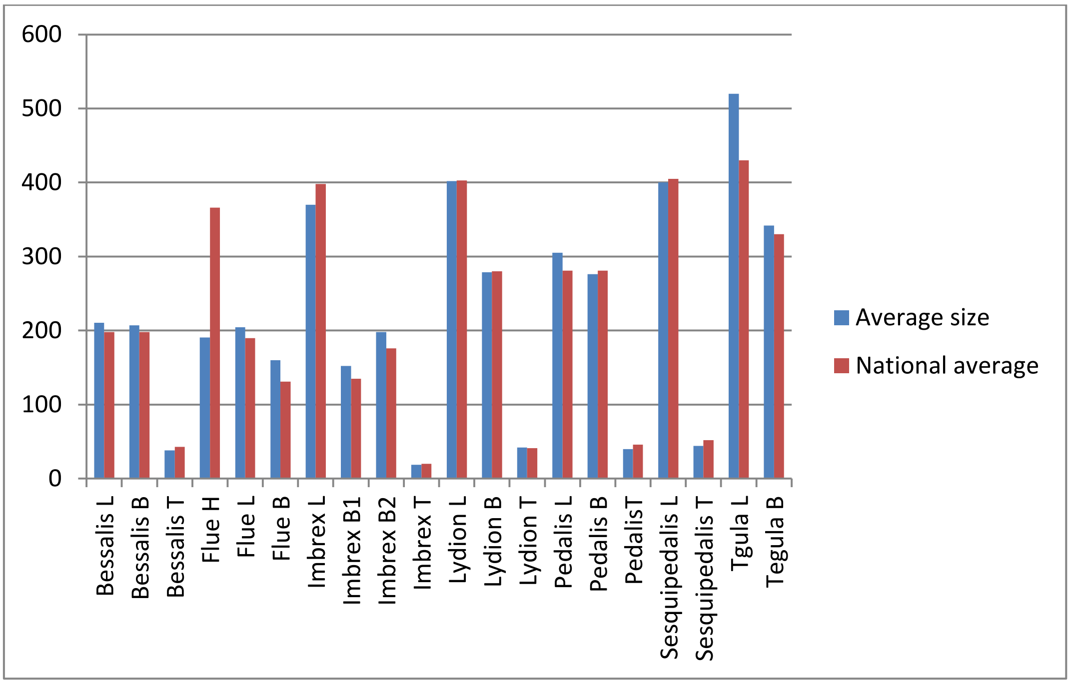


Figure 13. Comparison of the average dimensions in mm for various forms in the present study with the national averages as recorded by Brodribb (1989). The associated sherd count for the present study is in Table 11, while the sherd count nationally is in Brodribb (1989, 142-3). L = Length, B = Breadth, T = Thickness, H = Height, B1 = Breadth at top of the imbrex, B2 = Breadth at base of the imbrex.

4.1 Description of the various forms of tile

Although no examples of bipedales, ridge tiles or hollow voussoirs were present within the dataset, a brief definition of each of these forms and its principal uses in Roman architecture is included below, as they represented standard components of Roman architectural ceramics.

4.1.1 Antefix

Antefix tiles typically comprise a decorated vertical panel of triangular or pentagonal shape, though two are known from Caerleon with a rounded top, and they have a lug or a semi-circular flange on the reverse designed to fit into the open end of either the lowest-most course of imbrices on a roof or into the gable-end of the ridge-tiles (Brodribb 1989, 29-31). Antefix tiles have sanded decorated surfaces showing that they were made in sanded moulds rather than being stamped (Betts 1985, 161).

Roman tile from York and its environs

Ceramic roof decorations were uncommon in the western provinces of the Roman Empire, with antefixes representing the most widespread form, though even these were relatively rare (Blagg 1979, 277). The lack of antefixes in Britain has led to the suggestion that they were used at the ridge-ends of buildings rather than along the eaves, or that they were only placed intermittently along the eaves such as at the corners of buildings (Brodribb 1989, 31). It has been suggested that a triangular shaped front panel might be more appropriate for the eaves of a building, while pentagonal forms would be better suited to covering the ridge-pole at the apex of the roof (Blagg 1979, 279).

It has been noted that antefix tiles in Britain are usually from military sites, but there was a difference in terms of antefix-usage between the various military units stationed in Britain. Four examples from Caerleon bear a Legio II stamp beneath a human head wearing a diadem and surrounded by starts and crescents, and fifty-seven examples from Chester, Holt and Prestatyn, in eight differing designs relate to the Legio XX, while two examples both from Templeborough each in a unique design relate to the Cohors IIII Gallorum, one of which has a star above the text (Collingwood and Wright 1992, 119-24). There are no known examples with Legio IX or Legio VI inscriptions, though the presence of an example within the fortress in York suggests that they were used.

Some examples are known on civilian sites including Dorchester, Silchester and in the *colonia* at York, while moulds for two antefixes were found at a kiln site at Stibbington in the Nene Valley (Blagg 1979, 278). Lanchester has also yielded an example with the inscription Severi beneath a grotesque head, the name in this case probably relates to the name of a civilian manufacturer rather than the emperor (Collingwood and Wright 1992, 1124). It has been suggested that the examples from the *colonia* at York would have been influenced by the building practices of the nearby fortress and are therefore more likely to be of military rather than civilian types (Blagg 1979, 278). Toynbee (1964, 428) suggested that the ‘relatively large’ numbers of antefixes on military sites suggest use at the eaves of buildings, while the lesser number of examples from civilian sites indicate use at the gables; the number of antefixes recorded in Britain is, however, always small, even on military sites, casting doubt on this interpretation.

Roman tile from York and its environs

The majority of antefix tiles in Britain are decorated with human masks, though other designs include Celticised Medusa and Gorgon heads, and a goddess holding the tails of two dolphins. A group of eight designs related to the Legio XX depict the legionary symbol of a boar and the legend LEG XX, with either a Celticised head at the top of the tile or a *phalera* running the length of the tile behind both the boar symbol and the legend (Toynbee 1964, 428-31 and illustrations XCVIII and XCIX). A single example of a design from Chester has an *aedicula* of two twisted colonettes beneath an arch, framing leaf like sprays and a Jupiter Ammon head, this design is thought to represent a Continental import, as is a single example depicting a lion's mask from London (Toynbee 1964, 431). Ten published examples from York, all on pentagonal panels, depict a vine leaf with grapes, gorgon heads (two examples), a female head with a stylised headdress, a second design of female head (six examples) and a man fishing (RCHM 1962, 114 and Plates 38-39). It is possible that antefixes were painted, for example, an example is known from Caerleon which was whitewashed, possibly in preparation for painted decoration (Johnson and Haynes 1996, 26).

Fourteen examples of antefixes are known from York: ten are published in RCHM (1962, 114); an antefix was present in Trench 5 at Wellington Row but this sherd was not seen in the present study (Monaghan 1997, 1114); an antefix decorated with a face was recovered in excavations at York Minster (Phillips and Heywood 1995, 270); an antefix was found at 31-37 Gillygate; and an antefix has recently been recovered at excavations at Hungate.

Two examples of antefixes were present within the dataset (Figure 14) representing 0.003 percent of the total volume of tile examined. The scarcity of antefixes in the present study accords with the rarity of such tiles within York, and Britain, as a whole. The first example recorded in the present study was recovered from excavations at 16-22 Coppergate to the south-east of the fortress, and comprises the top corner from the front panel of an antefix (Figure 15). The panel of the antefix is 26mm thick, but no other dimensions survive, and the fabric was identified as R11, a commonly occurring fabric within the study area. Although the sherd is small, making it difficult to determine the original design, it seems to represent the upper portion of a type previously seen on an antefix from York (RCHM 1962, Plate 39 21f), which depicts a female head wearing a head-dress, with a leaf flanking each side of the face. If this identification is correct the sherd would have originally been of pentagonal shape, perhaps suggesting that it was designed for the ridge line of a building.

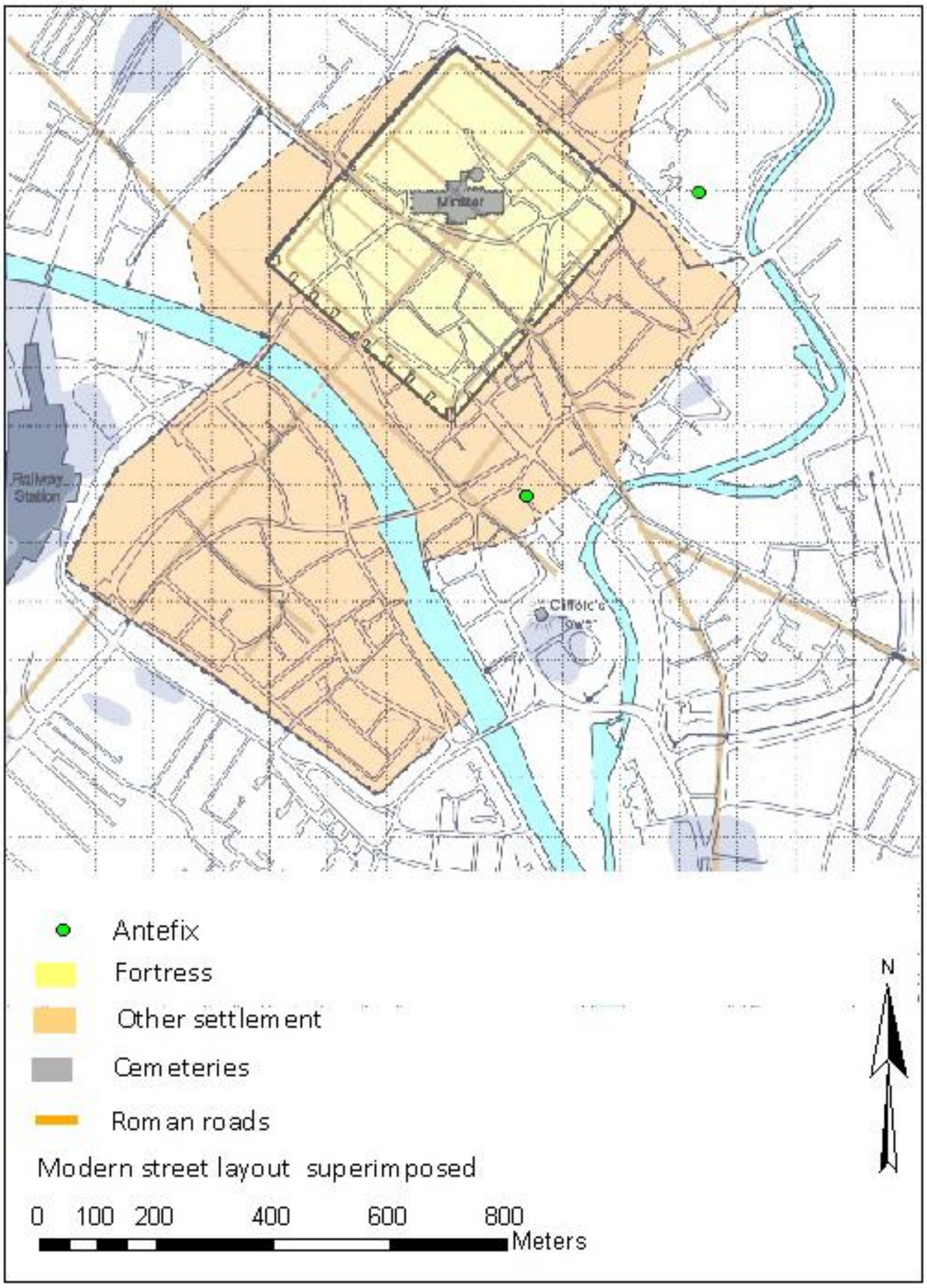


Figure 14. The location of antefix tiles within the study area (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Figure 15. An antefix sherd from 16-22 Coppergate, York, Context 33121, © YAT

The second antefix sherd was from the County Hospital site in the environs to the east of the fortress (Figure 16), this sherd represents a small portion of an antefix depicting a female head in a hooded frame surrounded by stalk like ornament, and this design has been previously recorded in York (RCHM 1962, 114 and Figure 21a-d). The sherd was in fabric R16, which though recorded elsewhere in York is a relatively rare fabric. The tile in the study represents the base portion of the female neck, and basal portion of the hooded frame from this design. Although not recorded for the present study two further examples of this design have been excavated by YAT, the first was recovered in 1972 from a site at 31-37 Gillygate, which lies to the immediate north-west of the fortress (this sherd could not be recorded as it is on display in a museum), while the second example was recovered in November 2011 from the YAT excavations at Hungate, to the south-east of the fortress (this was not recorded in the present study as it was recovered after the cut-off date for data selection).

Figure 16. An antefix sherd from the County Hospital site, Context 9, © YAT

4.1.2 Bessalis

Bessales are the smallest size of Roman brick, with dimensions of eight Roman inches square, that is 197mm² in size. Bessales are usually square in plan, though circular examples are known from twenty-three sites in Britain (Brodribb 1989, 35), and octagonal examples are known from Silchester (Williams 1971, 181). Bessales were principally used to form the columns or *pilae* of hypocausts, though they were also used for other purposes, such as bonding courses within walls, for flooring, and in arches (Brodribb 1989, 34). When used in pilae they usually rested upon a larger basal pedalis brick, as in the caldarium in the legionary baths suite in York (RCHM 1962, 42).

Bessales were made on sanded work benches using appropriately sized open-bottomed sanded moulds, giving rise to sand on the sides and bases of the bricks, and sometimes to lips of clay around the bottom of the tiles where clay had been squeezed between the mould and the work bench (Betts 1985, 158). Sometimes the sanded undersides have drag-lines from wires which were used to separate the tile from the workbench (Betts 1985, 162).

Signatures and tally marks are rare on bessales in Britain, only 9 percent of the 608 complete bessales recorded in a national survey of Roman tile in Britain had signature marks and only 1.9 percent had tally marks, with all the examples of tally marks coming from sites associated with the Roman navy (Brodribb 1989, 35-6). Military stamps are also rare on bessales in Britain. For example, at Beauport Park, Sussex, only one of the seventy-two complete bessales present was stamped, despite the widespread use of legionary stamps on roofing tiles at the site (Brodribb 1989, 35-6).

Seventy-six bessales were recorded in the present study, which collectively weighed 116,525g, representing 1.4 percent of the total volume of tile examined. The bessales were recovered from fifteen sites in the study area (Figures 17-18). In terms of location seven examples were from the fortress, fifty were from the *colonia*, nine were found up to 800m south-east of the fortress, and ten were from Heslington East, 3km south-east of the fortress.

Two sites in the fortress yielded bessales, the Swinegate Sewer repairs and the adjacent excavations at 12-18 Swinegate. Three of the bessales at the Swinegate Sewer repairs were *in situ*, forming a *pila* column resting on a Lydion brick (Marwood 1990, 22), while the site at 12-18 Swinegate yielded a single *in situ* example forming part of a hearth or flue, together with three re-deposited examples. These two sites are clearly related to the legionary baths complex, hence the presence of a hypocaust and hearth.

Five sites in the *colonia* yielded bessales: Leedhams Garage and Wellington Row (which were on the same plot of land); 1-9 Micklegate; George Hudson Street; and 24-30 Tanner Row. The excavations at 1-9 Micklegate produced the largest group of bessales from the *colonia*, with twenty-two examples, which were related to a major baths building on the site. A further sixteen examples in the *colonia* came from Leedhams/Wellington Row, though none of these bessales were *in situ*. This site was interpreted by Whyman (2001, 288, 293) as having a hypocaust, which presumably explains the presence of the bessales at the site. A hypocaust at the George Hudson Street site yielded a further four *in situ* examples in a short length of walling, together with one redeposited example (McComish 2001, 15). The 24-30 Tanner Row site yielded six redeposited examples.

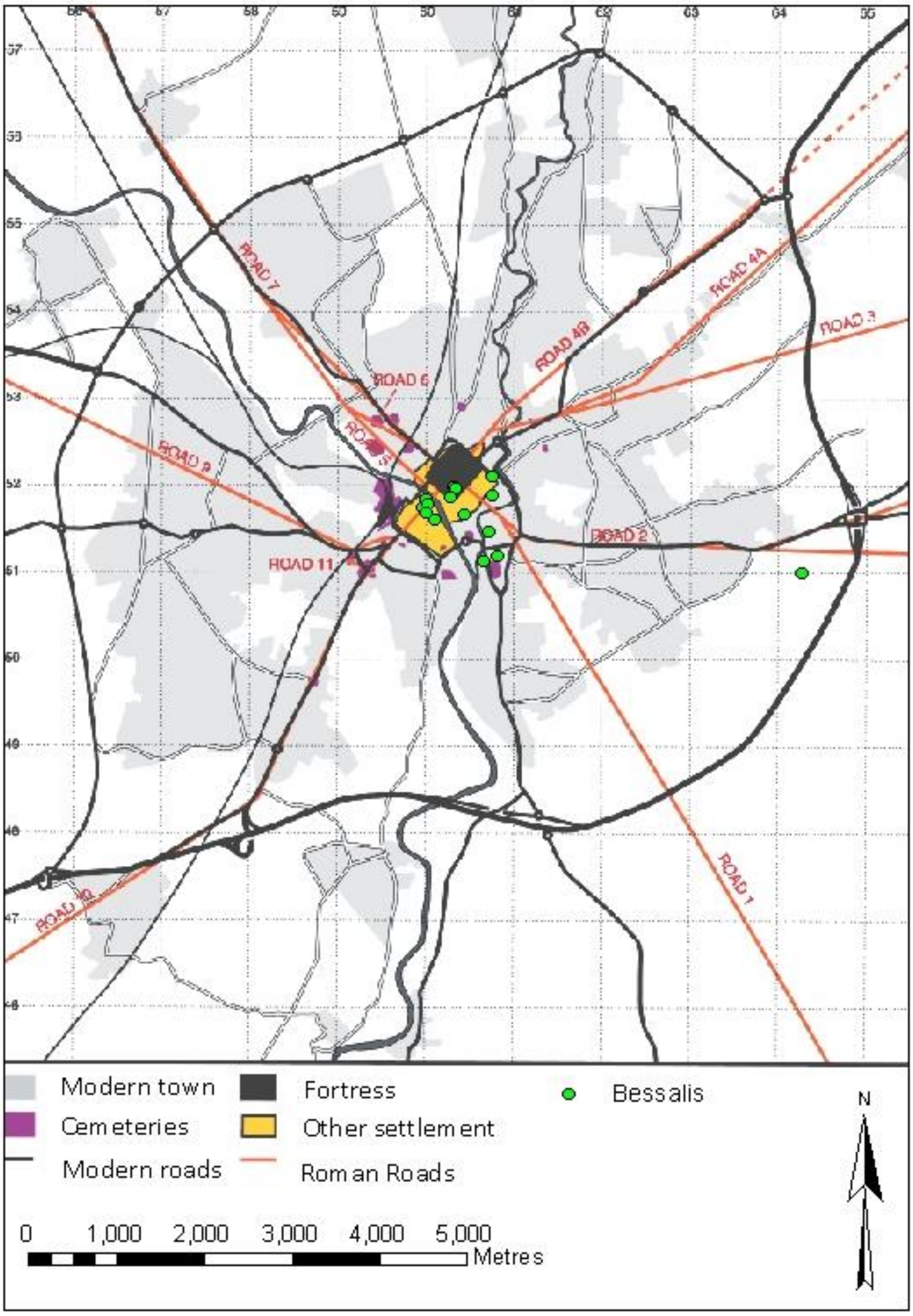


Figure 17. The location of bessalis within the study area (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

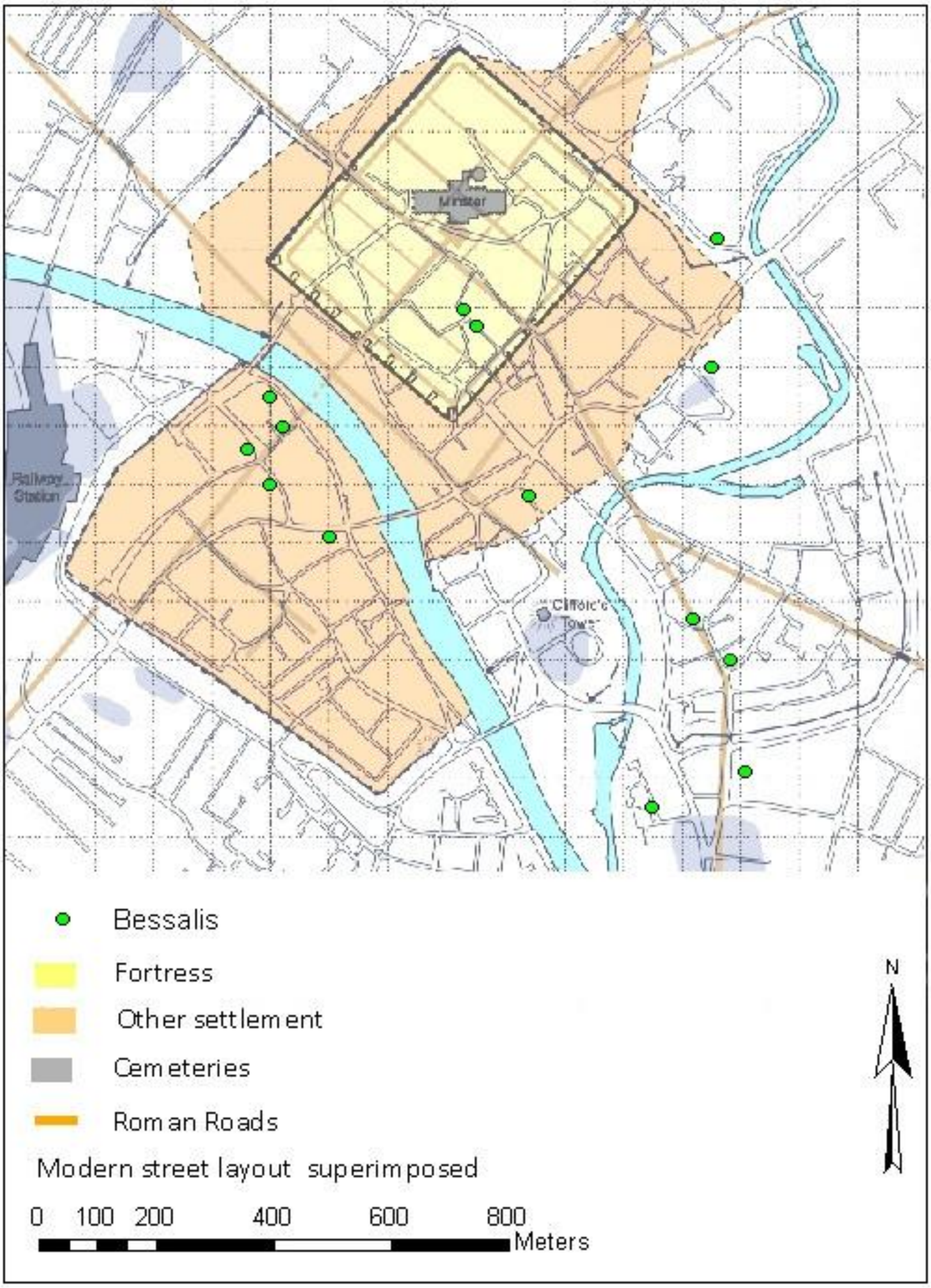


Figure 18. The location of bessalis within the central area (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Roman tile from York and its environs

Eight sites in the environs yielded bessales. Four of the bessales were from a hypocaust at the Heslington East site, 3k south-east of the fortress, with a further six from elsewhere on the site (McComish 2010, 11). It should be noted that only one tile per pilae column was removed from the site, leaving the remainder *in situ*, and these *in situ* tiles were not, therefore, recorded in the present study, though measurements of these tiles were taken during the course of excavation (McComish 2011, 12). The remaining seven sites in the environs each yielded one or two bessales, but none of these were *in situ*.

The total weight of bessales in each zone of the study area and the associated sherd count are listed on Table 12. The presence of bessales was closely associated to the location of hypocausts, rather than to a specific zone of the study area.

Table 12. The weight and sherd count for bessales in relation to zone			
Zone	Fortress	*Colonia*	Environs
Weight in grams	21175	67775	27575
Sherd count	7	50	19

Sixty-six of the bessales in the present study were square, nine were circular in plan and one was rectangular, and the dominance of square bessales accords with the picture from the rest of Britain. Three sites in the present study yielded both circular and square bessales (24-30 Tanner Row and 1-9 Micklegate, both in the *colonia*, and the site at Heslington East 3km south-east of the fortress), suggesting that some buildings must have contained a mixture of bessales forms. The use of both square and circular forms in structures has been recorded elsewhere, in hypocausts at Listercombe and Silchester (Brodribb 1989, 35) and in the furnace of a public baths at the site of the old Railway Station in York (RCHM 1962, 54 and Plate 21).

Fourteen of the bessales in the present study had complete surviving dimensions. Five of these were in the fortress, three in the Swinegate Sewer Repair, which were each 220mm^2, while two from 12-18 Swinegate were between 237-239mm in size. Five of the complete bessales were in the *colonia*, two from the George Hudson Street site, two from 1-9 Micklegate and one from Wellington Row, which ranged from 197mm^2 to

205-210mm in size. The only site in the environs with complete examples was Heslington East, where examples in the hypocaust had complete surviving dimensions of 190x190x28mm, 190x190x34mm, and 200x195x29mm respectively, the fourth example in the hypocaust was less complete being 200x30mm in size. A further six bessales from this hypocaust which were not recorded for the present study measured 200x200x32mm (Context 178), 200x195x32mm (Context 236), 200x195x32mm (Context 238), 202x198x30mm (Context 242), 190x192x31mm (Context 243) and 186x184x32mm (Context 240). The Heslington East bessales were clearly all part of a single structure, but ranged in size by up to 14mm, and this variation was probably due to differential shrinkage during manufacture. There was one other complete bessalis from the Heslington East site, not associated with the hypocaust, which measured 198x195x34mm.

The square bessales recorded in the present study ranged from 190-239mm in length with an average length of 210.5mm (thirteen complete lengths present), from 178-245mm in breadth, with an average breadth of 207mm (sixty-six complete breadths present), and in thickness from 20-70mm with an average thickness of 38mm (sixty-seven complete thicknesses present). No length or breadth dimensions survived on the circular bessales, though the thicknesses ranged from 47-65mm with an average thickness of 53.8mm (six complete thicknesses present). Both circular and square forms were present in the fortress, *colonia* and environs. The rectangular bessalis measured 188x210x32mm in size and may represent a specially commissioned brick of unusual size rather than a bessalis.

Five complete length measurements were present in both the fortress and *colonia*, with a further four examples being present in the environs. The number of length measurements in any given zone of the study area was too low to enable valid comparisons to be made between length and location. Bessales in the fortress were on average 223mm broad and 53mm thick (seven examples), those in the *colonia* were on average 206mm broad and 37mm thick (forty-six and forty-eight examples respectively), while those in the environs were on average 203mm broad and 39mm thick (ten and fifteen examples respectively). Although the number of examples recorded is too small to be statistically significant, these figures hint at bessales from the fortress being on average larger than those from the *colonia* or environs (Figure 10).

Length measurements were present on bessales in fabrics R1, R6-R7 and R9-R11 (Tables 41-2), but there were less than five examples in any given fabric, the sherd counts were therefore too low to enable valid comparisons to be made between length and fabric. Breadth and thickness measurements were present on bessales in fabrics R1, R3, R6-R12 and R15-R17, but most of the fabrics yielded five or less examples of breadth or thickness measurements (Tables 43-4 for breadth and Tables 45-6 for thickness). The exceptions were bessales in fabric R6 which were on average 203mm broad and 30mm thick (ten examples), fabric R10 which were on average 202mm broad and 37mm thick (twenty-three examples) and fabric R11 which were on average 215mm broad and 42mm thick (fourteen examples). Though the number of examples present was small it hints that R11 bessales were larger than those of fabrics R6 and R10 (Figure 19).

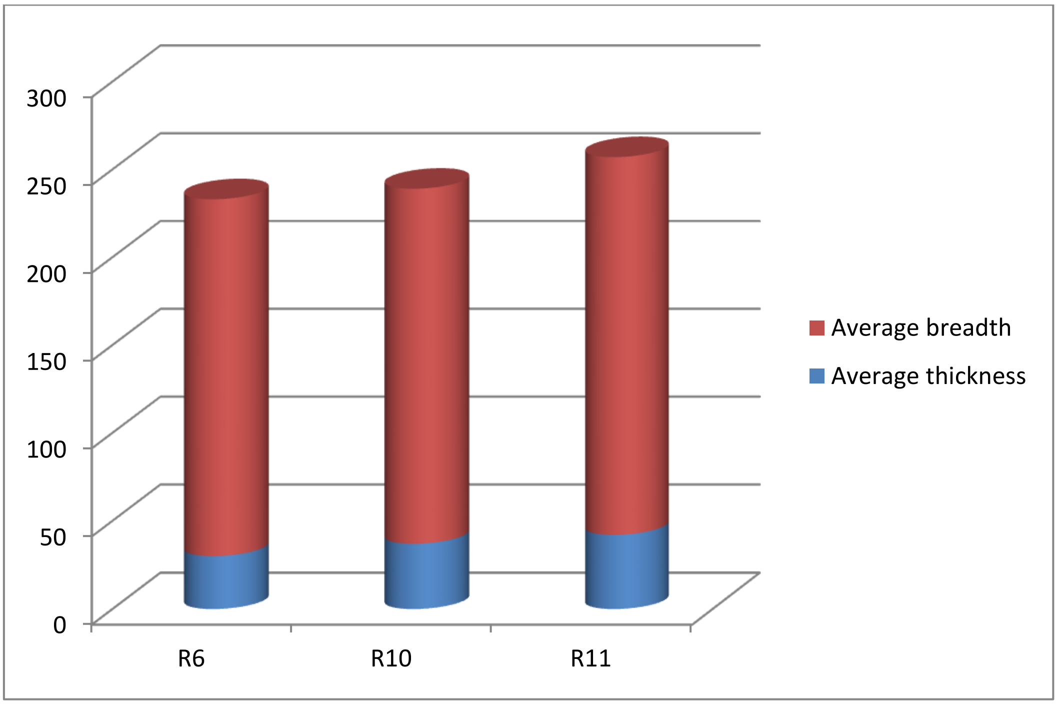


Figure 19. The average breadth and thickness of bessales in mm in relation to fabric.

Brodribb's (1989, 34) measurement of 608 bessales across Britain produced a size range of 170-235mm in size, with an average size of 198mm², conforming very closely to eight Roman inches. Betts (1985, 176) showed that examples from York were on average 220x210mm in size making them larger than the national average size. The examples from the present study correspond closely to the size range suggested by Brodribb, being 178-245mm in size. Although the average size recorded in the present study, at 211x207mm in size, is slightly smaller than that observed by Betts, the measurements do confirm Betts' observation that the York bessales are typically larger than the national average.

In terms of thickness Brodribb (1989, 34) recorded a range of 25-90mm for bessales nationally, with an average of 43mm, while Betts (1985, 176) recorded an average thickness in York of 50mm for square bessales and 60mm for circular bessales. The range of thicknesses seen in the present study of 20-70mm and average thickness of 38mm closely match Brodribb's observations, but the average thicknesses for square and circular bessales of 38mm and 53.8mm respectively are smaller than the size recorded by Betts.

There were nine complete weight measurements for bessales within the present study which were 1,500g, 2,075g (two examples), 2,200g, 2,325g, 3,500g and 4,000g (three examples). The examples at 2075g, 2200g and 2325g were from Heslington East, 3km south-east of the fortress, while the remaining examples were from 12-18 Swinegate in the fortress. While the number of examples is too low to compare weight by zone, the range of weights present at 12-18 Swinegate clearly shows that there was no standard weight for such bricks.

A number of features relating to manufacture were present on the bessales: two bessales had smoothing lines on the upper surface; one had a grip mark from being lifted while wet; and finger drawn keying lines were present on the upper surface of one bessalis, which must also have been drawn while the tile was wet. None of the bessales in the present study had legionary stamps, signature marks or tally marks present. The lack of these marks on the bessales within the present study conforms to the rarity of such marks elsewhere in Britain (Brodribb 1989, 34-5). A possible graffito was present on the upper surface of one bessalis, but much of this was broken off making the original form of the graffito unclear. A bessalis from 1-9 Micklegate in the *colonia* was pierced by a circular-hole 15mm in diameter, the function of which is unclear (Figure 20).

Figure 20. A bessalis pierced by a hole, from 1-9 Micklegate, Context 7159, © YAT

Rain marks were present on the upper surface of five bessales and a further five sherds had dog's paw prints on the upper surfaces, showing animals had walked over the tiles while they were drying; the presence of such marks shows that at least ten of the bessales in the present study were dried in the open air as opposed to being dried in open-sided sheds. None of the bessales were overfired or underfired. Sooting was present on one sherd from the Heslington East site, resultant from the use of the tile in a hypocaust.

The weight of bessales in relation to fabric, together with the associated sherd count is listed in Table 13. Bessales were present in fabrics R1, R3, R6-R12 and R15-R17, showing that no one fabric was used for their manufacture. The absence of fabrics R2, R4-R5, R13-R14 and R18-R19 is not surprising given that these fabrics are rare in the study area overall. The sherd count was too low to enable any comparison of bessales by fabric to either dimensions or zone.

Table 13. The total weight in grams of bessales in relation to fabric and the associated sherd count		
Fabric	Weight in grams	Sherd count
R1	5900	5
R3	5275	5
R6	15600	10
R7	2225	1
R8	2000	2
R9	14200	9
R10	33350	24
R11	30175	15
R12	1575	1
R15	3275	2
R16	1575	1
R17	1375	1

4.1.3 Bibipedalis

Bipedales were the largest size of Roman brick, being two Roman feet square, which is equivalent to 591mm². Bipedales were used to cover the spaces at the top of hypocaust *pilae* thus forming the basal course of the floor, but they were also used in arches, in bonding courses within walls, as quoins at the corners of buildings and occasionally as wall facings (Brodribb 1989, 41-2). Bipedales were manufactured in the same way as bessales (see p138). Classis Britannica bipedales at Beauport Park were often combed on the upper surface to provide keying for mortar (Brodribb 1989, 42), but combing is rare on bipedales elsewhere (I. Betts pers. comm.).

Bipedales are rare in Britain with only twenty-three complete examples being recorded in a national survey (Brodribb 1989, 42). Surviving *in situ* examples are known from Beauport Park which were used above hypocaust channels, while at Holt bipedales were used to face once side of a hypocaust wall below ground level, at Gilligaer bipedales were set against the walls of a hypocaust providing a ledge for the suspended floor above (Brodribb 1989, 42), and at Piddington villa a bipedalis was used to form a step into a cellar (Ward 1999, 43).

No bipedalis were recorded in the present survey, which conforms to their rarity across Britain, though it should be noted that there were some large sherds classed as Rbrick which could have originated from bipedales.

4.1.4 Chimney pots or finials

There are a small number of objects described variously as chimney pots or finials. Typically these take the form of tapering cylinders pierced by tiers of vents, usually triangular in shape, separated on the external surface by horizontal flanges of clay, which are often notched or finger-impressed (Lowther 1976, 36-7). Examples where the chimney is integral to a ridge tile are known from Norton in East Yorkshire (Lowther 1976, 36), from Silchester, and from both the Rhine and Danube regions (Blagg 1979, 279). One example within the Yorkshire Museum collections has a flange at the base suggesting that it was also integral to a ridge tile (RCHM 1962, 114, Plate 38).

The majority of objects described as chimneys or finials in reports are free standing pots, which typically have a conical top, though examples are known from Verulamium and Chalk which are open at the top (Lowther 1976, 37). There is no conclusive evidence to prove that such objects were used on roofs, indeed they could only be used on the ridge line of a building if it was capped with flat tegulae with a central hole over which the pot could be set, or to cap columns of box flue tiles within a wall (Brodribb 1989, 31-2). Alternative uses which have been suggested for these free standing pots are as ventilators, finials or as covers for either lamps or burning aromatics (Brodribb 1989, 32).

Early baths buildings did not use chimneys, but were heated with charcoal or wood-burning braziers to create dry-heat rooms. An example of a richly decorated bronze brazier survives which was given to the Forum Baths of Pompeii by a patron called M. Nigidius Vaccula (Adam 1994, 264). The earliest known Roman chimneys made of ceramic pipes are in the Central Baths of Herculaneum, where the pipes were set into channels within the wall, and lead into a tunnel within the thickness of the wall at roof height (Rook 1979b, 304). The Romans did not heat their houses with fireplaces and chimneys, using braziers instead (Adam 1994, 264). It is unclear why the Romans did not use fires with chimneys to heat their houses, especially as such systems were known to them through bread ovens and hypocausts. Even in the more northerly reaches of the Roman Empire, where heating would have been more necessary, it is not until the sixth century that chimneys were definitely used in domestic architecture (Adam 1994, 264-5).

Lowther (1976, 37, 41-8) listed twenty-seven known examples of chimneys from across Britain, but noted that when fractured many of the sherds would be easily mistaken for pottery or imbrices, it is therefore possible that many examples of this category of tile have gone unrecorded. The lack of chimneys in domestic structures may also account for the comparative rarity of such pieces.

Fifteen sherds interpreted as being from chimneys were recorded in the present study, but the majority of these sherds weighed less than 25g, and collectively they represent 0.018 percent of the tile examined in the present study. The sherds were from five sites at 12-18 Swinegate, County Hospital, Wellington Row and 35-41 Blossom Street with one outlying example at Heslington East, 3k south-east of the fortress (Figure 21, though the outlying example is not illustrated on this figure).

Given their original location on buildings, it goes without saying that none of the chimney sherds were *in situ*. The presence of a chimney sherd at 12-18 Swinegate fits with the location of the legionary bath-house on the site. At Wellington Row, in the *colonia*, the sherds may have originated from a hypocaust at the site (Whyman 2001, 288, 293), likewise the sherds at Heslington East, in the environs, presumably related to a hypocausted building on the site. The example from County Hospital, to the north-east of the fortress, occurred residually in a deposit of medieval date, while the example from 35-41 Blossom Street, to the south-west of the *colonia*, was within a Roman dumped deposit and could have originated from clearance elsewhere. Although the chimney sherds are rare they were always found on sites which also yielded flue tiles, confirming the link between chimneys and hypocausts.

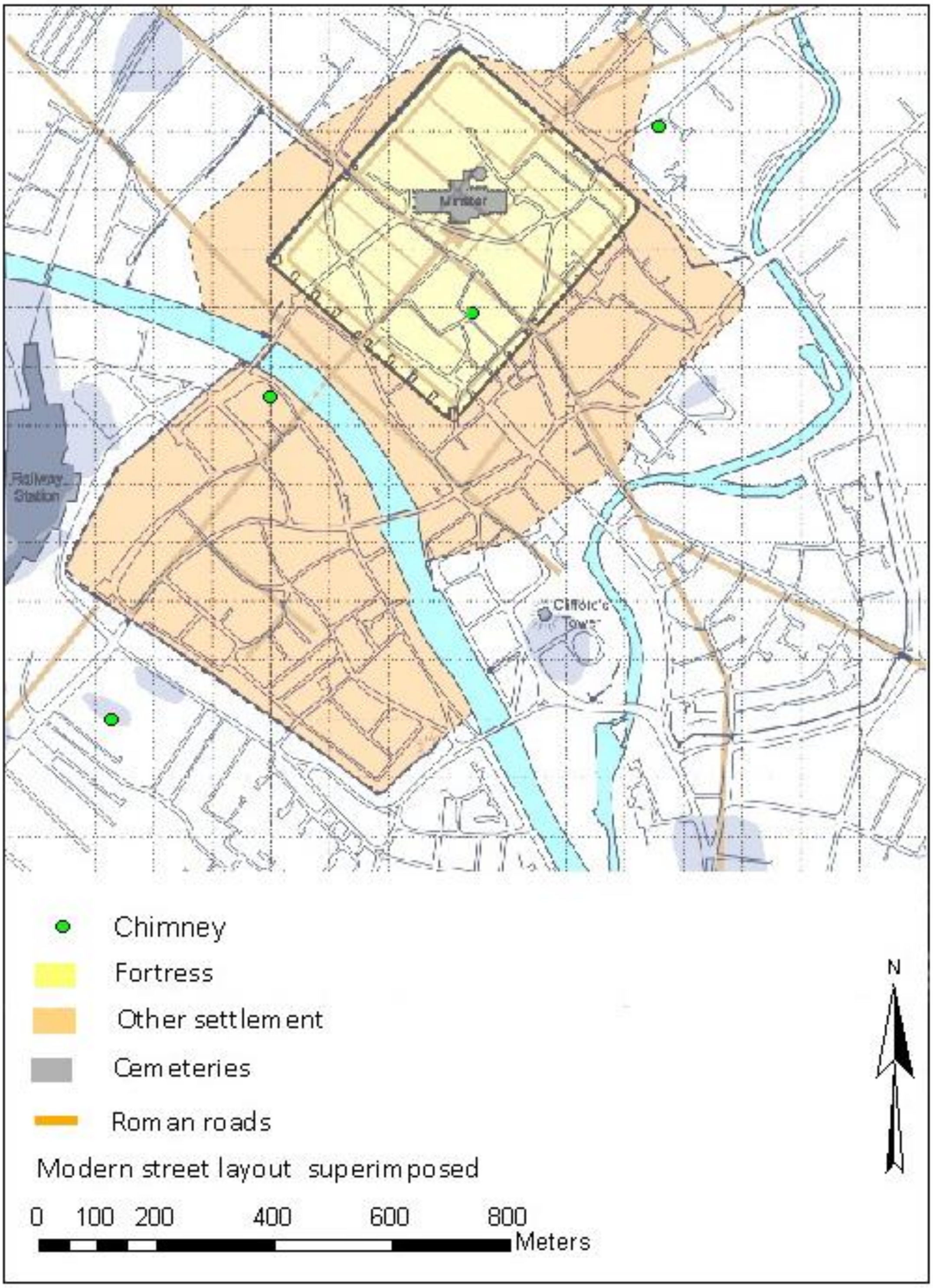


Figure 21. The location of chimney sherds within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

The example from 12-18 Swinegate was sooted and had an incised X on the outer surface, which was possibly a tally mark (Figure 22). An example from Wellington Row had part of a circular vent, while the examples from Heslington East and 12-18 Swinegate each had part of a rectangular vent present. Unfortunately none of the sherds recorded in the present survey were of sufficient size to indicate whether they were originally attached to a ridge tile or not. Two of the sherds had external decorative ridges.

Figure 22. A sooted chimney sherd with an incised X from 12-18 Swinegate, Context 3520, © YAT

Ten of the chimney sherds, all in fabric R15, were from a single context at the Wellington Row site in the *colonia*, and these probably originated from a single chimney pot, but the sherds were non-adjoining, so nothing could be said of the overall size or form of the original piece. The chimney sherds were in fabrics R9-R11 and R15, and ranged from 10-19mm in thickness. Too few sherds were present to determine any relationships between thickness and either fabric or location.

4.1.5 Flue

Flue tiles were used in hypocausts and two differing forms are known, half-box flue tiles and box flue tiles, both of which were used to line the interior walls of heated rooms, thereby enabling hot air to circulate within the walls.

Half-box tiles, *tegula hamatae* (Rook 2002, 14), are rectangular, with a flange on each longer side, the middle portion of the flange is cutaway, with the cutaway portion usually being half the length of the tile (Brodribb 1989, 67). The non-flanged face usually has incised keying in a diamond pattern, such as an example from the Blake Street excavations in York (Betts 1985, 149, 151), though nationally some combed examples are known (Brodribb 1989, 67). There are no *in situ* half-box flue tiles in Britain, so the precise method of use is unclear, but they were presumably attached to walls either by T shaped clamps or nails, with the keyed surface facing the centre of the room (Brodribb 1989, 67). Early use of half-box tiles is seen at the Stabian baths at Pompeii (Rook 1979b, 305). It has been suggested that half-box flues went out of use in the late-first or early second century as box flue tiles became increasingly popular (Betts 1985, 151), and examples of half-box tiles from Holt, Exeter, Loughor and Red House Corbridge could all predate the end of the first century. A series of half-box flue tiles from Llantwit Major are, however, said to date to the later third century date (Brodribb 1989, 67), but Betts (pers. comm.) has suggested that these tiles could have been re-used. Half-box tiles were made in sanded moulds resulting in the outer surface of the flanges and base being sanded, and the sanded surface was then usually keyed to aid the attachment of the mortar/plaster room-lining.

Box flues, *tubuli* (Rook 2002, 15), are hollow rectangular or square cross-sectioned tiles, with sanded interior surfaces, and they have vents in two opposing sides, while the other two sides are usually keyed. The keying can be incised, finger drawn, combed, or relief-patterned, and some sites have several types of keying present. For example, at Piddington villa, combed, incised and relief-patterned box flue tiles were all present (Ward 1999, 48). Box flues were made by wrapping a slab of clay around a sanded former then joining the edges of the clay together with a single seam, and the vents were cut out after the tile was removed from the former (Rudling et al. 1986, 204). Box flues were usually positioned in vertical columns around the sides of a room to provide a lining, with the keyed surfaces facing towards and away from the centre of the room and the vents abutting one another, allowing air to circulate through the wall. Several sites in Britain have yielded *in situ* vertically set box flue tiles, including Chedworth, Bath, Binchester, Beauport Park, Spoonley Wood, Ashtead, Wiggonholt and Compton (Brodribb 1989, 72-3). Box flues were attached to the walls by metal clamps and an example of five box flues with intact clamps is known from Beauport Park (Brodribb 1989, 71). At Ashtead box flues with a projecting lug of clay are known, and the lugs seem to have been designed to attach the tile to the wall (Brodribb 1989, 74, Figure 32). There are *in situ* examples at Great Witcombe, Silchester and Holt where box flues were laid horizontally beneath floors (Brodribb 1989, 72-3), while at Piddington villa a box flue tile had been re-used as a bath-house drain with a lead pipe inserted inside (Ward 1999, 49).

Box-flues seem to have developed during the mid-first century; Seneca, who died in AD 65 said they had been developed “within our memory” (Rook 1979b, 306). Box flue tiles are known at Herculaneum dating to between AD 62 and AD 79, and at Pompeii box flues were being installed in a baths at the time of the AD 79 eruption (Brodribb 1989, 71). Legio VI stamped box flues are known from the collections of York Minster and from St. Mary’s Bishophill, York (Collingwood and Wright 1992, 153, 159) which must post-date AD 120, when the Legio VI was stationed in York. Box-flues have keying lines on two surfaces of the tile (Rudling et al. 1986, 207). Keying could be incised, drawn with the fingers or combed, and although no combs survive an imprint of a wooden example is known from Beauport Park (Brodribb 1979a, 149) while a series of parallel stab marks on a tile from Itchingfield, Suffolk, is the result of stabbing with the comb (Green 1979b, 364). The keying could also be applied by running a wooden roller over the surface resulting in a relief-patterned tile (Betts et al. 1994, 5).

A total of 1,345 sherds of flue tile weighing 358,642g in total were recorded in the present study, comprising 4.4 percent of the total volume of tile examined. Flue tiles were widespread over the central portion of the study area, with examples also present at six outlying sites (Figures 23-4). The weight of flue tiles in each zone of the study area, together with the associated sherd count is given in Table 14.

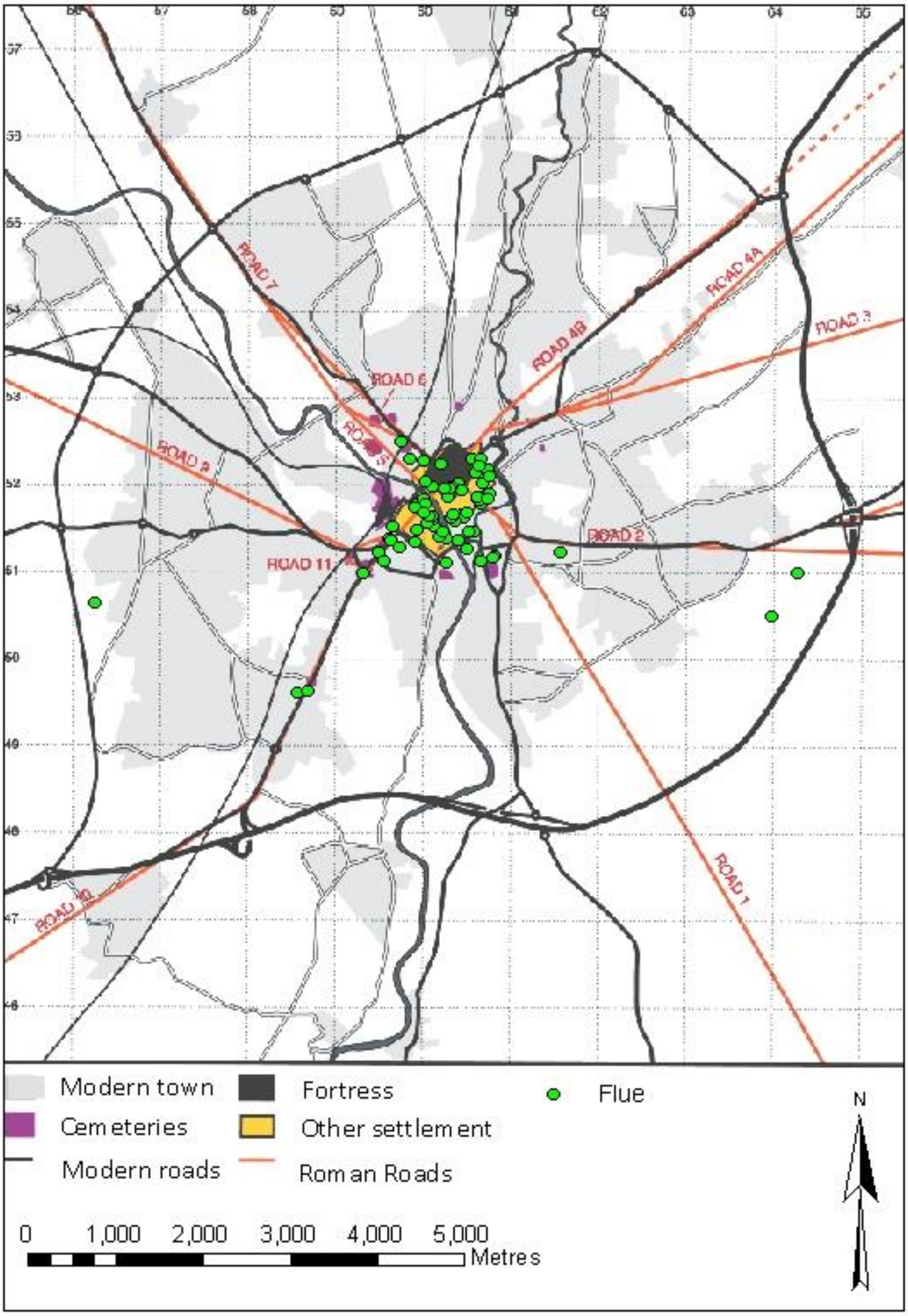


Figure 23. The location of flue tiles within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

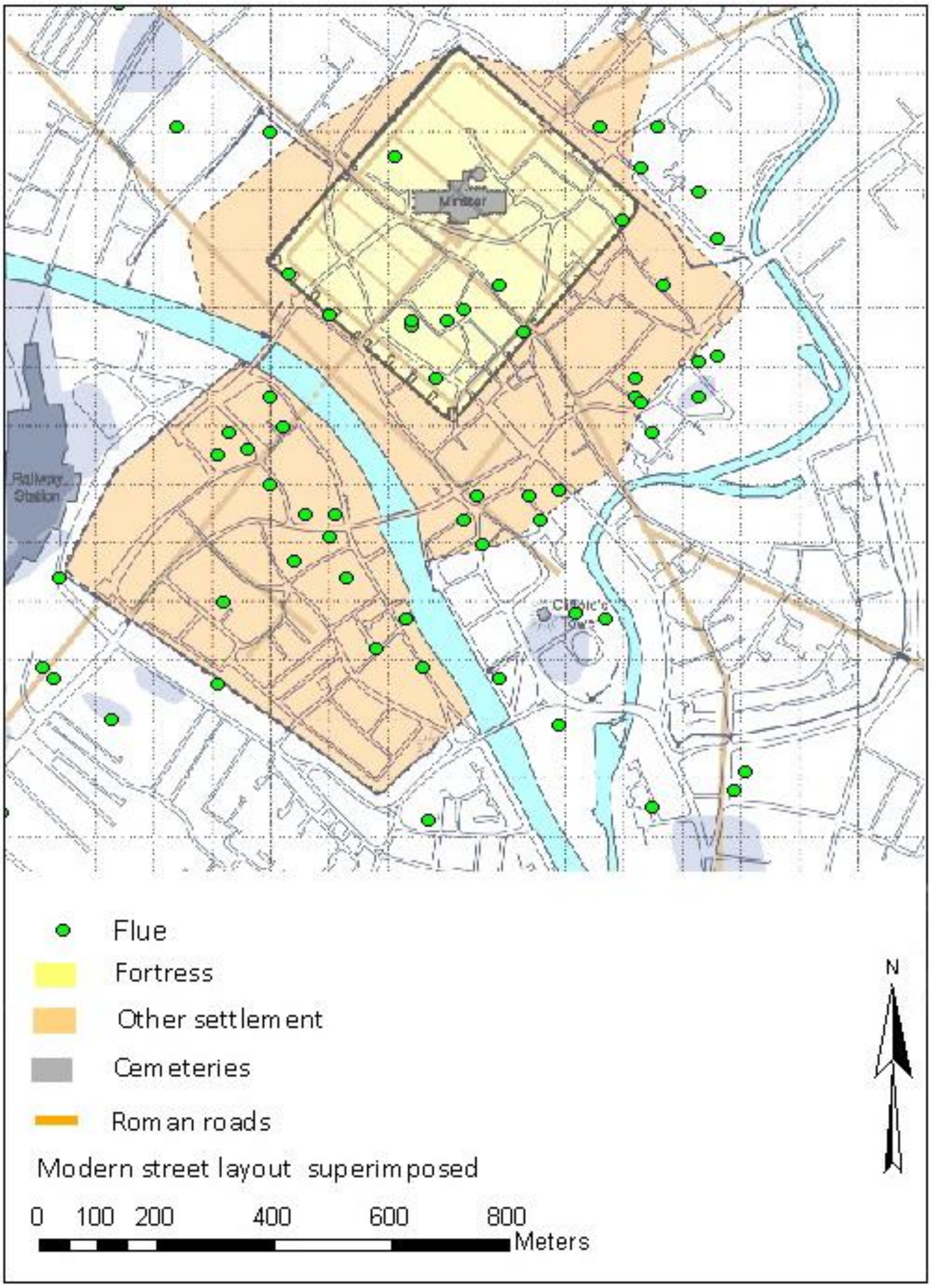


Figure 24. The location of flue tiles within the central area (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Table 14. The total weight and sherd count of flue tiles in relation to zone			
Zone	Fortress	*Colonia*	Environs
Weight in grams	162070	121222	75350
Sherd count	406	618	321

The location of flue tiles within the study was related to the presence of hypocausts or baths, notably at 12-18 Swinegate in the fortress, at 1-9 Micklegate and Wellington Row in the *colonia*, and at Heslington East in the environs. Flues were also present in considerable numbers at 5 Rougier Street and 24-30 Tanner Row in the *colonia*, perhaps suggesting that these buildings also had hypocausts. The other large grouping of flue tile present at 35-41 Blossom Street, to the south-west of the *colonia*, was the result of the dumping of waste, which presumably originated from the *colonia*.

Originally 107 tiles were recorded as possible half-box tiles, but a re-examination of these sherds undertaken for the present study showed that these were in fact box flue tiles. Only one example of a possible half-box flue was present but this identification is uncertain as the fragment in question could be a thin tegula. Effectively therefore there were no half-box flues recorded in the present study.

There was no standard size for box flue tiles nationally, with heights ranging from 155-470mm and lengths/breadths from 85-330mm (Brodribb 1989, 74). A previously recorded example of a box flue tile in York measured 330mm tall and 280x120mm in area, with two further examples being 375mm tall and 150x140mm in area, and all three of these tiles had rectangular vents (Betts 1985, 181).

Only four tiles in the present study, all from the Heslington East site had complete surviving dimensions, which were 147mm high x 188mm broad x 126mm deep, 154mm high x 201mm broad x 127mm deep, 131mm high x 205mm broad x 129mm deep and 299mm high x 216mm broad x 127mm deep. These flue tiles were associated with a kiln structure and lacked both vents and keying. Their association with a kiln may suggest that they were made for a specific purpose and were not therefore typical flue tiles. There were six additional height measurements present in the collections, five from the Heslington East site which were 133mm, 142mm, 147mm, 161mm and 292mm in height while the sixth sherd from 21-33 Aldwark (Figure 25) was 301mm high. Four of the tiles from the Heslington East site with surviving heights were shorter than the range recorded by Brodribb, but this may be related to their function in a kiln, but the remaining six tiles from the site were at the shorter end of Brodribb's range. All of the surviving heights present were shorter than the heights recorded by Betts.

Figure 25. The exterior and interior surfaces of a combed box flue tile with a complete surviving height and breadth, unstratified from excavations at 21-33 Aldwark, © YAT

Length measurements in the study were taken as the non-vented sides of the flues, and breadths as the vented sides. The box flues in the present study ranged from 120-301mm in length with an average length of 204.5mm (fifteen measurements present), and in breadth from 102-257mm with an average of 159.9mm. The range of lengths/breadths recorded conformed to that noted by Brodribb (1979, 74) but was greater than that recorded by Betts (1985, 181). There were insufficient examples to determine if there were any links between flue tiles in any given fabric to dimensions or zones (Tables 44 and 44).

The box flues ranged in thickness from 11-36mm, with an average thickness of 20mm (1,273 complete measurements). Brodribb did not specify the thicknesses of the flue tiles in his survey, there are therefore no national figures to compare with the present results. Comparing the average thickness of the flue tiles in relation to zone (Table 8,) showed that they were on average thickest in the fortress and thinnest in the environs.

The average thicknesses for the flue tiles in relation to fabric and zone were tabulated (Table 15) with the associated sherd count listed in Table 16 (the ten sherds in fabric R0 are excluded as the fabric is unclear in these cases, and the ten sherds in fabric R99 are excluded as they represent 'one-off' sherds in terms of their fabric). The average thickness for each fabric in each zone is shown on Figure 26, but fabrics R4, R12, R13, R16, R17, and R19 are excluded from this figure due to low sherd counts (less than ten sherds present for each of these fabrics).

Table 15. The average thickness in mm of flue tile in relation to fabric and zone

Fabric	Overall	Fortress	*Colonia*	Environs
R1	20	21	19	19
R2	23	23	21	18
R3	21	23	20	17
R4	17		17	
R5	20	20	19	16
R6	19	19	19	18
R7	20	24	19	18
R8	23	24	18	20
R9	20	22	20	18
R10	19	22	19	18
R11	20	23	20	19
R12	22	29	17	14
R13	18		18	
R14	21	22	18	16
R15	18	19	18	15
R16	21		21	20
R17	20	18	21	
R19	22		22	

Figure 26 shows that the flue tiles in the fortress were consistently the thickest, irrespective of fabric, while those in the environs were usually the thinnest. If thickness was in proportion to overall size this may hint at flue tiles in the fortress being larger than those in the *colonia* or environs. This conclusion seems to be backed by the dimensions of the fourteen complete flue tiles in the study which show the fortress tiles ranging from 220-239mm in size, those in the *colonia* from 192-210mm in size and those from the environs from 190-200mm in size (though it must be stressed that the number of examples is too low to be statistically valid).

Table 16. The sherd count used in Table 15

Fabric and form	Overall	Fortress	*Colonia*	Environs
R1 Flue	54	17	23	13
R2 Flue	136	113	17	6
R3 Flue	120	49	54	17
R4 Flue	1		1	
R5 Flue	18	3	11	4
R6 Flue	95	12	37	46
R7 Flue	26	6	13	7
R8 Flue	37	31	5	1
R9 Flue	197	89	76	32
R10 Flue	252	15	192	45
R11 Flue	182	4	76	102
R12 Flue	11	5	3	3
R13 Flue	2		2	
R14 Flue	33	25	2	6
R15 Flue	79	3	67	9
R16 Flue	6		3	3
R17 Flue	4	1	3	
R19 Flue	4		4	

Vents on 231 box flue tiles recorded nationally were usually rectangular, though forty-four examples were circular (19 percent of the total), eleven were diamond shaped and a few were triangular (Brodribb 1989, 75). Of the ninety-three examples where vent shape was noted in the present study, seventy-one were rectangular and twenty-one were circular (23.6 percent of the total), and one was irregular in shape, though this did not survive in full, so the original shape is unclear. The proportion of rectangular to circular vents is broadly similar to Brodribb's observations.

Vent sizes nationally ranged from 30x30mm to 150x70mm in size, with and average size of 77.5x43mm (Brodribb 1989, 75). There were only two complete vents in the present study, one measuring 38x38mm the second being 116x68mm in size. Partial rectangular vents ranged in size from 35-160mm in breadth or length (twenty-eight examples), while two of the circular vents were 31mm and 52mm in diameter. The range of vent sizes present therefore conforms to the sizes recorded by Brodribb.

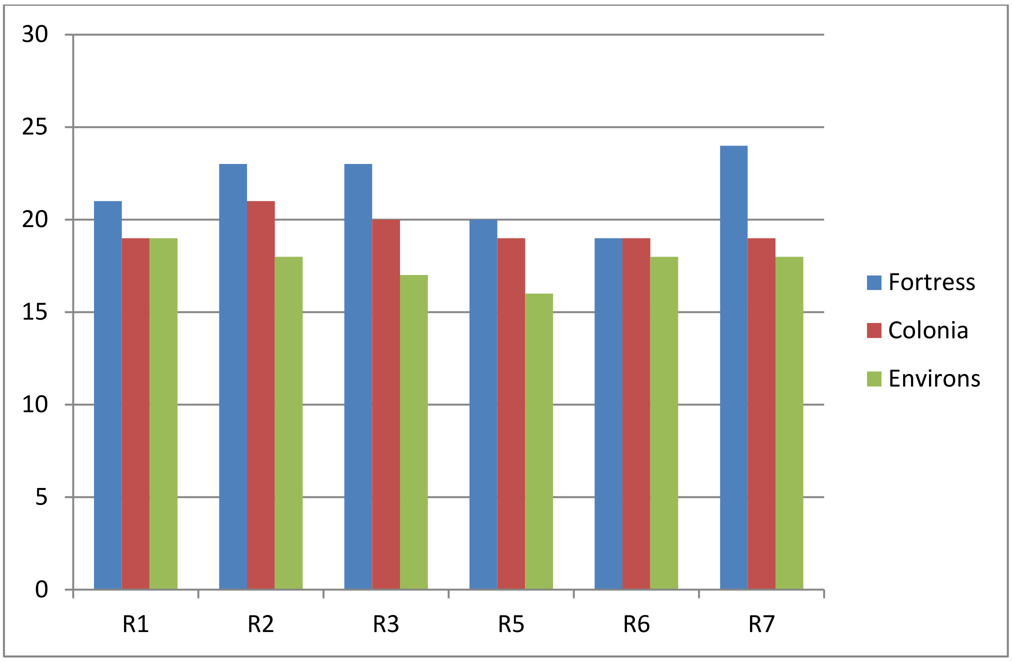


Figure 26a. The average thickness of flue tiles in mm (the associated sherd count is given in Table 16).

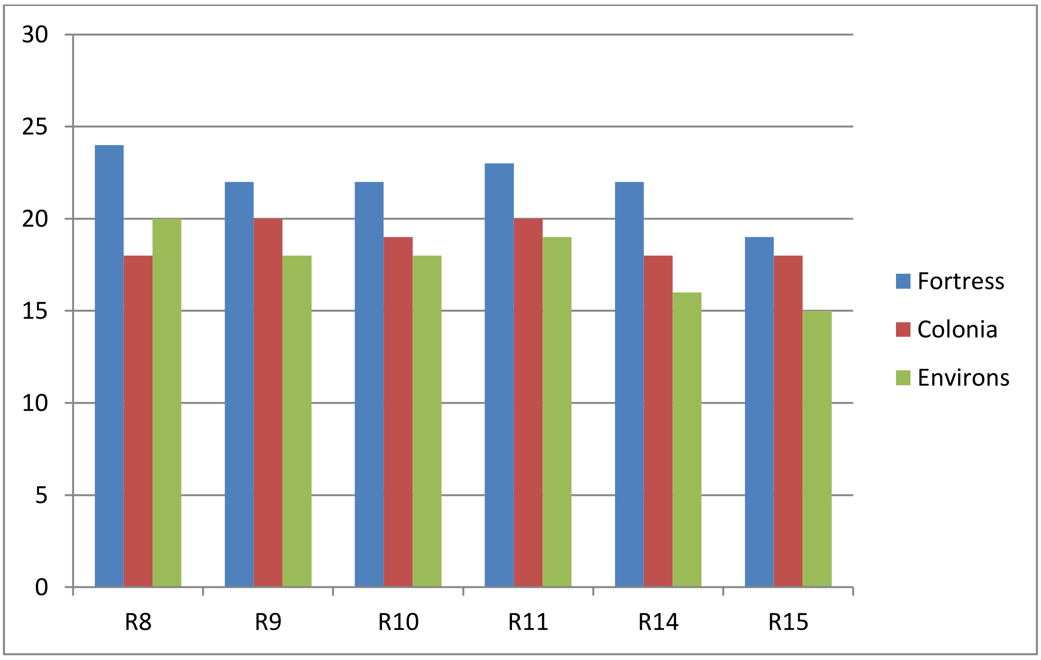


Figure 26b. The average thickness of flue tiles in mm (the associated sherd count is given in Table 16).

While there is usually one vent per side, examples with two vents in one side of the tile are known in Britain (Brodribb 1989, 75); no examples with two vents per side were recorded for the present study, but this could simply be a reflection of the highly fragmentary nature of the flue tiles present. It should also be noted that there was seven flue tiles at Heslington East which clearly lacked vents.

A rare type of box flue takes the form of a double box, having a central vertical divider producing two adjoining square or rectangular sectioned vents. Examples are known from Angmering (Brodribb 1989, 76-7). A single example of this type was recorded in the present study, weighing just 75g, which came from 24-30 Tanner Row, in the *colonia*, and the rarity of sherds of this type within the study conforms to the national picture.

A small sherd of tile from the County Hospital site had relief-patterning (Figure 27). This was matched to Die Type 2 from a national survey of relief-patterned flue tiles, a design which has previously been recorded in Hertfordshire, Bedfordshire and London (Betts et al. 1994, 65-6 and 74). No examples have previously been recorded in the north of England (Betts et al. 1994, 26-8; Betts et al. 1994, Table 1).

Figure 27. A relief-patterned flue tile from the County Hospital site, Context 99, © YAT

A national survey of Roman tile recorded that 95 percent of box flues were keyed, of which 49 percent were combed, 33 percent were incised and 13 percent were relief-patterned, though no examples of relief-patterned flues were noted in northern England (Brodribb 1989, 78). A study of flues in York showed that combing was the dominant form of keying (Betts 1985, 151). Keying was present on 515 of the flue tiles in the present study, of these 478 were combed, thirty-four were incised, five had finger drawn lines and one was relief-patterned (93 percent, 6 percent, 0.9 percent and 0.1 percent of the total respectively). The proportion of the differing types of keying noted in the present study therefore conforms to Betts' observations but differs from Brodribb's, largely due to the lack of relief-patterned examples.

Ten of the flue tiles in the present study showed that the keying was arranged in patterns, one example from 21-33 Aldwark had an X shape between two vertical lines (Figure 25), three from Heslington East had an X shape with a centrally placed clay pellet (Figure 28), five from Heslington East had an X shape and one partial example from Heslington East, of which only the corner survived, had a horizontal and vertical combed line adjacent to the edges of the tile with a diagonal line running from the corner. The keying patterns on the remaining sherds were impossible to determine due to the fragmentary nature of the material.

Few marks resultant from manufacture were present on the flue tiles, a single example had a thumb print from being lifted while wet, and one tile from 12-18 Swinegate in the fortress had an incised X on the surface which may represent a batch number or a graffito. Eight sherds of flue tile in six differing fabrics were overfired, and six were reduced. Forty-eight of the examples from the present study had sooted interiors, in keeping with their function, while two had *opus signinum* adhering to one surface which represented the interior surface of the room.

Figure 28. The exterior surface of a combed box flue tile with a central clay pellet, from Heslington East, Context 1126.

The weight of flue tiles in each fabric, and the associated sherd count, is given in Table 17. Flue tiles were present in fabrics R1-R17, R19 and R99, and the lack of flue tile in fabric R18 is a reflection of the rarity of this fabric, likewise the low sherd counts for fabrics R4-R5, R7-R8, R12-R14, R16-R17 and R19 are also a reflection of the rarity of these fabrics overall. The remaining fabrics in descending order by weight are R9, R2, R11 R10, R3, R6, R15 and R1. The presence of so many fabrics suggests that no one fabric was used exclusively for the production of flue tiles.

Table 17. The total weight in grams of flue tiles in relation to fabric and the associated sherd count		
Fabric	Weight in grams	Sherd count
R0	2020	10
R1	10235	54
R2	60665	149
R3	34195	126
R4	100	1
R5	4185	18
R6	18615	99
R7	5280	29
R8	12405	39
R9	62317	214
R10	57295	258
R11	57680	190
R12	4300	12
R13	175	2
R14	10625	36
R15	13790	84
R16	1460	6
R17	825	4
R19	825	4
R99	1650	10

There is one fabric, however, which stands out as unusual in terms of the volume of flue tile present, namely fabric R2. This is the seventh most commonly occurring fabric overall, representing just 5.32 percent of the total volume of tile, but 16.92 percent of all flue tiles were in this fabric. Similarly fabrics R3 and R11, which represent 6.35 percent and 11.5 percent of tile overall, accounted for 9.53 percent and 16.08 percent of the total volume of flue tiles. While this could be seen as evidence of fabric R2/R6/R11 producers specialising in the production of flues, it is more likely to be due to patterns of recovery, with the high levels of both fabrics R2 and R3 being explained by the presence of 119 sherds of R2 flue tile and fifty-three sherds of R3 on the excavations of the legionary baths at 12-18 Swinegate, while the high levels of R11 are explained by the presence of flues in this fabric associated with a kiln at Heslington East.

The Heslington East flue tiles

Special mention should be made of the collection of flue tiles from the Heslington East excavations, where there was both a hypocausted building, which must have been associated with flue tiles given the number of sherds recovered from the site, together with a kiln with associated flues, thereby providing a substantial number of sherds for analysis. The lack of post-depositional disturbance on the site, as compared to sites within the fortress, *colonia* or immediate environs of the fortress and *colonia*, resulted in a collection of larger than normal sherds. These two factors have enabled a typology to be established for the site. The following types were present:

Heslington East Type 1 – Short box flues

There was a group of seven short box flues present at the site, which ranged from 131-161mm in height, 188-205mm in length, 126-129mm in breadth, and from 17-21mm in thickness. They were all in fabric R11 and were characterised by being slightly reduced, having no vents, and being poorly made with uneven surfaces. These shared characteristics imply that the tiles represent a single batch made for a specific purpose. Given that three of these tiles were found *in-situ* in association with a kiln and could have been made for use in the kiln or re-used from elsewhere. .

Heslington East Type 2 – Box flue with fine combing

There was a single example of a Type 2 flue tile, which had a reduced core, was in fabric R11, and the only dimension to survive was the thickness of 17mm. The flue was keyed on one face with ten very narrow grooves in each band of keying. Although the overall design is impossible to determine, there were horizontal and vertical bands of keying adjacent to the edges of the tile and a line of diagonal keying running from the surviving corner of the tile.

Heslington East Type 3 – Box flue with combing in the shape of an X on one side (four teeth on comb)

There were five examples of flue Type 3, all of which were in fabric R11. The most complete example was 299mm high, 216mm in length, 127mm in breadth, and 21mm thick, with a rectangular vent in each of the narrower sides. There was combed keying in the form of an X design on one long side, the opposing long side and the two breadths being plain. One of the vents in this tile was 116x68mm in size, while the second was 64mm wide, but the length did not survive. Four other examples of this type were present.

Heslington East Type 4 – Box flue with combing in the shape of an X with a central clay pellet on one side (four teeth on comb)

There were three examples of box flues which were decorated with combed keying in the form of an X design with a central clay pellet on one longer side, and rectangular vents on the narrower sides, but none of these were complete enough to determine whether the second longer face was also decorated, or was plain (as was the case in the Type 3 flues). The surviving dimensions were 200-213mm in length, and 15-23mm thick, and though no complete heights survived, one of the tiles was in excess of 220mm high. All three tiles were in fabric R11 and the combs used had four teeth. This could represent a variant of the Type 3 design.

Heslington East Type 5 – Box flue in fabric R6 with combing (five or more teeth on comb)

There were two sherds of combed flue tile where the comb had five or more teeth, and could not therefore relate to Types 3 or 4. The sherds were not sufficiently well preserved to determine any surviving dimensions other than the thicknesses which were 16mm and 18mm respectively. These sherds were in fabrics R6 (which is from the same fabric group as R11 and may simply represent a reduced version of fabric R11).

Heslington East Type 6 – Box flue in fabric R9 (five or more teeth on comb)

There were two sherds of combed flue tile where the comb had five or more teeth, which were not sufficiently well preserved to determine any surviving dimensions other than the thicknesses which were 16mm and 19mm respectively. As these were in fabric R9 they do not seem to relate to Types 1-5.

Heslington East Type 7 – Box flue in fabric R9/R10 with combing (three teeth on comb)

There were three sherds with combed keying with three teeth per comb. These were in Fabrics R9 and R10 (which are from a single fabric group and are therefore related). These were not sufficiently well preserved to determine any surviving dimensions other than thicknesses of 15-17mm.

The remaining sherds at the site were insufficiently well preserved to determine which category they belonged to, eleven sherds could be Type 3 or 4, four sherds could be Type 3- 5, 107 sherds could be Types 2-5 and thirty-six sherds could be Type 6 or 7.

Clearly the Type 1 tiles were associated with a kiln on site. Presumably the remainder of the flue tiles originated from the hypocaust on the site, though none were found *in situ*. Given that the bulk of the sherds were in fabric R11, it is possible to suggest that the hypocaust flue system was originally built of fabric R11 flues, probably with a mixture of Type 3 and 4 keying. The smaller number of Type 2 and 5 flues, together with the forty one sherds in Types 6-7 may have originated from other structures on the site or represent repairs to the hypocaust. Alternatively the hypocaust flues could have been built using flues from a number of suppliers, or represent material robbed from a number of sources for re-use.

4.1.6 Imbrex

Imbrex are hollow half cylinders which taper inwards at the top. Imbrices were principally used to cover the junction between tegulae, with the wider basal end of one imbrex overlapping the narrower upper end of the adjacent imbrex, and they were mortared into place to ensure a sealed joint (Betts 1985, 143). Some imbrices are notably thicker at the basal end and it has been suggested that this was to accommodate antefix tiles (Betts 1985, 145). Imbrices were put to other uses: placed upside-down they could be used as drains, as at Verulamium (Brodribb 1989, 26) and St Anthony’s Hall, York (G. Dean pers. comm.); at Rockbourne pairs of imbrices placed vertically were used as flues instead of box-tiles; imbrices were also used to form the ridge-lines on a group of tile lined tombs in York (RCHM 1962, Plate 28). Brodribb

(1989, 27) has stated that imbrices must have been used as ridge tiles, but Warry (2006, 107) has noted that for Roman roofs with a typical classical 20 degree pitch, imbrices would be insufficiently wide to cover the angle of 140 degrees at the ridge-line. Betts (pers. comm.), however, suggests that since ridge tiles were attached by mortar that imbrices could have been used on a classically pitched roof.

Imbrices were made using a trapezoidal slab of clay, which was either inverted over a suitably sized convex former, in which case the sanded side would be uppermost and would require further smoothing, or the slab of clay was placed into a concave former; examples of the two types of manufacture are known from Beauport Park and Piddington respectively (Warry 2006, 37). The imbrices in the present study were made using convex formers.

Decoration of imbrices was rare, but at Piddington villa combed decoration was used at the wider end of fourteen third to fourth century imbrices (Ward 1999, 21) and at Cirencester two imbrices were decorated with an animal and a human figure (McWhirr and Viner 1978, 362). Nail-holes are rare on imbrices, though a few examples are known, such as two imbrices from York (Betts 1985, 16), an example from Frilford with a nail-hole penetrating the tile, and a further four imbrices from the site with blind holes (Brodribb 1989 26), while at Piddington there was an example where attempts were made to put a hole through the tile after firing (Ward 1999, 19). The lack of nail-holes on imbrices suggests that they were not normally nailed to the roof. A national survey of Roman tile undertaken in 1987 recorded that 14 percent of imbrices have signatures, though at Beauport Park all but one of the fifty-six complete imbrices had signatures; this national survey also recorded seventy imbrices with military stamps, nearly all of which related to the navy, the *Classis Britannica* (Brodribb 1989, 25).

The curving profile of imbrices makes them more susceptible to breakage than any of the other forms of tile examined (except perhaps for flue tiles). This vulnerability to breakage was seen in a national survey of Roman tile in Britain which recorded 330 complete imbrices, as compared with 613 complete tegulae (Brodribb 1989, 26). Despite their tendency to breakage, imbrices are the easiest form to identify, even among severely fragmented material such as that examined in the present study, due to their distinctive curving profile. It is possible, however, given the fragmentary nature of the material, that sherds of ridge tiles or chimneys may have been incorrectly identified as imbrices.

There were 5,876 sherds of imbrices present in the dataset, which weighed 916,651g in total, representing 11.29 percent of the total volume of tile examined. Imbrices were present in all zones of the study area (Figures 29-30). As noted above (see p129) imbrices, together with tegulae, were the most widespread forms of tile identified, suggesting that the use of imbrices was not linked to any particular zone of the study area, being common throughout Roman York.

Nationally imbrices range in length from 360-510mm, with an average length of 398mm (Brodribb 1989, 26). A survey of York's tiles undertaken in 1985 yielded four complete imbrices with Legio IX stamps, which were 441-490mm long, while six complete imbrices with Legio VI stamps were 486-506mm in length, placing the York tiles at the longer end of the national spectrum (Betts 1985, 172-3).

Only four substantially complete imbrices were present in the study. The first example from St Anthony's Hall, close to the south-east of the fortress, was 441mm long and 143mm wide, and this had been set into the ground to act as a drain, thus protecting it from breakage. The remaining three examples were all from the Heslington East site, which had suffered relatively little post-depositional damage, leading to better preserved tiles. The Heslington East imbrices measured 373x160-200x14mm, 290x138-162x20mm, and 375x170x17mm (this example was incomplete at the basal end, so the breadth at that point is uncertain).

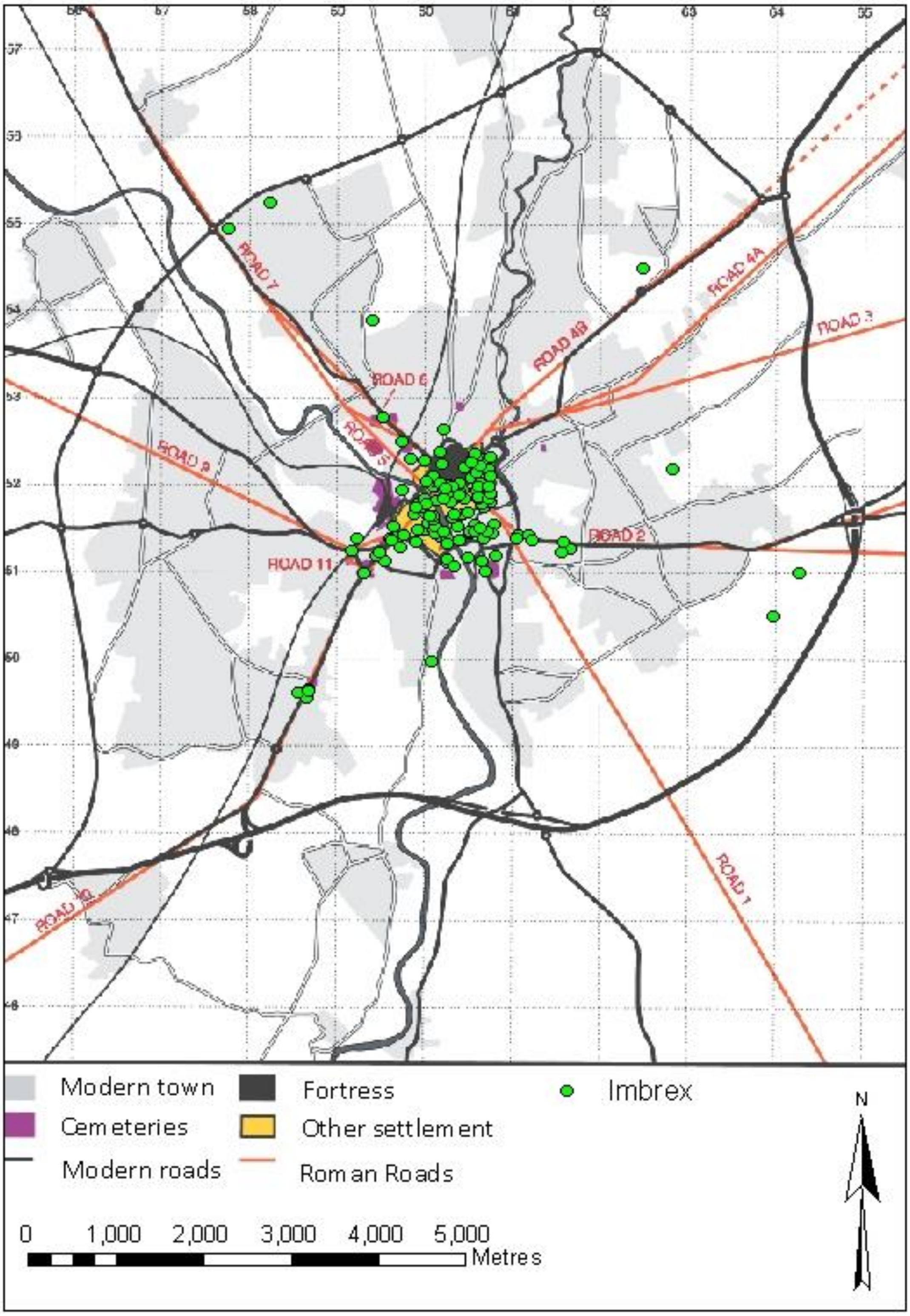


Figure 29. Location of imbrex within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

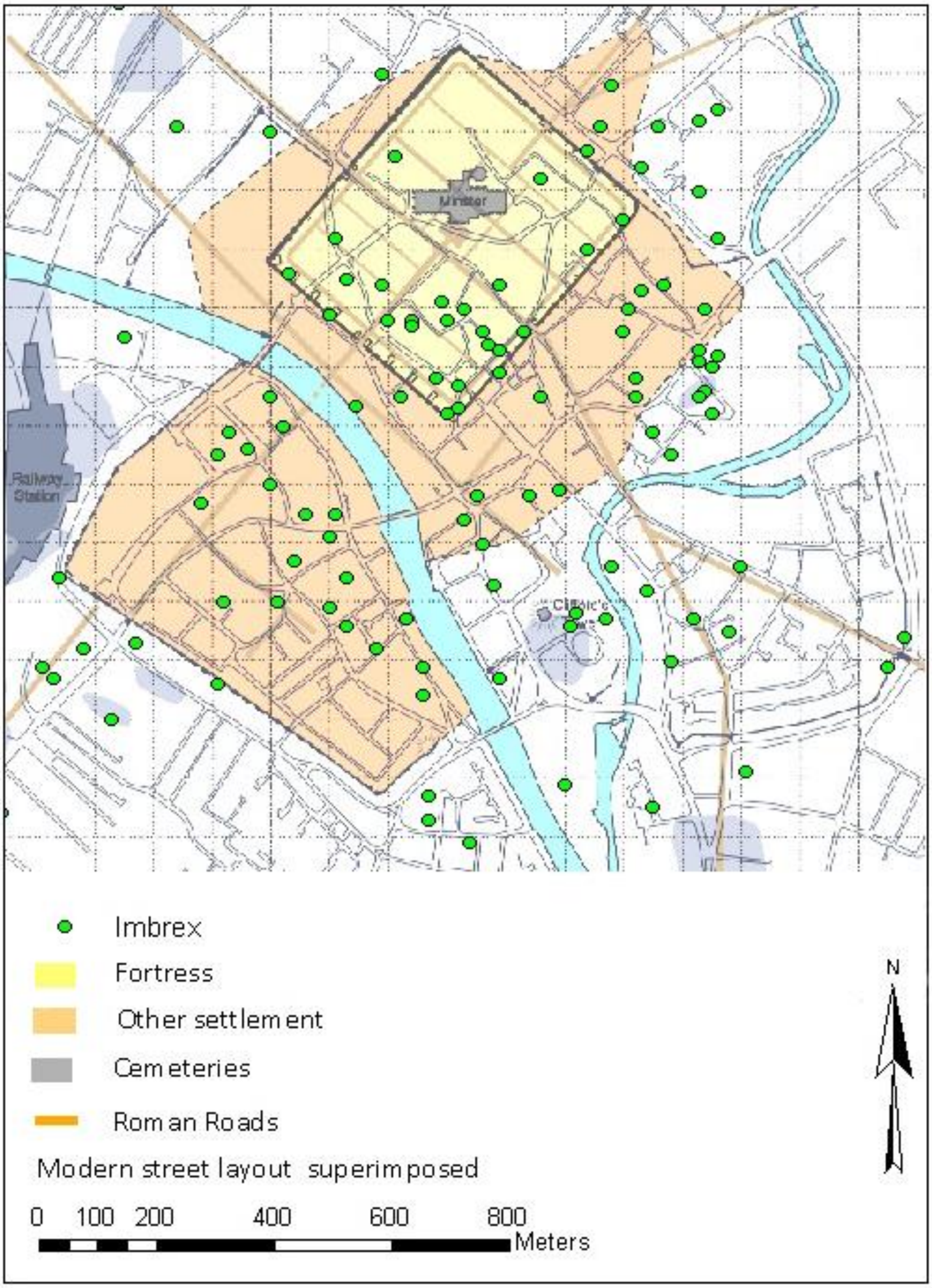


Figure 30. Location of imbrex within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

These four tiles were the only examples where the length was preserved and there is a clear difference in length between the St Anthony's Hall tile and those from Heslington East. Although unstamped, the St Anthony's Hall imbrex was from a site located close to the Legio IX kilns, and exactly matches the size of a Legio IX stamped imbrex recorded by Betts (1985, 173), suggesting that it is of military origin. All three of the Heslington East imbrices were considerably shorter than the stamped Legio IX or Legio VI examples recorded in York by Betts (1985, 172-3). Two of these tiles fit into the nationally recorded size range, but the example at 290mm long is shorter than any other examples recorded in Brodribb's (1989, 26) national survey of Roman tile. Betts (1985, 168-70) recorded a group of unstamped small tegulae in York (Group C^{Betts}), which he interpreted as relating to the Legio VI on the basis of similarly sized stamped examples from York Minster; perhaps the small imbrices at Heslington East can be seen as relating to Betts' Group C small tegulae.

Two of the breadths in the present study lay outside this range. In addition to the four substantially complete tiles listed above, there were four other complete breadths, giving a total of ten breadths from either the upper or lower ends of the imbrices. The breadths from the upper ends of the imbrices were 127mm and 150mm (from the upper ends of two imbrices in the *colonia*) and 143mm (from the upper end of an imbrex found near the south eastern corner of the fortress). The remaining breadths were all from the Heslington East site and were 138mm, 160mm, 170mm and 177mm from the upper end of the imbrices, while those from the basal ends were 162mm, 200mm and 232mm. There were insufficient examples to determine if there were any links between breadth and either location or fabric.

Nationally imbrex breadths ranged from 130-220mm, with an average at the wider end of 176mm and an average at the narrower end of 135mm (Brodribb (1989, 26). Betts (1985, 172) suggested that there might have been two differing breadths of imbrex relating to the two legions stationed in York (Betts 1985, 173), but that there were insufficient examples to state this with certainty; unfortunately the present dataset cannot contribute to this question, as there were no examples of imbrex with both a surviving breadth and a legionary stamp.

The thickness range for imbrices nationally is 14-30mm with an average thickness of 20mm (Brodribb 1989, 26), while imbrices previously recorded in York range from 10-28mm in thickness (Betts 1985, 174). The imbrices in the present study range from 10-35mm in thickness, with an average thickness of 18.5mm (5,625 complete measurements present), making them slightly thinner on average than the national norm, but with a greater range of thicknesses.

The average, thickness for the imbrices in relation to fabric and zone is given in Table 18, with the associated sherd count listed in Table 19 (the nine sherds designated as R0 are excluded as the fabric is uncertain for these sherds, and the seven sherds designated R99 are excluded as they represent 'one-off' sherds in terms of their fabric). Table 18 is illustrated on Figure 31 (Fabrics R4, R13, R16, R18 and R19 are excluded from Figure 31 due to low sherd counts, with less than ten sherds present in each of these fabrics). Although the average thickness of imbrices for any given fabric was usually greatest in the fortress, and smallest in the environs this was not always the case, but when comparing the average thickness of imbrex from the three zones, to that of the study overall, irrespective of fabric, the pattern was more clear cut (Figure 11).

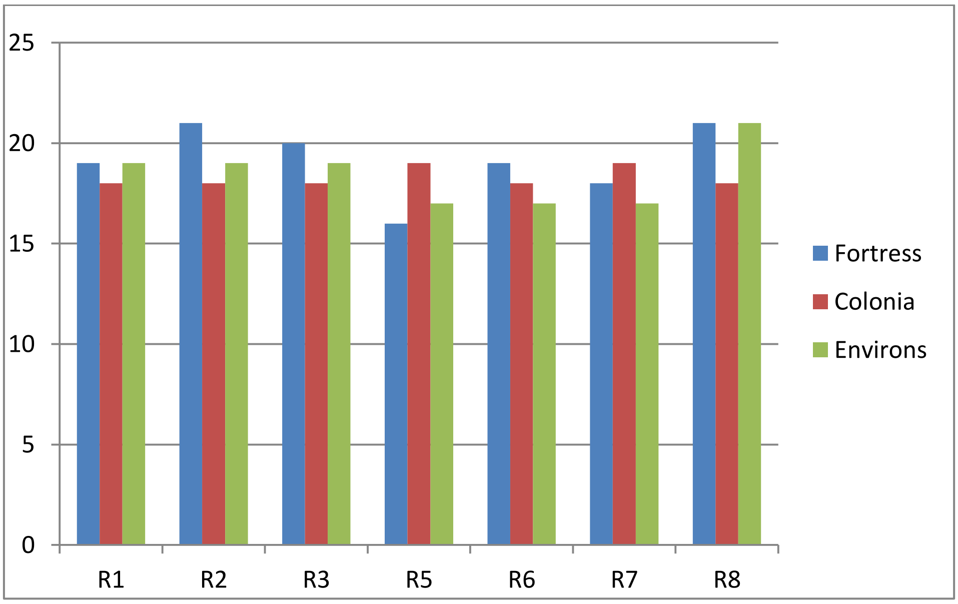


Figure 31a. The average thickness of imbrices in mm in relation to zone (the associated sherd count is given in Table 19)

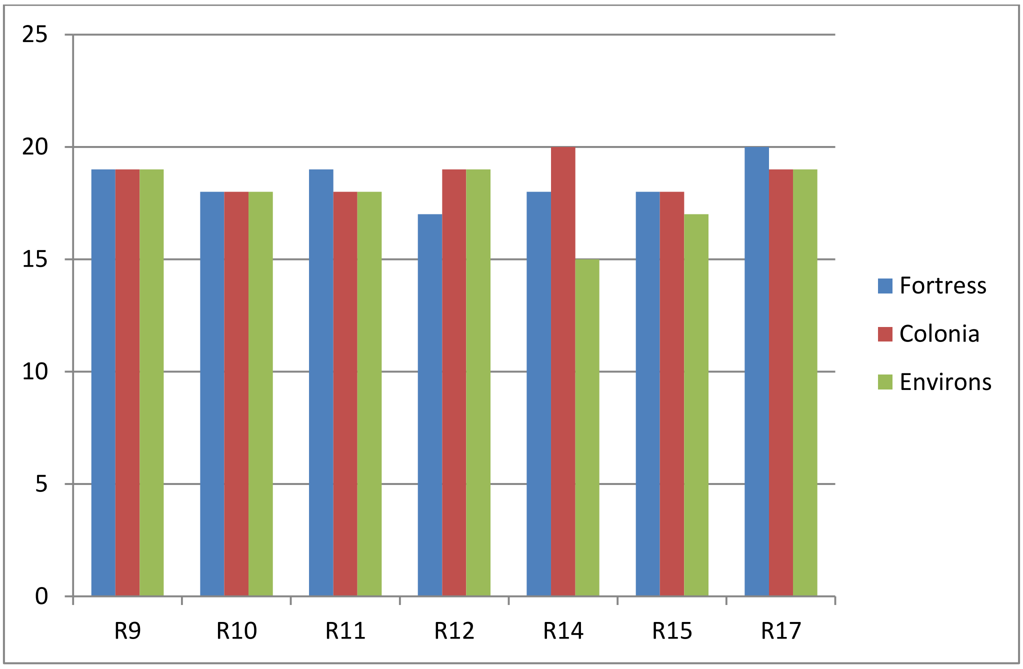


Figure 31b. The average thickness of imbrices in mm in relation to zone (the associated sherd count is given in Table 19)

Table 18. Average thickness in mm of imbrex (for each fabric with extant examples) in relation to zone				
Fabric and form	Overall	Fortress	*Colonia*	Environs
R1 Imbrex	18	19	18	19
R2 Imbrex	20	21	18	19
R3 Imbrex	19	20	18	19
R4 Imbrex	17	17	17	20
R5 Imbrex	19	16	19	17
R6 Imbrex	18	19	18	17
R7 Imbrex	18	18	19	17
R8 Imbrex	20	21	18	21
R9 Imbrex	19	19	19	19
R10 Imbrex	18	18	18	18
R11 Imbrex	18	19	18	18
R12 Imbrex	19	17	19	19
R13 Imbrex	16	13	18	
R14 Imbrex	18	18	20	15
R15 Imbrex	18	18	18	17
R16 Imbrex	18	24		16
R17 Imbrex	19	20	19	19
R18 Imbrex	18		19	16
R19 Imbrex	18		19	17

Table 19. The sherd count used in Table 18				
Fabric and form	Overall	Fortress	*Colonia*	Environs
R1 Imbrex	387	49	240	98
R2 Imbrex	133	102	18	13
R3 Imbrex	607	76	362	169
R4 Imbrex	8	2	5	1
R5 Imbrex	204	3	185	16
R6 Imbrex	414	26	228	160
R7 Imbrex	155	10	108	37
R8 Imbrex	105	67	20	18
R9 Imbrex	1478	196	830	352
R10 Imbrex	1214	64	945	205
R11 Imbrex	637	55	345	237
R12 Imbrex	22	2	10	10
R13 Imbrex	2	1	1	
R14 Imbrex	27	15	6	6
R15 Imbrex	277	13	243	21
R16 Imbrex	3	1		2
R17 Imbrex	27	4	19	4
R18 Imbrex	11		7	4
R19 Imbrex	5		4	1
All tile	5625	689	3576	1358

Various marks relating to production were seen on the imbrices in the present study. Five of the imbrices had finger marks or grip marks from being lifted while wet. Smoothing lines were seen on twenty two of the imbrices parallel to the long edges, and in the case of the most complete four imbrex sherds the tile was first smoothed lengthways then smoothed widthways at the lower end of the tile. No examples of imbrices with nail-holes were seen in the present study, and the lack of nail-holes fits the picture seen nationally (Brodribb 1989, 26). One imbrex has two small stab marks in the surface which may represent a manufacturing error. A fern-leaf impression on the reverse of one imbrex (Figure 32), and grass impressions on the reverse of another presumably resulted from material accidentally being blown onto the former before the tile was moulded. Smudged paw prints, probably of a cat, were caused by an animal walking over the tile while it was drying. Rain marks on the upper surface of nine tiles show that some imbrices were dried in the open-air rather than in open-sided sheds.

Figure 32. A leaf impression on the underside of an imbrex from 16-22 Coppergate, York, Context 14433, © YAT

A single example of an imbrex seems to have had a deliberate longitudinal ridge (Figure 33), and it is possible that this may, in fact, represent part of a ridge tile, as a 'triangular sectioned ridge-tile' is mentioned in the York Minster excavation report (Phillips and Heywood 1995, 270).

Figure 33. Imbrex with longitudinal ridge from Wellington Row Context 7568, © YAT

Only one imbrex in the present study had evidence of a signature, which matched Type 1 of Betts's typology (Betts 1985, 192). The lack of signatures accords with an earlier study in York, where only one complete imbrex had a signature (Betts 1985, 197). Graffiti were present on three imbrices, in the form of an incised V, an incised X (Figure 34) and an incised [..]VVX between two lines (Figure 35).

Figure 34. Imbrex with incised letter X, from excavations at 24-30 Tanner Row, Context 2078, © YAT

Figure 35. Imbrex with incised lettering VVX between two lines, from excavations at 24-30 Tanner Row, Context 3078, © YAT

Legionary stamps were present on thirty-two imbrices in the dataset, four of which related to the Legio IX and eighteen to the Legio VI, while the remaining stamps were illegible (Table 20). Tiles produced by both legions were clearly present beyond the confines of the fortress. The imbrices with Legio IX stamps were on average 22mm thick, while those with Legio VI stamps were on average 19mm thick, and while this may imply that imbrices became thinner over time, it must be stressed that the number of sherds concerned is small.

Table 20. Sherd count for imbrices with legionary stamps by zone			
Zone	Fortress	*Colonia*	Environs
Legio IX		3	1
Legio VI	3	8	7

While one of the Legio IX stamps was illegible the remaining three matched 2462.6, 2462.9 and 2462.9a of Collingwood and Wright's typology (1992, 170-71), all of which have been previously recorded in York. Seven of the Legio VI stamps were too poorly preserved to match to the national typology, but the remainder matched 2460.5, 2460.6, 2460.8, 2460.16, 2460.17, 2460.39, 2460.86, 2460.92, 2460.93 and probably types 2460.63 and 2460.79 (Collingwood and Wright 1992, 150-66), all of which have been previously recorded in York. As there was only one example of each design of legionary stamp it was not possible to compare specific stamps to either fabric or dimensions. An imbrex previously recorded in York had been stamped before the clay was laid over the convex imbrex-former, resulting in a distorted stamp (Betts 1985, 165), but no examples of this practice were seen in the present study, with all of the tiles being stamped after the clay was laid over the former.

Eight of the imbrices in the data set had reduced cores while nine were overfired and blown, one was vitrified, and there were two possible wasters. The wasters were from 1-9 Micklegate in the *colonia* and the Adams Hydraulics site to the south-east of the fortress. The location of wasters on the Adams Hydraulics site is to be expected given the presence of the legionary kilns nearby, but the presence of wasters at 1-9 Micklegate is less easily explained, presumably the imbrex concerned was deemed fit for use in a building. There were too few overfired sherds present to determine if there was any link between the over-firing of sherds and fabric.

The weight of imbrices in each fabric and associated sherd count is given in Table 21, which shows that imbrices formed a normal part of the production in any given fabric. The dominant imbrex fabrics by weight in descending order are R9, R10, R11 and R3 (which are the dominant fabrics for all tile in the study irrespective of form), with all the other fabrics each representing less than 5 percent of the total weight of imbrices.

Table 21. The total weight in grams of imbrices by fabric, with the associated sherd count

Fabric	Weight in grams	Sherd count
R0	2050	9
R1	55295	411
R2	40225	174
R3	91468	654
R4	1350	8
R5	29900	209
R6	69855	431
R7	22193	174
R8	24970	127
R9	216593	1464
R10	189771	1245
R11	117479	657
R12	4290	22
R13	200	2
R14	6380	36
R15	34062	286
R16	375	3
R17	5650	28
R18	1725	11
R19	845	5
R99	1975	7

4.1.7 Lydion

Lydions were the only rectangular bricks used by the Romans, and they measured 1 x 1.5 Roman feet in size, equating to 297x444mm in size. Lydions were used in flooring, as bonding courses within walls and as the bases and/or caps for hypocaust pilae (Brodribb 1989, 40). Lydions were manufactured in the same way as bessales (see p138).

Six Lydions were recorded in the present survey (Figure 36), these bricks weighed 26,550g and account for 0.3 percent of the total volume of material examined in the present study, but only two examples were complete. The bricks came from four sites, two examples were from two separate excavations on the Roman sewer on Swinegate in the fortress; the Lydion in the first of these (site code 1983.35) was residual in a context of later date, while the second example (site code 1990.20) was *in situ* in a hypocaust floor and supported a *pila* column, of which the basal three bessales survived (Marwood 1990, Figure 1). One Lydion was from a site at 1-9 Micklegate in the *colonia* which was residual in a pit fill, and three Lydions from the site at 16-22 Coppergate, to the south-east of the fortress, occurred residually in deposits of post-Roman date.

A national survey of 314 Lydion bricks from Britain showed that they ranged from 335-480mm in length, with the average length being 403mm, the breadths ranged from 230-310mm, with an average breadth of 280mm, and the thicknesses ranged from 25-70mm with an average of 41mm (Brodribb 1989, 40). Two sizes of Lydion bricks have previously been recorded in York, the first group averaging 360x290x50mm in size, and the second group 440x280x60mm in size (Betts 1985, 178). Both these earlier surveys recorded examples that were far smaller than the Roman standard size, showing that there was considerable variation in the dimensions of Lydion bricks.

The Lydion bricks in the present study ranged from 386-410mm in length with an average of 402mm (three length measurements present), in breadth they ranged from 270-295mm with an average of 279mm (three breadth measurements present), and in thickness they ranged from 29-62mm with an average thickness of 42mm (six thickness measurements present). The two complete examples both measured 410x270mm in size, and were 29mm and 62mm thick respectively, and both of these were from the Swinegate sewer repairs. All the Lydion bricks in the present study fell within the nationally recorded size ranges (Brodribb 1989, 40), though they did not match the sizes previously recorded In York (Betts 1985, 178).

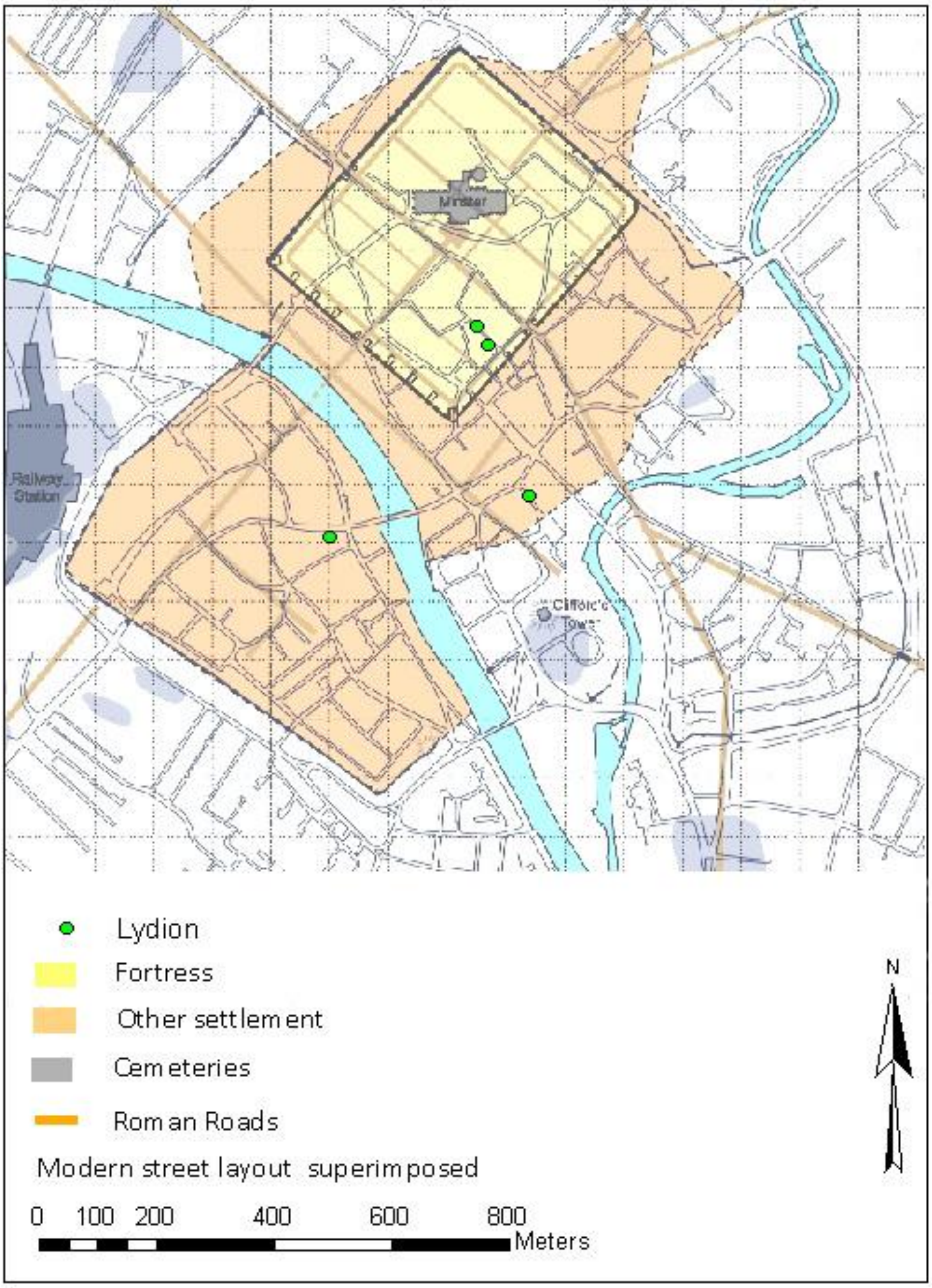


Figure 36. Location of Lydion bricks within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

One of the Lydion bricks from the present survey had keying lines on the upper surface to aid the adhesion of mortar, while one Lydion had a hob-nail boot impression caused by a person standing on the tile while it was still wet.

One example in the present survey from 16-22 Coppergate had a graffito on the upper surface which seems to represent letters in a cursive script, and while the letters NI or AVI are clearly visible the remainder of the graffito is difficult to read (Figure 37).

Figure 37. Lydion with graffito, from 16-22 Coppergate, Context 5248, © YAT

Nationally only 2.5 percent of Lydion bricks were stamped (Brodribb 1989, 40), and two of the Lydion bricks previously recorded in York were associated with Legio VI stamps (Betts 1985, 178). Only one example of a Lydion with a legionary stamp was seen in the present survey, which came from 16-22 Coppergate, but the stamp was illegible.

The Lydion bricks were in fabrics R3, R9, R10, R11 (two examples) and R99, but given the small numbers present it is impossible to analyse links between fabric and either dimensions or zone, but it is notable that five fabrics were present on just six examples suggesting that such bricks were produced in any fabric as required.

4.1.8 *Opus spicatum*

The term *opus spicatum*, coined by the late first century Roman architect Vitruvius, refers to small bricks laid on their stretchers in an arrangement resembling the ears of wheat, but the pattern would now be described as herringbone (Ward 1999, 43). Opus spicatum were made in the same way as bessales (see p138).

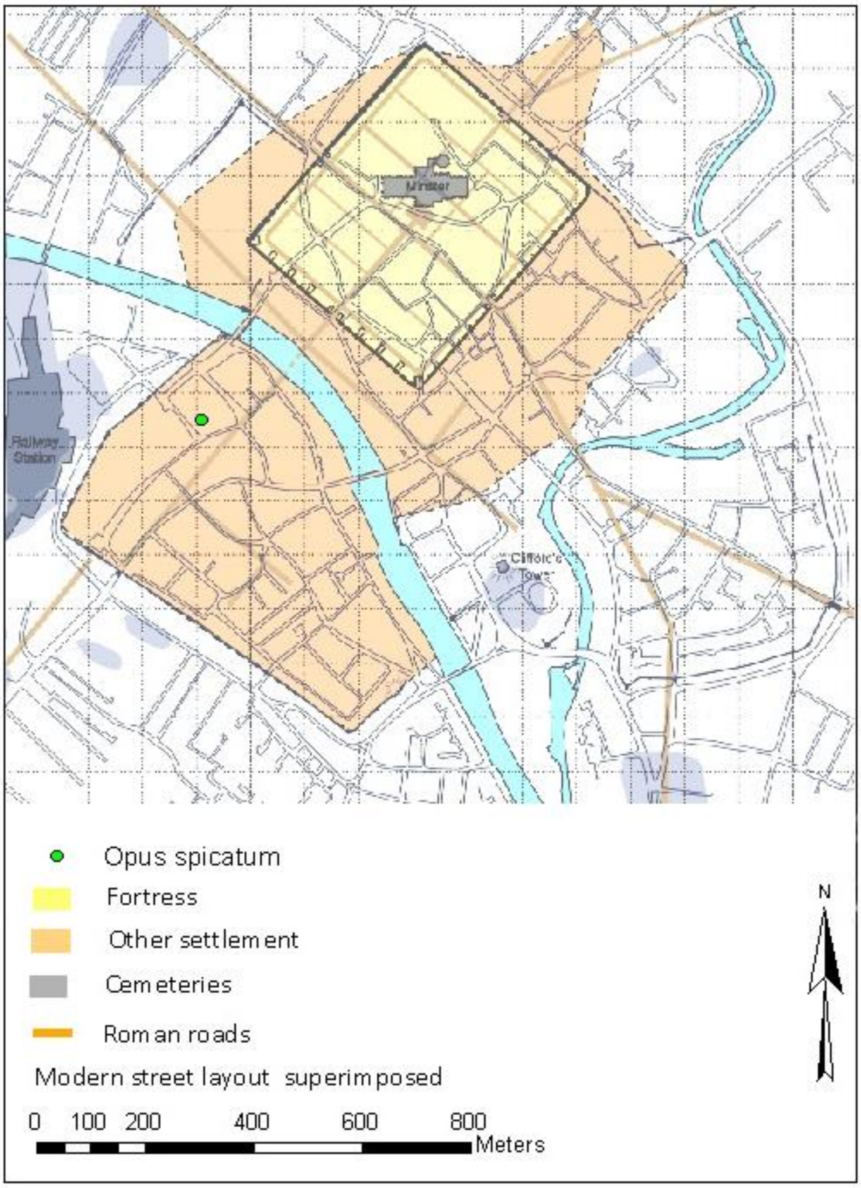


Figure 38. Location of opus spicatum within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Thirty sites in Britain have provided evidence of such floors (Brodribb 1989, 51). The use of brick for flooring created a hard wearing surface suitable for external areas such as courtyards (Cowan 1992, 145). *Opus spicatum* bricks are often in a wide range of colours, suggesting that polychromatic arrangements may have been used, an in situ example being Piddington villa where an *opus spicatum* floor was laid in sections that were orange, pink-buff and bluish-black respectively (Ward 1999, 43). There was no standard size for such bricks, and nationally they range from 70-155mm in length, 30-90mm in width and 20-60mm in thickness (Brodribb 1989, 52).

A single example of an *opus spicatum* brick was recorded in the present survey, representing 0.004 percent of the total tile examined (Figure 38). The rarity of such bricks in the present survey suggests that flooring of this type was little used in the York area. The sherd was recovered from Station Rise, in the *colonia*, and was re-deposited in the backfill of a medieval cut. The location is significant, being the site of a major public baths, where elaborate flooring would be expected; the presence of two tesserae at this site confirms the standard of flooring in the baths (Evans 2000, 13, 31). The length of the brick did not survive, but it was 57mm broad and 37mm thick, comfortably fitting into the size range suggested by Brodribb (1989, 52). It was in fabric R16, which is one of the rarer fabrics in York.

4.1.9 Sherds of unusual form and size

Twenty-one sherds have been classed as 'other' in the present survey, the term being used for any tiles of unusual form or size, together these sherds accounted for 0.52 percent of the total volume of tile examined. These tiles came from seven sites (Figures 39-40): two in the fortress (the site of St Leonard's Hospital and 12-18 Swinegate); one in the *colonia* (1-9 Micklegate); two sites to the immediate west of the *colonia* (35-41 Blossom Street and 28-40 Blossom Street); and one outlying site at Heslington East, 3km south-east of the fortress.

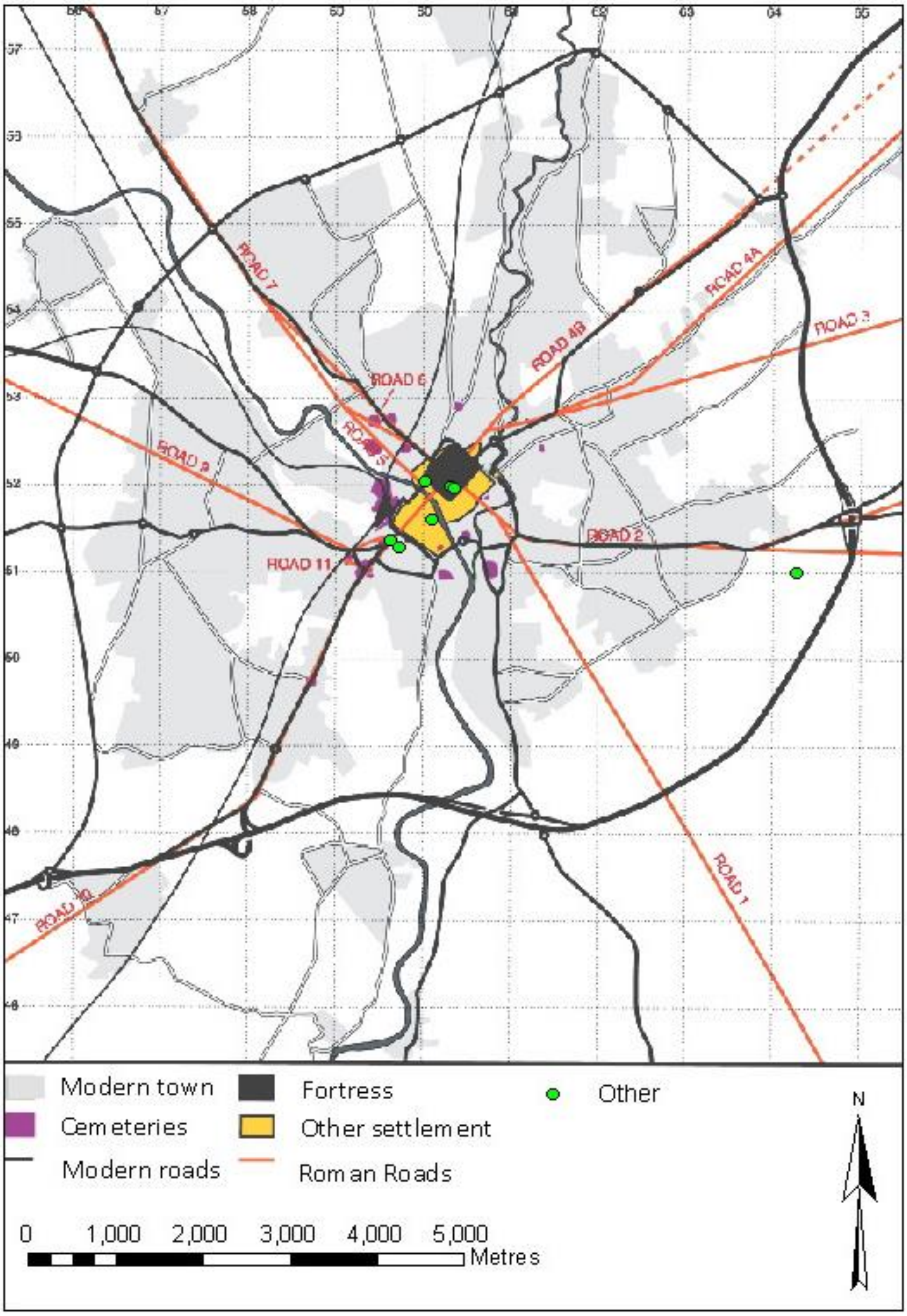


Figure 39. The location of sherds termed 'other' within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

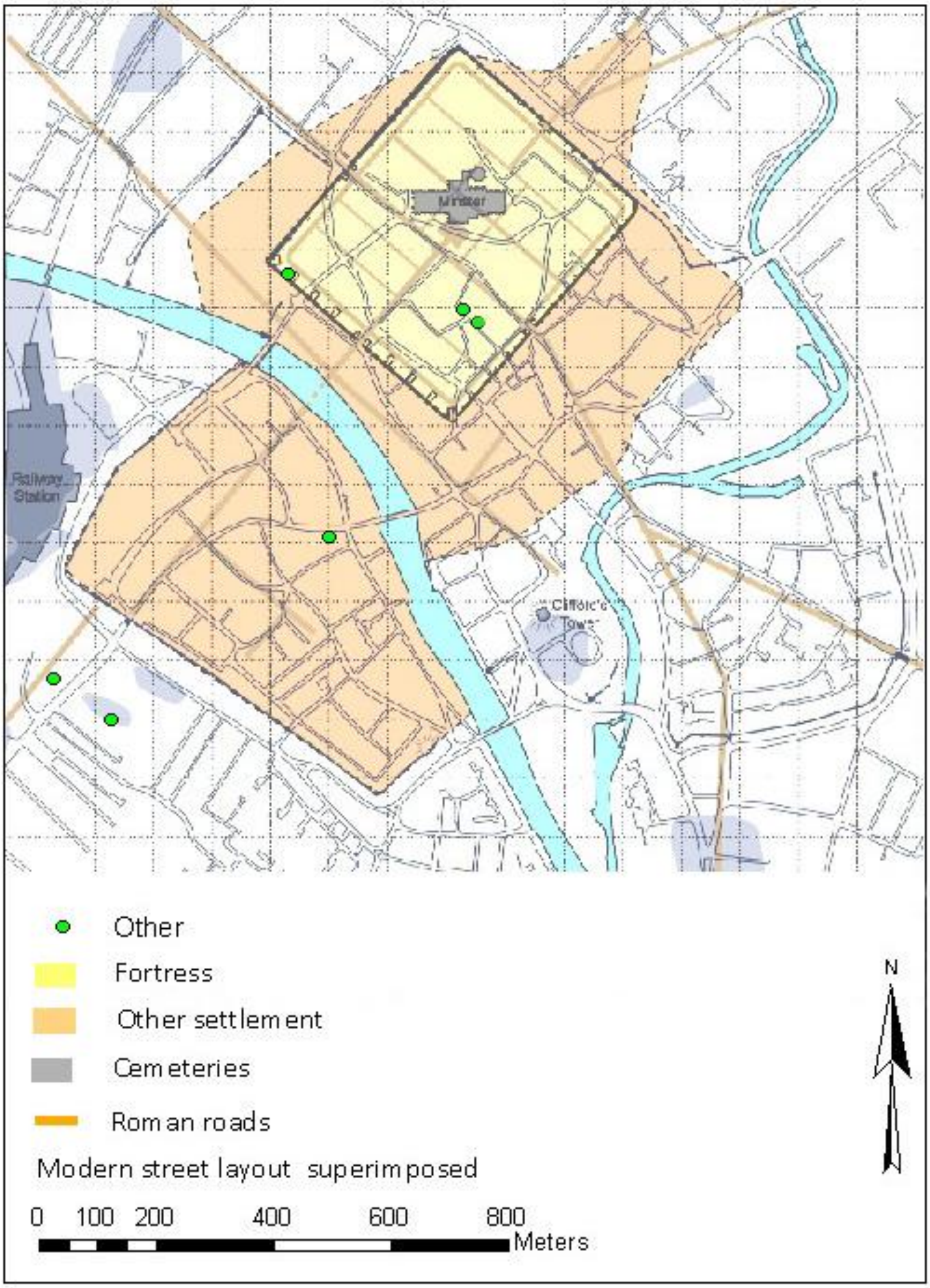


Figure 40. The location of sherds termed 'other' within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

A sherd with a curving profile 45mm thick was present at 35-41 Blossom Street, and as this seems too thick to be an imbrex its precise function is unclear, though it may have been a ridge tile. At 12-18 Swinegate there was a sherd with an unusual concave shaped edge which was finished on both sides, the curving edge may simply have been a manufacturing error, with the tile being damaged while wet. There was a possible graffito on one side of this tile most of which had broken off but part of the letters VVV were still partially visible (Figure 41).

Figure 41. A tile with unusual edge and graffito in the form of VVV, from the 1-9 Micklegate, Context 2113, © YAT

A tile from 12-18 Swinegate (Figure 42) was almost cube like in shape, but was clearly broken off on one side, the surviving length was 60mm, the height 54mm and the thickness 52mm. It is possible that this sherd represents the lowest portion of an armchair voussoir. Armchair voussoirs were stepped in profile and used in conjunction with flat tiles to produce spaces within a roof, either to reduce its weight, or to enable the circulation of air through the roof (Brodribb 1989, 47). Tiles of this type have been found on twelve sites in Britain including York (Brodribb 1989, 47, Figure 19) and the sherd in the present study resembles the lowest external portion of Types 1-2 in

Brodribb's illustration. Two other examples of armchair voussoirs from York have been recorded in earlier work, with one almost complete example in the collections of the Yorkshire Museum, and a second example coming from excavations at Blake Street within the fortress (Betts 1985, 149). It is however equally possible that this represents a fragment of a non-standard L shaped brick, given that two examples of such bricks (albeit larger) have been found in the present study.

Figure 42. A possible armchair voussoir sherd from 12-18 Swinegate, Context 3614, with the broken off portion being at the left side of the photograph, © YAT

Nine rectangular bricks of non-standard sizes were present, one from the Swinegate sewer, seven from 1-9 Micklegate and one from Heslington East. Non-standard sized bricks have been noted on other sites nationally and are listed by Brodribb (1989, 57). The largest of the non-standard sized bricks in the present study measured 530x280x37mm in size, was recovered from repairs to the Roman sewer in Swinegate and was in fabric R11, a commonly occurring fabric within the study area. This tile was *in situ* forming part of a hypocaust floor (Marwood 1990, 22). It compares closely to the size of a brick recorded at Heckington in Lincolnshire which measured 530x290x50mm (Brodribb 1989, 57). Only one of the seven non-standard sized bricks from 1-9 Micklegate was complete, measuring 352x190x38mm in size, for the others the breadths ranged from 200-218mm and the thicknesses ranged from 33-41mm. Four of these bricks were *in situ* in Context 7179 which was a limestone drain bonded with tile, suggesting that they were manufactured specifically for the purpose, while the remaining examples occurred residually.

The smallest non-standard rectangular brick from Heslington East (Figure 43) measured 319x215x30mm, and was the basal brick of a hypocaust *pila* column. It should be noted that a further two non-standard sized rectangular bricks were present in the Heslington East hypocaust, and though these bricks were not sampled they were measured on site and were 318x210x30mm and 320x218x39mm in size (McComish 2011, 15). In each case the brick was the base of a hypocaust pilae adjacent to the wall of the building, suggesting that the bricks were manufactured specifically for that purpose.

Figure 43. Rectangular brick of a non-standard size from Heslington East, Context 173

The site at 28-40 Blossom Street produced a group of underfired clay cuboid blocks, one of which measured 150x123mm in cross-section though the length did not survive, while the second which was partially preserved was 140mm by in excess of 78mm in cross-section. These blocks formed the packing in a posthole. A further three sherds of underfired clay from the same site, which occurred residually in contexts of a later date, were clearly from related objects.

Two bricks, both from Context 7162 at 1-9 Micklegate, were 'L' shaped (Figures 44-45), but neither of these was complete. The first example was in excess of 275x185mm in size, with the shorter arm being 63x97mm in size, and the larger arm being in excess of 180x185mm. The second brick was in excess of 179x180mm, with the shorter arm being 64x71mm in size, and the larger arm being in excess of 108x185mm in size. One of these bricks had two incised parallel lines on the surface, possibly representing a batch number. Both of these bricks occurred residually in a dump of demolition derived material.

Figure 44. An ‘L’ shaped brick from 1-9 Micklegate, Context 7162, © YAT

Figure 45. An ‘L’ shaped brick from 1-9 Micklegate, Context 7162 with a possible batch number on the surface, © YAT

One sherd from the St Leonard’s Hospital site in the fortress was recorded as having a broken off flange “round two sides of the tile”. This sherd was not retained at the time of excavation, so its precise form is unclear, but it is possible that this may have been a hollow voussoir. There was also a partially preserved polygonal shaped brick from this site.

4.1.10 Parietalis

There is evidence that some walls were lined with tiles called parietales which were then plastered over (Brodribb 1989, 58). Parietalis are identified by holes or notches in the sides of the tiles designed to carry nails or cramps for fixing the tiles to the walls, together with keying on one face to aid the adhesion of plaster. Thirty examples of such tiles from eighteen sites across Britain were recorded in a national survey of Roman tile but only five of these were complete (Brodribb 1989, 58-9). No complete parietalis bricks are known from previous studies in York, but it has been suggested that brick sherds 30-40mm thick with pronounced keying on the upper surface probably represent parietalis (Betts 1985, 181). Parietalis were made in the same way as bessales (see p138), then keyed on the upper surface.

The only clearly identifiable parietalis within the YAT collections is in the teaching collection and is unstratified, though it was presumably excavated in York (it is not included in the present study as its precise origin is uncertain), and the notch to accommodate a nail or clamp can be clearly seen on this tile (Figure 46).

Fifty-seven sherds of tile between 28-37mm in thickness with keyed surfaces have been classed as probably parietalis within the present study, these weighed 40,581g in total, accounting for 0.5 percent of the total volume of material examined, and they were present across the study area (Figures 47-8). It should be noted that as this tile was very fragmentary the identification as parietalis is by no means certain, as these sherds could simply be bricks with heavily keyed upper surfaces. The presence of parietalis was linked with the location of baths or hypocausts within the study area. The parietales were largely from excavations at 12-18 Swinegate in the fortress (twenty-three examples) which presumably related to the legionary baths on the site. There were fifteen examples from the site of 24-30 Tanner Row in the *colonia*, while all the other sites with possible parietales had less than five examples per site.

Figure 46. An unstratified parietalis brick from the YAT collections, © YAT

The only complete example of a possible parietalis in the present study measured 273x160mm in area, which is considerably smaller than the size of 400x260mm cited by Brodribb for the complete examples recorded in his survey of Roman tiles from Britain (Brodribb 1989, 58).

Several features relating to manufacture were seen on the probable parietalis bricks in the present study. There was a dog's paw print on the upper surface of one tile, while a second had rain marks on the upper surface showing that it was dried in the open. The keying was usually done with the fingers (twenty-nine sherds), but seven examples had incised keying and four had combed keying. So few of these tiles are recorded nationally it is impossible to know whether this ratio of keying types is typical for the country as a whole or not. One parietalis was partly vitrified and another had blown during firing to a thickness of 65mm, one of these was from a site on Little Stonegate, and the second was from the excavations at 12-18 Swinegate. Both tiles almost certainly relate to the fortress legionary baths, and presumably were considered fit for use despite the over-firing.

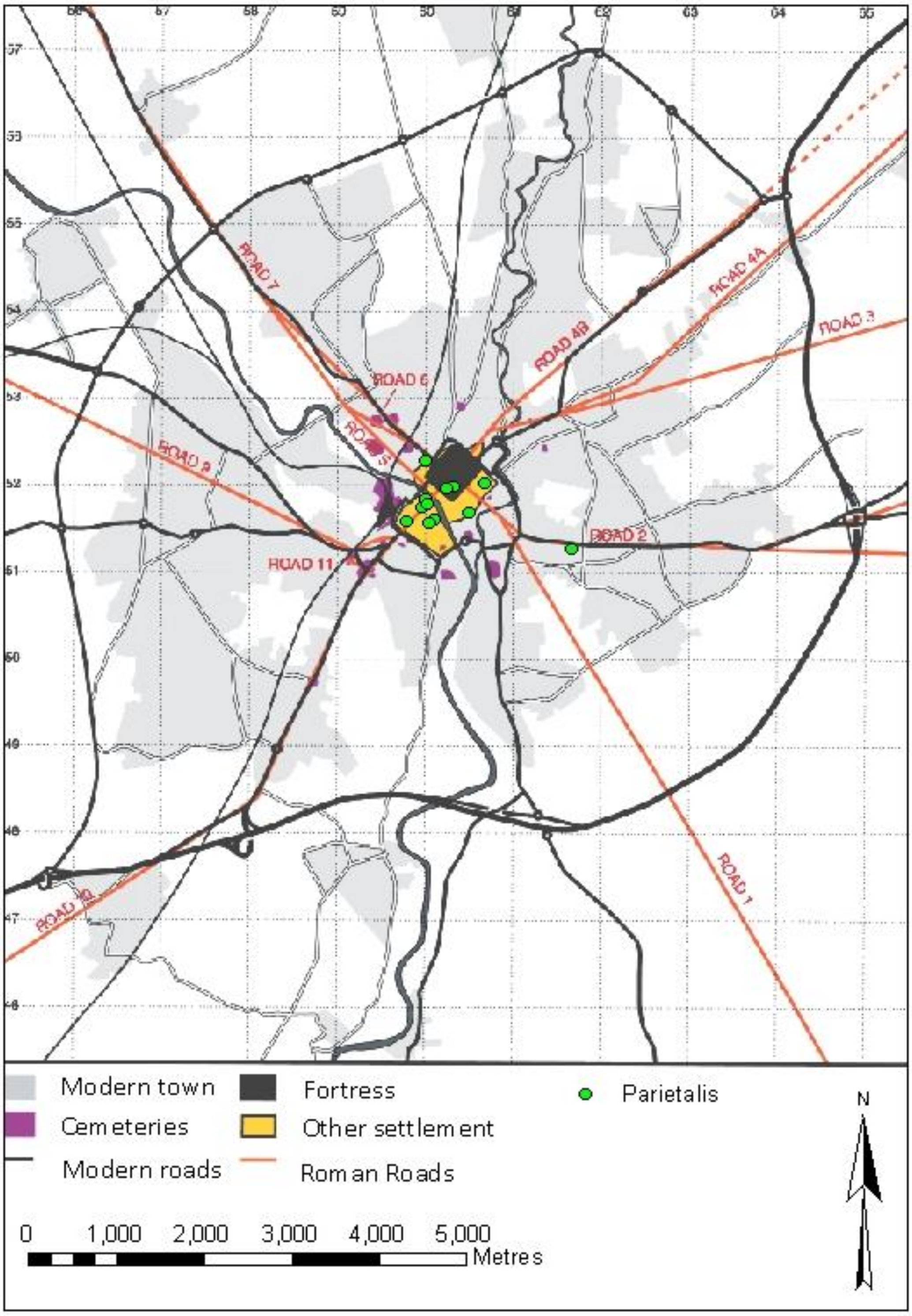


Figure 47. The location of possible parietalis within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

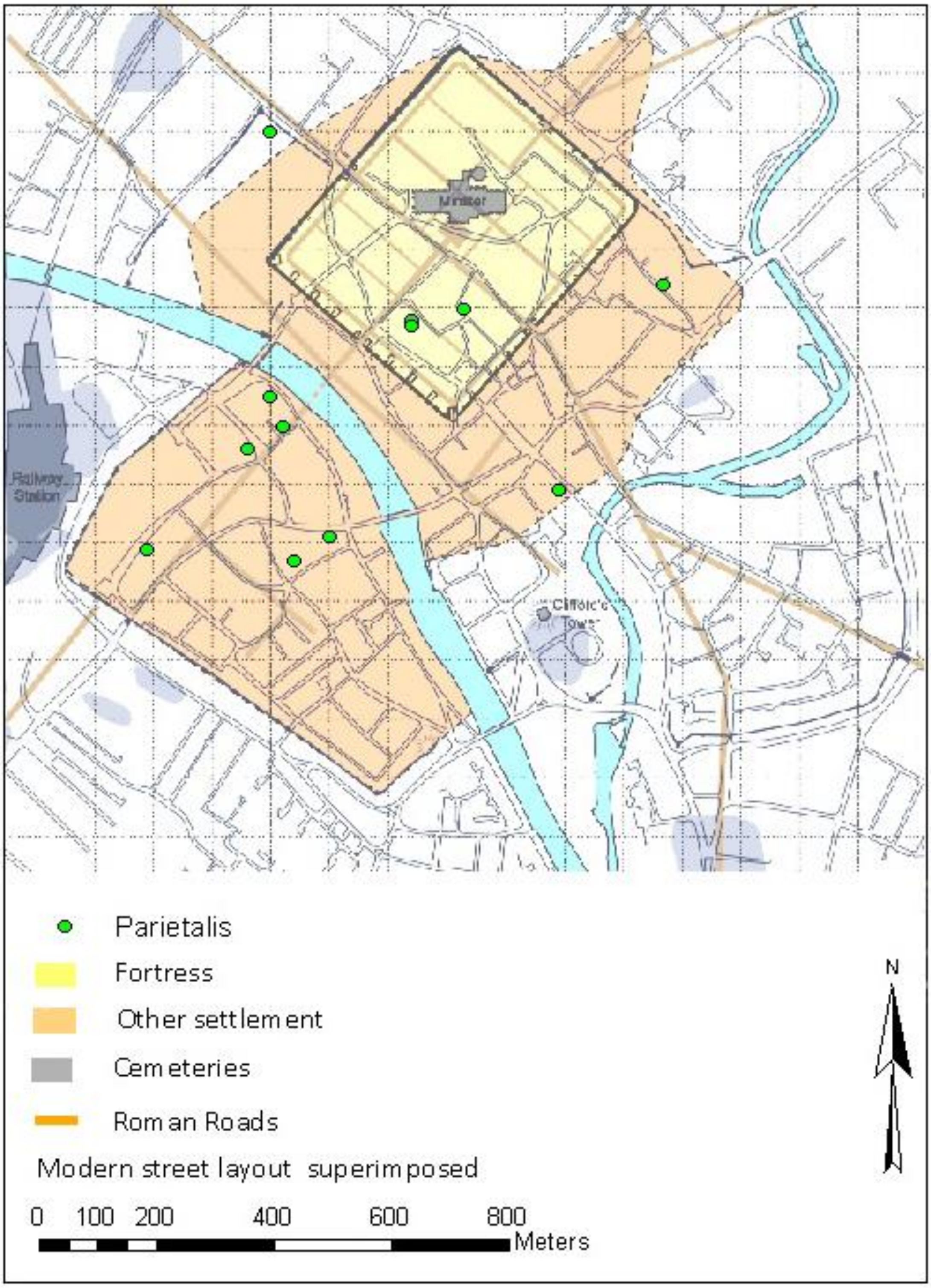


Figure 48. The location of possible parietalis within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Possible parietalis bricks were present in fabrics R2, R6, R8-R11 and R14-R15 (Table 22). The sherd count is too low to enable any comparison of fabric to location or dimensions.

Table 22. The total weight in grams of parietales in relation to fabric, with the associated sherd count		
Fabric	Weight in grams	Sherd count
R2	1550	3
R6	2175	4
R8	4725	4
R9	21631	28
R10	7000	11
R11	1875	3
R14	850	1
R15	775	3

4.1.11 Pedalis

A pedalis was a brick that measured one Roman foot square, that is 295.7mm² (Betts 1985, 176). Pedales were principally used as the base and capping tiles for hypocaust *pilae* columns (Brodribb 1989, 36), as at the legionary bath-house in St Sampson's Square, York (RCHM 1962, 62 and Plate 18), but they were also used in ovens such as at the Ebor Brewery site, York, and in hearths with examples known at Blake Street in York (Betts 1985, 175, 178), Pevensey, Watercrook and Newport on the Isle of Wight (Brodribb 1989, 37). Pedales were manufactured in the same way as bessales (see p138).

There were five pedales in the present study accounting for 0.2 percent of the total volume of tile examined (Figures 49-50). One partial example was from 1-9 Micklegate in the *colonia*, and this occurred residually. There was one partial and one complete example from the Wellington Row/Leedhams site in the *colonia*, both of which occurred residually. A partial pedalis was recovered from Heslington East, 3km south-east of the fortress, and though this tile was not *in situ*, it may have originally been a *pila*-capping tile from a hypocaust seen on the site. Three pedalis bricks were present in an *in situ* hypocaust at Heslington East where they acted as the bases of pilae columns. These bricks were not sampled on site so are not included in the present study but were measured at 280x272x25mm, 278x275x28-32mm and 280x275x28-32mm (McComish 2011, 14).

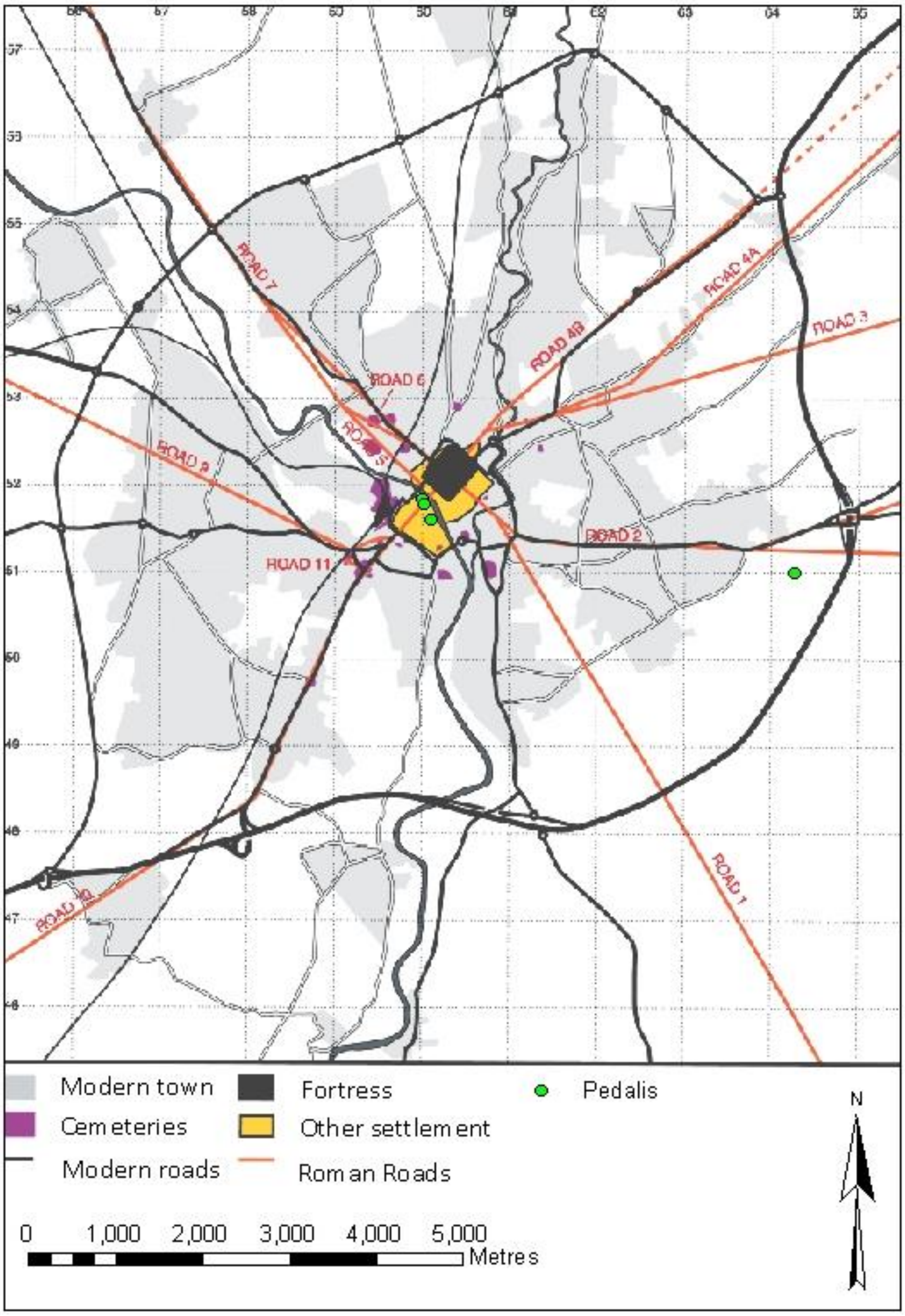


Figure 49. The location of pedalis within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

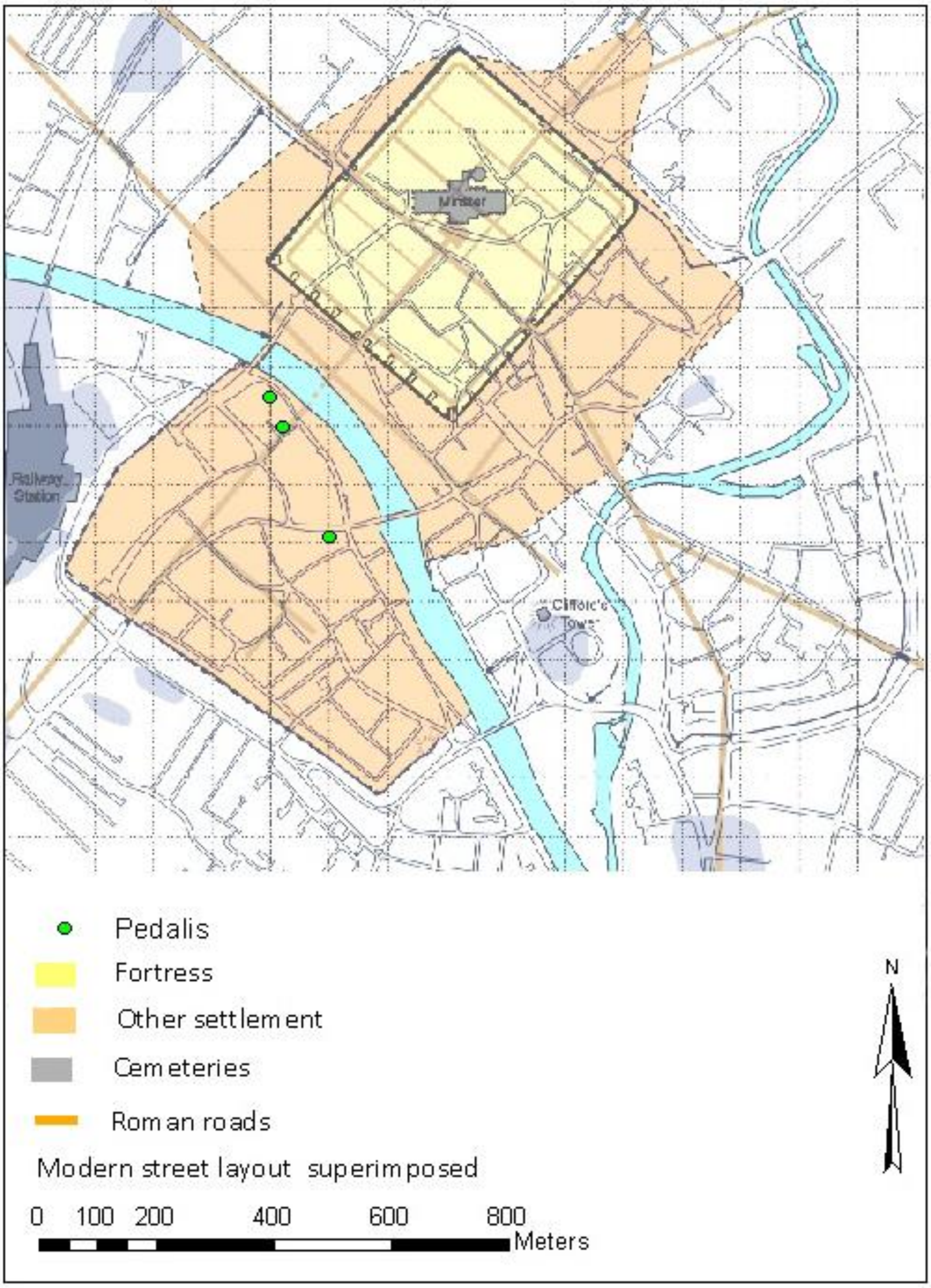


Figure 50. The location of pedalis within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Pedales are uncommon finds, a survey of Roman tiles from Britain recorded 200 complete examples with an average size of 281mm square, a thickness range of 25-70mm and an average thickness of 46mm, and these sizes are smaller than the Roman standard for such tiles (Brodribb 1989, 36). Previously recorded examples from York have an average size of 305mm square (Betts 1985, 178). The tiles in the present study measured 275mm broad and 35mm thick, 262mm broad and 37mm thick, 260mm broad and 32mm thick, and 305mm² and 62mm thick. Three of the four examples from the present study are smaller than the Roman standard for such tiles, while the fourth matches the examples previously recorded in York by Betts, and is larger than the Roman standard for such tiles.

Two of the pedales were in fabric R10 and three were in fabric R11, which are two of the commonest fabrics seen in York. Features relating to manufacture recorded on the pedales were two dog's paw prints on one tile, and faint smoothing lines on another.

4.1.12 Pipe

Roman ceramic pipes were made in a variety of shapes and sizes reflecting the various uses to which they were put, including as down-flow pipes for upstairs latrines (Adam 1994, 261-2), for moving water into, around and out of buildings, for drainage beneath roads, as conduits for aqueducts, as chimneys associated with wall heating systems (Brodribb 1989, 84-7), and for use in vaults in order to reduce the weight of the roof (Mason 1990, 220-21). Vaulting pipes are termed *tubuli lingulati* (Mason 1990, 220).

The method of manufacture for pipes is debated, it has been suggested that the deep internal corrugations seen on examples from York indicate formation by coiling (Whitwell 1976, 41 and 43), but similar internal ridges on pipes from Chester are seen as indicative of the pipes being thrown on a wheel (Mason 1990, 220). There were alternatives to the use of ceramics for water pipes. Pliny describes pipes made of wood and leather (Brodribb 1989, 84), and examples of this type have been found at Caerleon (Zienkiewicz 1993, 116), while a wooden pipe was found in York at St Paul's Green to the west of the *colonia* (YAT site code 1999.251). Lead pipes were also widely used, as at Bath where lead was the standard material for the water-pipes (Cunliffe 1976, 32), or at York where examples have been recovered from excavations at Church Street (Whitwell 1976, 28), from beneath the intervallum road (RCHM 1962, Plate 17), at 12-18 Swinegate (YAT project 1989.28 small find number 1638) and at Wellington Row (Ottaway 1993, 74). The Roman architect Vitruvius writing in the late first century BC noted that the use of lead pipes was unhealthy and recommended clay pipes instead, he also suggested that pipe joints should be sealed with a mixture of quicklime and oil (Betts 1985, 153, 155).

A variety of pipe forms were used within York, Brodribb (1989, 85-7) records a hexagonal cross-sectioned pipe, a pipe with a junction outlet and a pipe with a flared end. Lawton (1993, 7) recorded the presence of two types of pipe at a kiln site at Apple Tree Farm, Heworth, 3km north-east of the fortress, the first type were thin walled pipes tapering to smooth blank rims, while the second type were in excess of 250mm long and had circular or triangular perforations up to 40x70mm in size. The perforated types were heat damaged on the interior surfaces, suggesting that they had been used to distribute hot gasses within a kiln. Betts also recorded vaulting pipes in York that resembled a syringe shape, the neck of one pipe slotting into the base of the adjoining pipe, but none were complete, with the most complete example being 190mm long and 75mm in diameter, with a neck 30mm in diameter (Betts 1985, 182).

Tubuli lingulati are known to have been used in vault construction in Morgantina in Sicily as early as the third century BC, and in North Africa from at least the second century AD (Mason 1990, 220). It has been suggested that at Chester five continuous lines of interconnected hollow pipes arranged in two layers, with three lines in one layer and two in the other, collectively formed a rib of a vaulted *tepidarium* roof, placed at the intersection of two barrel vaults (Mason 1990, 217, 221). Some of the pipes at Chester were straight sided while others had a pronounced longitudinal curvature reflecting their use in a vault (Mason 1990, 220).

There were 468 sherds of pipe, specifically *tubuli lingulati*, recorded in the present survey, which weighed 28,129g in total, accounting for 0.34 percent of the total volume of tile examined. All of the pipes were from the central portion of the study area (Figure 51). The sherds were a mixture of neck, shoulder or body sherds, and none of the pipes were complete, neither was it possible to reconstruct a complete example.

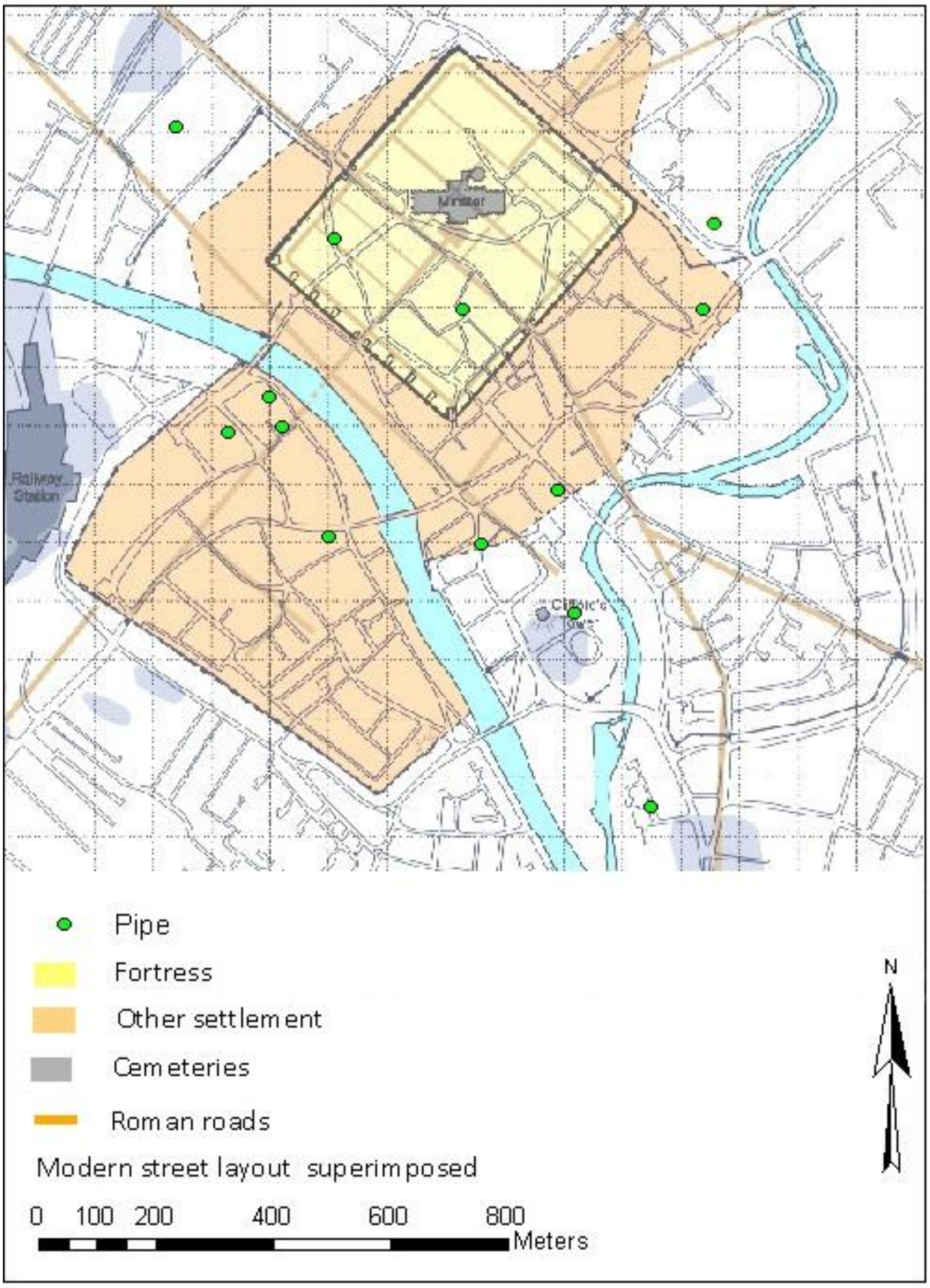


Figure 51. Location of pipe within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

The majority of the pipes (436 examples) were from 12-18 Swinegate, in the fortress, which is the site of the legionary baths, but none of these pipes were *in situ*, occurring as residual tile in dumps, build-ups, cut backfill deposits and within metalled surfaces. The Wellington Row site in the *colonia* produced seventeen examples all of which occurred as residual material. The remaining sites with Roman pipes (1-9 Micklegate, 5 Rougier Street, 22 Piccadilly, 26-28 Marygate, Jewbury, York Castle Car Park, 46-54 Fishergate, the Theatre Royal, St Anthony's Hall and 5-13 Clifford Street) each yielded only one or two examples per site, all of which occurred as residual material.

Most of the pipe sherds were small, the average weight being 59g. The dimensions of the necks ranged from 22-43mm in diameter (Figures 52-53), while the body portions ranged from 59-90mm in diameter (Figure 54-55), and the thicknesses ranged from 5-30mm, the average thickness being 12mm, and the pipes were often thicker at the basal ends. No complete lengths were present. The dimensions of the pipes were comparable to those previously recorded in York (Betts 1985, 182). No attempt was made to compare thickness to fabric or location, given that thickness was variable along the length of these pipes, and that for the majority of sherds it was unclear precisely which portion of the body of the pipe was represented. Furthermore the small number of examples from most sites made comparisons of fabric to zone invalid.

Most of the pipes in the study had pronounced ridges on the interior surfaces forming a spiral pattern, in some cases the exteriors also showed pronounced ridges (Figure 54) while in others the exterior surfaces were smoother (Figure 55). It has been previously suggested that corrugations of this type seen on examples from York indicate formation by coiling (Whitwell 1976, 41 and 43), however, the concave nature of the interior of the ridges would seem to be more indicative of wheel throwing than coiling (Dr A. Mainman pers. comm.).

Figure 52. Pipe necks from 12-18 Swinegate, Contexts 3278, 3520 and 3264, © YAT

Figure 53. Pipe necks from 12-18 Swinegate, Contexts 3278, 3520 and 3264, © YAT

Figure 54. Pipe from 12-18 Swinegate, Contexts 3583, © YAT

Figure 55. The smooth exterior surface and ridged interior surface of a pipe from 12-18 Swinegate, Context 3520, © YAT

Although the larger examples in the present study seem to be straight sided (Figure 54) most sherds are too small to determine the longitudinal shape. Four of the pipes in the present study were overfired, representing 1.7 percent of the total volume of pipes.

The pipes were in fabrics R0, R1-R3, R5-R11, R14-R15 and R99 (Table 23). The dominant pipe fabrics by weight in descending order are R6, R15, R10, R9 and R14 with all the other fabrics representing less than 2 percent of the total volume. The sherd count for most of the fabrics was very low, but the presence of so many fabrics suggests that pipes were manufactured by multiple producers. Although the high sherd counts for fabrics R6 and R15 might at first seem to indicate specialist production, this is in reality a reflection of patterns of recovery not manufacture, with all the sherds concerned relating to the legionary baths complex, they may therefore simply represent two specific batches of tile made for the roof of the baths.

Table 23. Total weight in grams of pipes in relation to fabric, with the associated sherd count		
Fabric	Weight in grams	Sherd count
R0	425	3
R1	330	4
R2	275	4
R3	545	11
R5	10	1
R6	10110	154
R7	455	4
R8	135	2
R9	3315	73
R10	3434	58
R11	1745	21
R14	1485	8
R15	5815	124
R99	50	1

4.1.13 Sherds classed as 'Rbrick' (Roman brick)

Sherds classified as Rbrick (an abbreviation of Roman brick) in the recording methodology are those which are too fragmentary for the original form to be determined. Rbrick accounted for 60.6 percent of the tile examined in the present study. Sherds of Rbrick were present on virtually all excavations within the York area (Figures 56-7), and were particularly common on a number of large scale excavations from the 1980s to early 1990s, where thousands of minute sherds of Roman tile of indeterminate form were recovered from extensive programmes of environmental soil sample sieving. Rbrick sherds must have originated from a mixture of all the various forms of tile, excluding imbrices or flue tiles, both of which are distinctive enough to recognise even among severely fragmented material.

The majority of Rbrick sherds were small, 19 percent of the Rbrick (12 percent of all tile recorded in the present study) comprised sherds so small that not even a thickness measurement survived. Thirty-nine of the sherds classified as Rbrick were large, ranging from 160x175mm to 420x260mm in size, but in each case there was no complete surviving length measurement, making it impossible to determine the original form. Of these large sherds two could have been sherds of bessalis, pedalis, Lydion, sesquipedalis or bipedalis, while eighteen of the large sherds could be pedalis, Lydion, sesquipedalis or bipedalis, a further sixteen of the large sherds could be Lydion, sesquipedalis or bipedalis, and the two largest could be sesquipedalis or bipedalis. It is likely that most of the thirty-nine sherds over 70mm thick came from bipedalis originally, as examples of this form are known nationally that are between 70-100mm thick (Brodribb 1989, 43), but since this identification is uncertain the sherds have been classified as Rbrick. It is also probable that many of the thinner Rbrick sherds originated from tegulae, but again as this cannot be proved such sherds are classed as Rbrick.

Numerous features relating to manufacture were present on the Rbrick sherds. Fourteen of the Rbricks had finger prints, thumb prints or grip-marks caused by the tile being lifted while still wet. A single tile had a textile impression, presumably left accidentally. One tile had scratches on the surface left by smoothing, while two had finger smoothing and two had finger drawn keying lines. Straw marks were present on four sherds, grass marks on five sherds and impressions of seeds on two sherds, all of which were presumably caused by other materials accidentally pressing into the tiles during manufacture or drying.

Sixty-five Rbrick sherds were pierced by holes ranging from 4-13mm in diameter, in four cases there were two holes present, and while the majority were pierced through while the clay was wet, five had been chipped out after the tile was fired. There was also a tile from 1-9 Micklegate in the *colonia* which had a small blind 3mm square hole in the upper surface. One of the tiles from Wellington Row had seven blind holes (Figure 58). Multiple holes are rare on Roman bricks but there is an example from Beauport Park punctured by frequent holes (Brodribb 1979b, 215). The function of such holes is unclear, but if they were intended as an aid to firing it is odd that there should be so few examples.

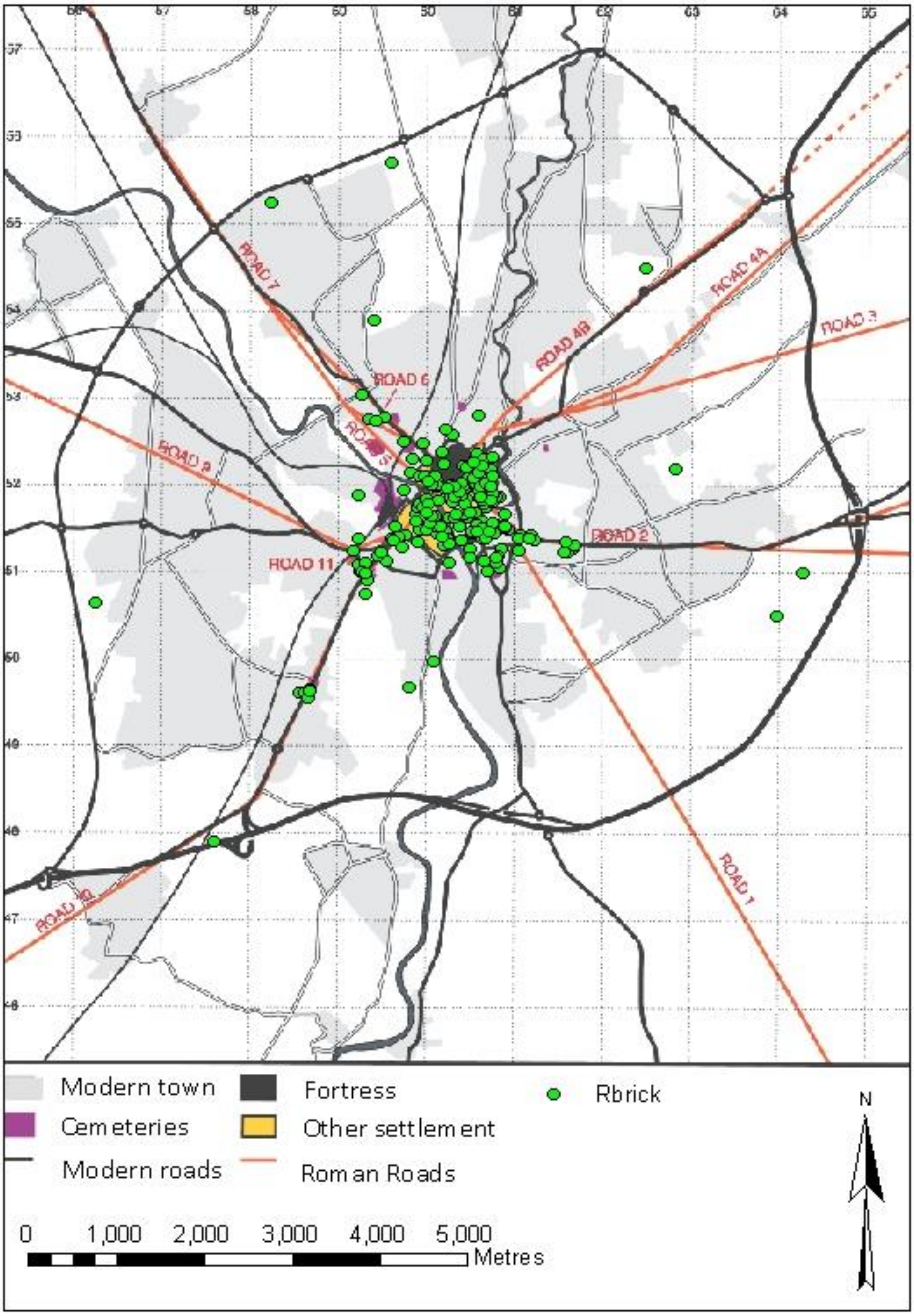


Figure 56. The location of form Rbrick within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

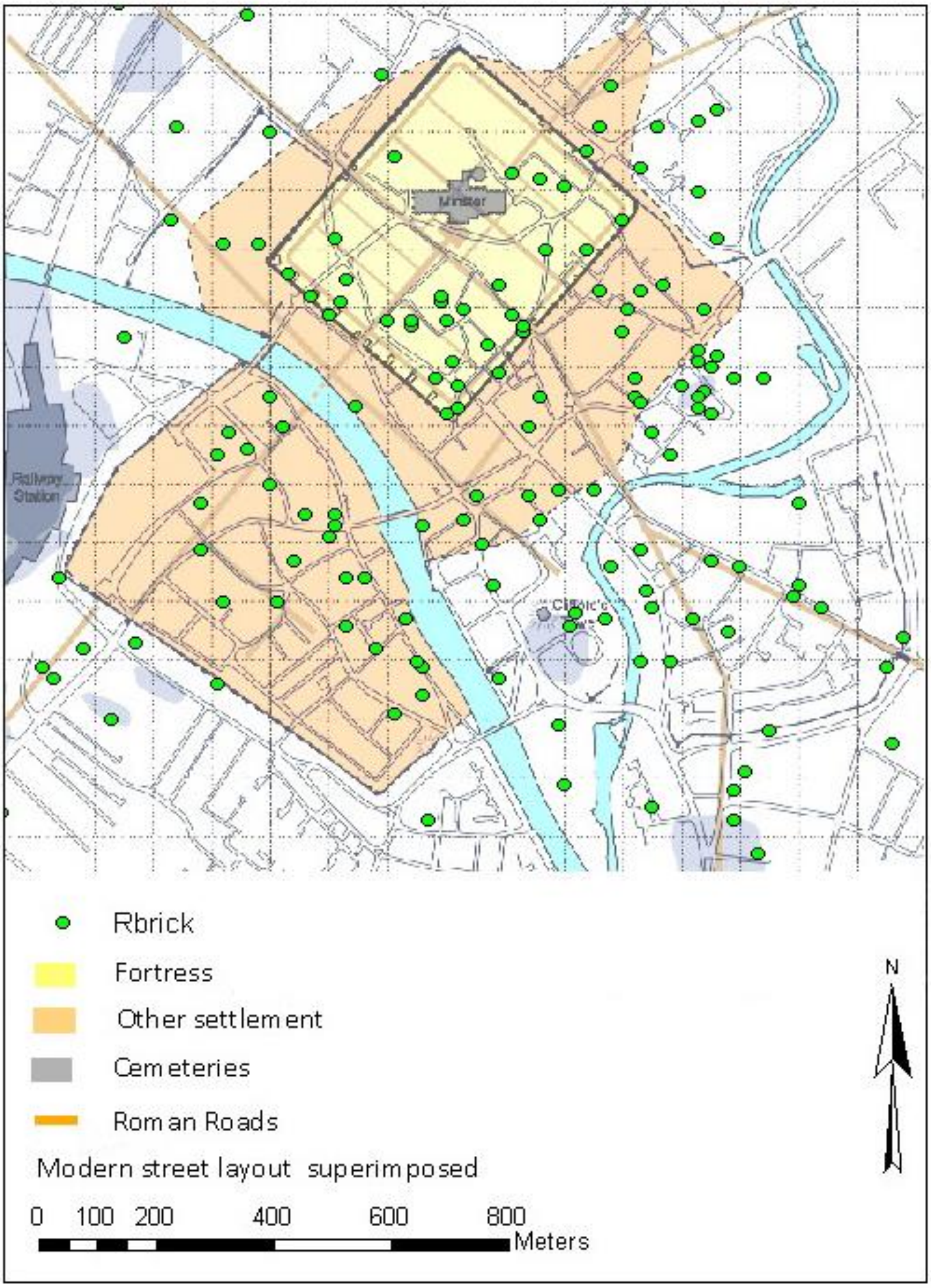


Figure 57. The location of form Rbrick within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Figure 58. An Rbrick with pierced holes from Wellington Row, Context 7259, © YAT

Seven Rbrick sherds had possible numbers incised on the upper surface, one from 12-18 Swinegate in the fortress had a single incised line, while a tile from Wellington Row in the *colonia* had two incised lines, a third tile from 1-9 Micklegate in the *colonia* had two, possibly three lines within a rough circle, together with nine small stab marks (Figure 59). In all three cases the incisions were adjacent to breaks on the tiles, so the original form of the numbers is unknown. Two examples from Heslington East, 3km south-east of the fortress, had a V and either an IX or XI on the surface. The best preserved example from the Bedern site, in the fortress, had the letters XI II or II IX depending on which way up it was drawn (Figure 60). The precise function of these numbers is unclear, though they may represent batch numbers. One of the Rbrick sherds from Wellington Row in the *colonia* had a graffito on the upper surface, in the form of two arcs and various straight lines (Figure 61). A single sherd, from Heslington East had a tally mark in the form XX, which was the only example of such a mark in the present study.

Figure 59. Rbrick with incised numerals inside a roughly drawn circle and nine small stab marks, 1-9 Micklegate, Context 6071, © YAT

Figure 60. Rbrick with incised numerals, from the Bedern, Context 1697, © YAT

Figure 61. Rbrick with graffito, from Wellington Row, Context 6212, © YAT

There were 199 signatures on the Rbrick, but of these ninety-one were too badly preserved to be matched to Betts' typology (Betts 1985, 192-4). Ninety-three signatures matched Betts' typology including Type 1 (thirty-two examples), Type 2 (twenty-one examples), Type 2a (one example), Type 3 (fourteen examples), Type 4 (one example), Type 5 (sixteen examples), Type 6 (three examples), Type 7 (one example), Type 8 (one example), Type 9 (one example) and Type 18 (two examples). A further fifteen signatures did not match Betts' typology and represent new forms (see p334-8).

Legionary stamps were present on sixty-three of the Rbrick sherds, of these fifteen were illegible, while a further nine relating to the Legio IX, and six relating to the Legio VI, were too poorly preserved to match to Collingwood and Wright's typology (1992). The legible Legio IX stamps present were types 2462.6, 2462.7, 2462.9 (two examples), 2462.9C (two examples), 2462.12 (four examples) and 2462.13, with a further three less clearly identified as 2462.7 and 2462.9A (two examples). All of these stamps have been previously recorded in York (Collingwood and Wright 1992, 170-3). There was also a Legio IX stamp on a sherd from the Adams Hydraulics site to the south-east of the fortress that did not match Collingwood and Wright's typology, but could represent the front and central portion of type 2462.13, the rear portion of which has been recorded in York before. Legio VI stamps present were 2460.6, 2460.9 (two examples), 2460.23, 2460.26, 2460.43, 2460.52, 2460.63, 2460.75 and 2460.84 (two examples) with a further four examples that were identified as probably 2460.7, 2460.40, 2460.81 (two examples), 2460.87 and 2460.90. All of these stamps have previously been recorded in York (Collingwood and Wright 1992, 148-167). There was also a Legio VI stamp on a sherd from 16-22 Coppergate to the south-east of the fortress that did not match Collingwood and Wright's typology and represents a new design (see p343-4).

Numerous marks were caused by animals walking over the tiles while they were drying. These were dominated by animals which could have been pets namely dogs (fifty-four examples) and cats (six examples), together with a further four unidentified paw prints which could be cat or dog, and one claw mark which was probably a large dog. The dogs varied in size considerably, but some were clearly very large. There were a smaller number of prints from livestock including one goat's hoof print and two chicken footprints, together with eight unidentified hoof prints. The only wild animal prints seen were of a small mammal. Thirty-nine tiles had hob-nail boot impressions caused by men walking over the tiles while they were still wet, while forty-three Rbricks had rain marks on the upper surface and four had hail-stone marks; in addition, two sherds had worm impressions on the base from being placed on sodden ground to dry. These surface marks show that these tiles at least, must have been laid on the ground to dry, the exception being the cat's paw prints as cats could easily jump onto tiles drying on shelves within open sided sheds.

There were six underfired sherds, forty-four reduced sherds, eight sherds were vitrified, and 171 over-fired sherds of which fifteen were blown and one was warped. There were only three sherds identified as wasters, two from the Adams Hydraulics site, which is hardly surprising given the presence of the legionary kilns at nearby

Peasholme Green, and one from excavations at 12-18 Swinegate. Clearly most of the Rbrick was carefully fired, in common with all other forms.

4.1.14 Ridge

Ridge tiles were heavy semi-circular tiles, larger than imbrices, which were laid abutting one another along the apex of a roof, and unlike imbrices they do not taper along their length. Ridge tiles tend to be of large diameter to ensure a good overlap with the columns of tegulae and imbrices on the roof. The rarity of ridge tiles suggests that other solutions were used to cap the ridge line, such as having a flat mortar ridge capped with alternating tegulae and imbrex (Rook 1979a, Figure 16.1), or by using a row of imbrices mortared into place (I. Betts pers. comm).

Ridge tiles are rare in Britain, though if fragmented they could easily be mistaken for imbrex, and therefore be under-represented in the archaeological record. Ridge tiles are known from Alcester, Brantingham, Cirencester, Charterhouse Mendip, Holt, Littlecote and Newport on the Isle of Wight (Brodribb 1989, 27-8). No examples of ridge tiles were present in the current study, confirming Betts' (1985, 145) observation that no examples had been found in York.

4.1.15 Sesquipedalis

Sesquipedalis are bricks that measured one and a half Roman feet square that is 444mm^2. They were used in hypocausts to form the layer above the *pilae* and in paving as at Beauport Park (Brodribb 1989, 41). Sesquipedales were manufactured in the same way as bessales (see p138). Sesquipedalis are rare in Britain, Brodribb recorded forty-two complete and ten partial sesquipedalis in a national survey of Roman tiles, which ranged in size from 350mm^2 to 460mm^2, and in thickness from 40-70mm with an average size of 406 mm^2 and 52mm thick (Brodribb 1989, 41). The average size in York has been recorded as 405mm^2 and 50mm thick (Betts 1985, 179).

A single sesquipedalis in R11 weighing 4650g (0.05 percent of the total volume of tile) was present. This was from the Heslington East site (Figure 62) 3km south-east of the fortress, and it was 400mm long and 44 mm thick. The rarity of the form accords with the national picture as do the dimensions.

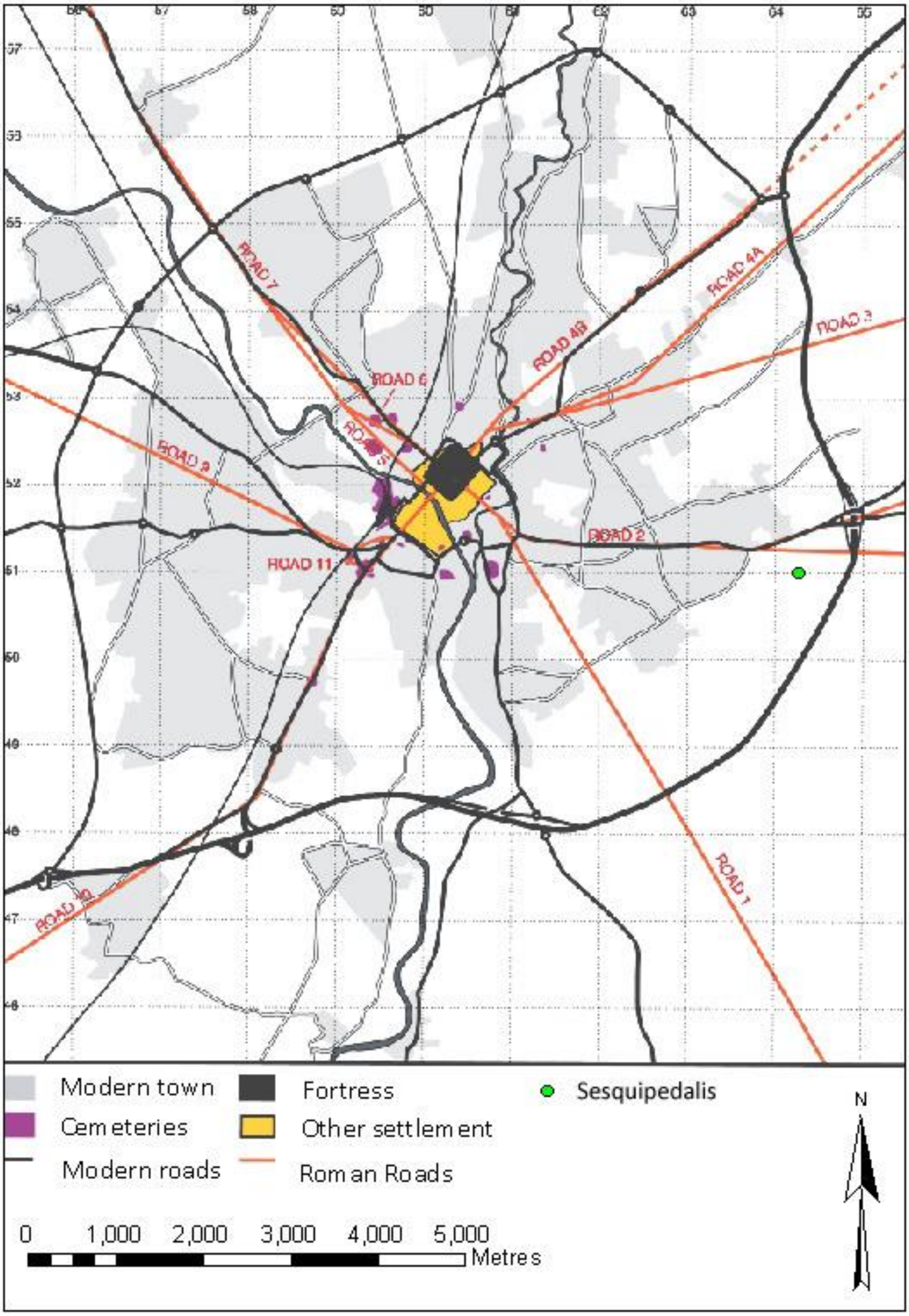


Figure 62. The location of sesquipedalis within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

4.1.16 Tegula

It should be noted that a superscript [Betts] or [Warry] is used in this section of text in order to distinguish between tegulae groups allocated by these two authors.

Tegulae are roofing tiles which are usually rectangular in shape, though some taper inwards slightly toward the base of the tile, tegulae have flanges on the upper face along each of the longer sides, there is a lower cutaway on the underside of the tile beneath the basal end of each flange, and an upper cutaway on the upper surface at the upper most end of each flange (Betts 1985, 143). The upper and lower cutaways of adjacent tiles overlapped when fitted on the roof. The arrangement of tegulae in columns on a roof facilitated repair work as it was easy to replace a single column of damaged tiles, while leaving the rest of the roof intact (Warry 2006, 104). Warry (2006, 99) has noted that there is a greater variation in the breadth of tegulae than the length, and has suggested that graduated sizes of tegulae may have been used on a single roof, and a similar suggestion has been made in the case of Piddington villa (Ward 1999, 14). Tegulae were not always used in conjunction with imbrices. For example, an *in situ* roof at Herculaneum is made entirely of tegulae (Brodribb 1989, 8).

Warry's (2006, 7-32) analysis of tegulae has shown that different manufacturing methods were used. The commonest form was the use of a four-sided bottomless mould which was sanded, and used on a sanded workbench. Blocks for the lower cutaways could either be integral to the mould, or fixed onto the workbench in the correct position, thereby holding the mould in place during manufacture. Alternatively lower cutaways could be knife cut. Clay would be thrown into the mould and punched into the corners, and the hands would then be run along the flanges to smooth them, often creating a noticeable finger-groove adjacent to the flange. The upper cutaway would then be cut with either a wire or knife, and the surface of the tile sponged down to improve surface strength. Five sided moulds with retractable sides also seem to have been used. An alternative method was to use an inverted box mould, with inserts for the upper cutaways, the clay would be thrown into the mould and punched into the corners, and then the upper side (which would eventually be the base of the tegula) could be trimmed smooth using a wire. The tegula would be turned out of the mould and the upper surface and flanges would then be smoothed.

Although primarily used as roofing tile, tegulae have been put to other purposes, flanges were often removed so that the tegulae could be used in flooring, walling or as *pilae* caps (Brodribb 1989, 14, 21-2), and tegulae have also been used as tomb linings (RCHM 1962, Plate 28). At Piddington villa window sills were made of tegulae with the flanges removed, and a column between two doorways rested on a stone and tegula base (Ward 1999, 17), while at 25-6 Lime street London, a cellar dating to AD 125-50 had been lined with tegulae, perhaps as a damp proofing exercise (Perring 2002, 109). At St Osyth a dwarf wall for a timber framed building was capped with tegulae facing upwards and it has been suggested that the basal timber sill-beam would have fitted between the flanges of the tegulae (Williams 1971, 175). The sides of the concrete floor of a store building in Dean's Park, York, near the north-western wall of the fortress, were supported by tegulae resting on a wall offset (RCHM 1962, 45). Some tegulae on the continent were adapted to provide ventilation, examples being a tegula with an occulus 260mm in diameter in the House of the Moralist in Pompeii, while a second tegula at this house with a hood was presumably to allow the escape of fumes (Adam 1994, 215).

Warry (2006, 63) devised a typology for tegulae of five groups based on cutaway forms, and dated these using associated legionary tile stamps; Group A$^{\text{Warry}}$ dating to AD 40-120, Group B$^{\text{Warry}}$ dating to AD 100-180, Group C$^{\text{Warry}}$ dating to AD 160-260 or later and Group D$^{\text{Warry}}$ dating to AD 240-380, while the fifth group were not closely dated and represented regional variations. Warry analysed these groups in terms of other characteristics such as dimensions and the presence of nail-holes, the results of which showed that both tegulae and roof design developed considerably during the Roman occupation of Britain. Firstly the size of tegulae decreased over time, with the Group A-B$^{\text{Warry}}$ tegulae being thicker and heavier than those in Groups C- D$^{\text{Warry}}$; a Group D$^{\text{Warry}}$ roof being 14 percent lighter than a Group A$^{\text{Warry}}$ roof of equivalent size (Warry 2006, 106). This reduction in thickness would have reduced both the cost of raw materials and the firing time required. It would also have allowed roof structures to be designed to carry less weight, again reducing the cost of materials (Warry 2006, 106). In general the Group A$^{\text{Warry}}$ tiles were the least well-made, while the Group D$^{\text{Warry}}$ tiles were the best in terms of quality (Warry 2006, 9). The flange heights and upper cutaway lengths also reduced over time (Warry 2006, 56). Tegulae were made in four sided moulds until c. AD 250 when some manufacturers, who produced Group D$^{\text{Warry}}$ tiles, switched to the use of inverted moulds (Warry 2006, 63, 135).

On the basis of material excavated in London and south-eastern England Betts (pers. comm.) questions Warry's categories, regarding the Group B$^{\text{Warry}}$ as variants of the Group A$^{\text{Warry}}$ cutaways, as both have a square cut-out which was modified by the removal of additional areas of clay with a knife, further noting that the additional area of clay removed may well have been at the whim of the tile maker. Betts (pers. comm.) also questions the dating of the various cutaway forms as recorded by Warry, noting that the data from London and south-east England suggests that the Group A$^{\text{Warry}}$ tegulae date to AD 40/70-120 but possibly as late as AD 160, the Group B$^{\text{Warry}}$ tegulae date from AD 40/140-300 or later, and Group C$^{\text{Warry}}$ tegulae date from AD 40 to AD 300 or later, and though there is no clear date range for the Group D$^{\text{Warry}}$ cutaways these could relate to the entire period of Roman occupation. If all Warry's types of cutaway were present from the outset of the Roman occupation in south-eastern Britain, there is no reason to suppose it was any different in northern Britain, and in the light of Betts' strong objections, Warry's suggested cutaway dates have not been used in this MA text.

Of the 480 complete tegulae seen by Warry, 22 percent were longitudinally convex, of which 15 percent were mildly convex and 7 percent were severely convex, but none of the tegulae were laterally convex, suggesting that the longitudinal convexity was deliberate (Warry 2006, 111). Many, though not all, of the convex tegulae have very smooth undersides suggesting that they were made in inverted moulds (Warry 2006, 112). One of the largest groups of complete convex tegulae is in a tile tomb from York. It is unlikely that the tiles were made specifically for use in tombs, as the example in York comprises tegulae with several different legionary stamps, which suggests that whatever was to hand was re-used (Betts 1985, 166). It has been suggested that convex tegulae were designed for use on vaulted roofs, with the lowest course of tegulae being set almost vertically and therefore not requiring antefixes. For example, the baths at Beauport Park, which have convex tegulae, and therefore may have had a vaulted roof are not associated with antefixes, while the baths at Exeter which seem to have had a pitched roof were associated with antefixes (Warry 2006, 114-15). Warry argues that the almost total absence of nail-holes on convex tegulae suggests that they were laid directly onto the concrete of vaulted roofs, where nailing would have been of little use, and points to the Basilica of Constantine in Rome, where there is evidence of tegulae placed directly onto a vault, and the roofs of Trajan's Market in Rome, where the impressions of tiles are seen on the mortar of a hemi-spherical dome (Warry 2006, 116-17).

A survey of 615 complete tegulae in Britain found that one in five had nail-holes, equal numbers of which were round or square (Brodribb 1989, 11). The relatively low number of tegulae with nail-holes has given rise to the suggestion that only the lowest course of tegulae were nailed in place, with the remaining courses being held in place by their own weight and/or mortar (Brodribb 1979b, 215). It has been pointed out that since there were no gutters on Roman buildings the basal course of tegulae would have to project beyond the wall in order to prevent water from flowing down the walls, creating the need for fixing or nailing the lower course of tegulae into place (Warry 2006, 102). This seems to be confirmed by a contract specification from Puteoli which mentioned the use of iron fixings, suggesting that iron brackets were sometimes used to support the lowest course of tegulae (Webster 1979, 291).

Nationally nail-holes on tegulae are up to 13mm in diameter, though they are typically 7mm, with the holes being pierced before firing, though examples of a hole being knocked out after the tile was fired are known, as at Piddington (Brodribb 1989, 10-11). Tegulae with intact iron nails have been found at Piddington, Brading, Silchester and Lydney (Ward 1999, 80). Nationally nail-holes on tegulae are usually centrally placed near the top of the tile, which suggests that they were aimed at securing a row of tiles. There are a few tegulae with nail-holes near the flange, which may suggest that the gable end column of tiles were also nailed into place (Warry 2006, 102), or perhaps the nail-hole in such cases was placed to ensure that the nail-head was protected by the imbrex (Betts 1985, 164). Some nail-holes were blind, that is they did not penetrate the full thickness of the tegulae, suggesting that the roofer would only break through the holes where they were required (Warry 2006, 102-3). While nail-holes were usually at the top of the tile examples are known from Britain with a hole near the bottom, a hole in the centre, two holes near the top and in one case six holes scattered across the tile (Brodribb 1989, 110). There are very few nail-holes on legionary sites as compared with civilian sites, which may suggest that the military usually mortared tegulae into place rather than nailing them (Warry 2006, 103).

In York nail-holes are more common on smaller tegulae (Betts 1985, 164), and given that the size of tegulae seems to decrease over time (see p82-3), this suggests that the practice of nailing tegulae to roofs may have been more common in York in the later Roman period. Warry also noted that the practice of nailing tegulae to the roof increased over time, and suggested that this might relate to an increase in the pitch of roofs over time, to better suit the British climate, with nail-holes being more of a necessity on steeper roofs (Warry 2006, 103 and 106).

A total of 5,101 tegulae sherds were recorded in the present study, which comprised 20.15 percent of the total volume of tile examined. Tegulae were present across the study area (Figures 63-4), being the most widespread identifiable form, and the weight in grams of tegulae in each of the three zones is given in Table 24, together with the associated sherd count.

Table 24. Tegulae weight and sherd count in relation to zone			
Zone	Fortress	*Colonia*	Environs
Weight in grams	378201	963898	294030
Sherd count	1129	2854	1118

The average size for tegulae in Britain is 430x330mm with external flanges of 50mm in height, though tegulae range from 310x270mm to 570x480mm in size (Brodribb 1989, 12, 142). Tegulae are usually 20mm thick but examples are known from Heddington, Ickham and Slonk Hill which are 9mm, 14mm and 18mm thick respectively (Brodribb 1989, 13).

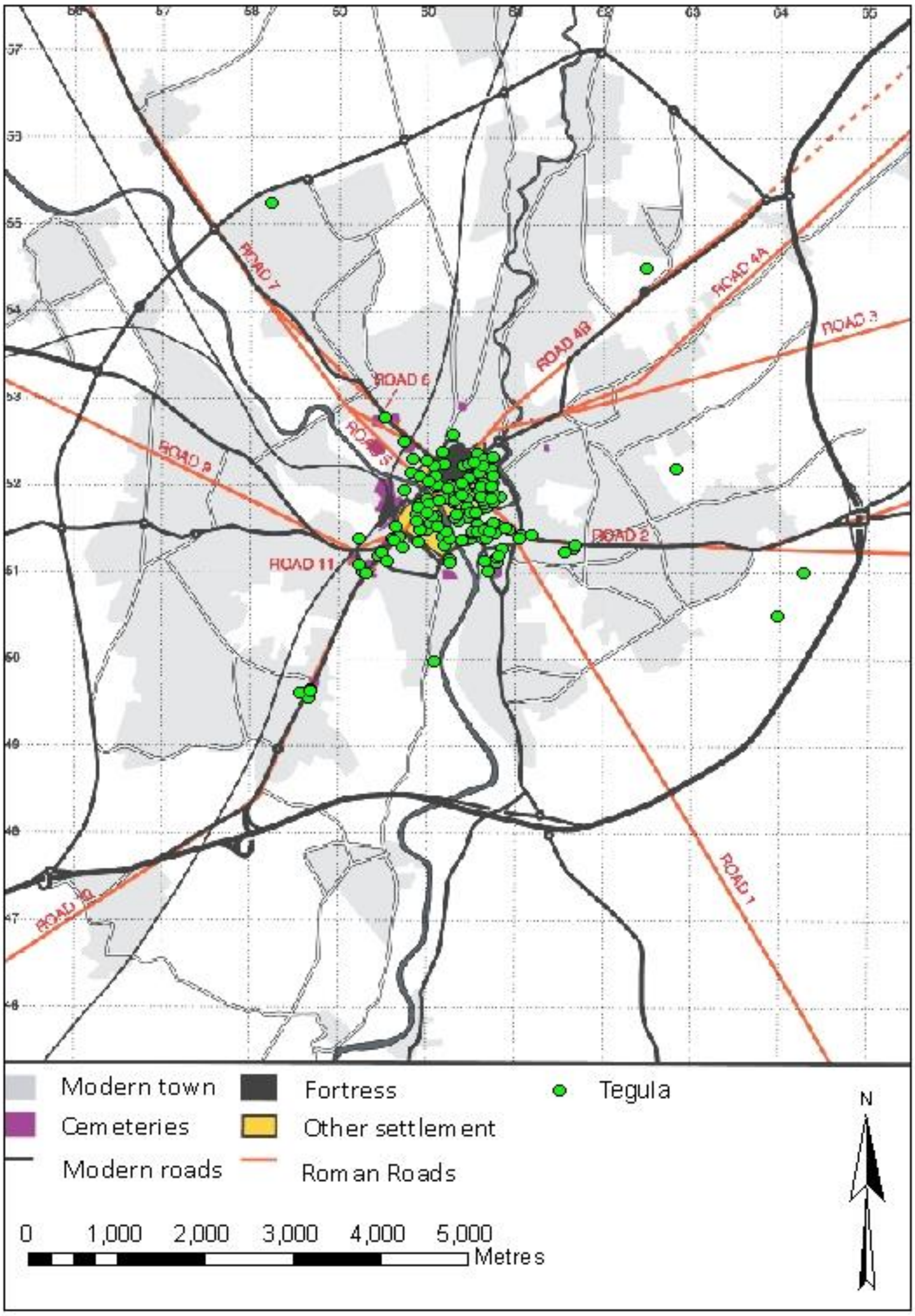


Figure 63. Location of tegula within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

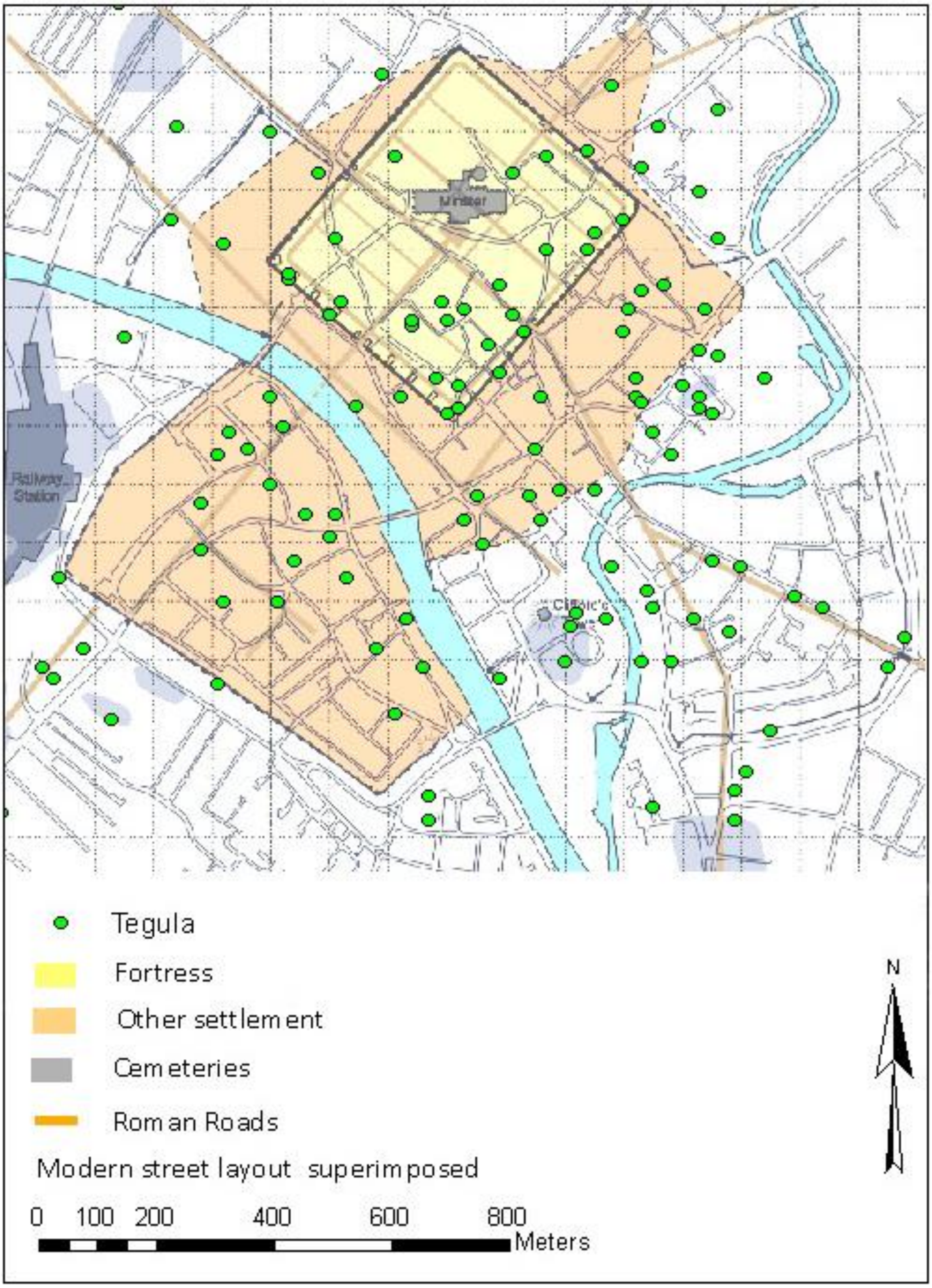


Figure 64. Location of tegula within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Roman tile from York and its environs

A previous survey of complete tegulae in York divided the tiles into three groups on the basis of their size (Betts 1985, 168-17). The Group A[Betts] tegulae were the largest ranging from 485-547x365-412mm in size, and these had both Legio IX and Legio VI stamps. The Group A[Betts] tegulae were interpreted as the Legio VI continuing to use Legio IX moulds on arrival in York. The Group B[Betts] tegulae were slightly smaller ranging from 523-555x345-362mm in size, and had only Legio VI stamps suggesting that they were of later date than the Group A[Betts] tegulae. The Group C[Betts] tegulae were the smallest ranging from 372-393x291-328mm and were unstamped, these could be of military or civilian manufacture, though the presence of Legio VI stamped tiles of similar size at York Minster suggests the former. There were also two tegulae that did not fit into any of these groups which were 344mm and 460mm long respectively (Betts 1985, 168-72). Betts (1985, 171) also noted that the legionary stamped tegulae in York were larger than the national average ranging from between 524x392x62mm to 542x357x58mm in size. The only other sites in Britain to have produced tegulae greater than 500mm in length being Bath, Caerleon, Chichester, Folkestone, Holt and Silchester.

Only one tegula with complete surviving dimensions was recorded in the present study, this was from a site at 24-30 Tanner Row in the *colonia*, and measured 520x380x27mm in size, with flanges 62mm deep, it weighed 12kg and was in fabric R11. The only other complete length measurement present, also from the 24-30 Tanner Row site, was 520mm in length with a thickness of 22mm and a flange 65mm deep, and this sherd was in fabric R9. Both of these tiles would fall into Group A[Betts] of the types previously recorded in York, which could relate to either the Legio IX or the Legio VI. Both these tiles had Type B[Warry] lower cutaways. Too few length measurements were present in the dataset to enable comparisons between length and either fabric or zone.

Five complete breadth measurements were recorded in the present study ranging from 302-380mm with an average breadth of 342mm. All five examples were from the *colonia*, three from the site at 24-30 Tanner Row, and two from 1-9 Micklegate. The tegulae with complete breadths were in five different fabrics, R1 (2 examples), R6, R10, R11 and R15. The complete breadth measurements mostly fall into the size groups previously recorded in York, with the example at 380mm being in Group A[Betts], the two examples at 353mm being in Group B[Betts], and the examples at 302mm and 322mm being in Group C[Betts]. None of these examples had legionary stamps to suggest dates. The widest tile had a Type B[Warry] lower cutaway, while the example at 322mm wide had a Type C[Warry] lower cutaway. There were insufficient examples to compare breadth measurements to either fabric or zone.

The tegulae ranged from 11-50mm in thickness with an average thickness of 24.7mm (3,631 complete thickness measurements present). Unfortunately neither Brodribb (1989, 13), nor Betts (1985, 170), discuss the thickness of tegulae in detail, there is therefore no large-scale survey with which to compare the present results, but these authors mention tiles ranging from 9-24mm in thickness.

The average thickness of tegulae in relation to fabric and zone was tabulated, Table 25, with the associated sherd count listed on Table 26 (the seventeen sherds designated R0 are excluded from these tables as the fabric is uncertain, and the eight sherds designated R99 are excluded as they represent ‘one-off’ sherds in terms of their fabric). Table 25 is illustrated on Figure 65 (Fabrics R4, R7, R12, R13, R16, R17 and R18 are excluded from the figure due to low sherd counts). Figure 65 shows that the tegulae from the fortress were usually the thickest on average, irrespective of fabric, and since thickness is in direct proportion to length and breadth (Warry 2006, 56), this would imply that the tegulae in the fortress were the largest.

The flanges were missing on 2,699 of the tegulae recorded in the present study, whether this represents deliberate removal or accidental damage is unclear. There were 2,402 complete flange-height measurements within the present study, which ranged from 24-82mm in size with an average height of 48mm. There were too few examples present for any comparisons to be made between flange-height and either length and breadth measurements. There was a clear correlation between the thickness of the tegulae and the height of the flange (Table 27), with the thinnest tegulae having flange-heights greater than the thickness of the tile, and the thicker tegulae always having a flange-height less than the thickness of the tile. There was a decline in tegula size over time (Betts 1985, 172; Warry 2006, 56), and if the thicker tiles in the present study are indeed earlier this would imply that the ratio of thickness to flange-height also changed over time.

Figure 65a. The average thickness of tegulae in mm in relation to fabric and zone (the associated sherd count is given in Table 26)

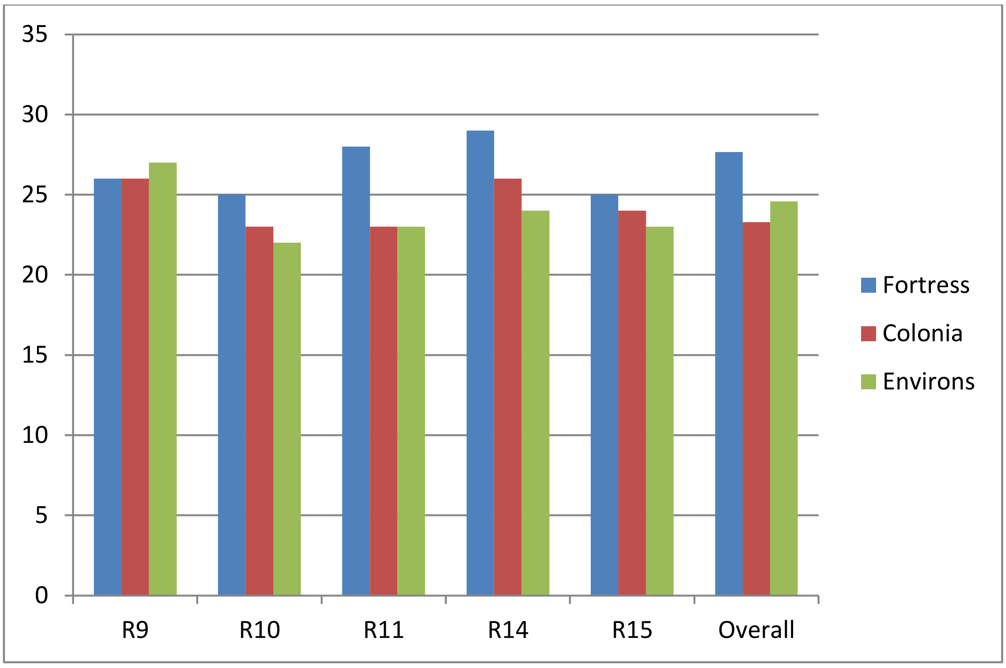


Figure 65b. The average thickness of tegulae in mm in relation to fabric and zone (the associated sherd count is given in Table 26)

Table 25. Average thickness in mm of tegula (for each fabric with extant examples) in relation to zone				
Fabric and form	Overall	Fortress	*Colonia*	Environs
R1 Tegula	26	27	23	29
R2 Tegula	27	29	23	19
R3 Tegula	25	28	24	24
R4 Tegula	20		20	
R5 Tegula	27	35	27	32
R6 Tegula	23	27	22	23
R7 Tegula	23	33	23	22
R8 Tegula	26	28	22	25
R9 Tegula	27	26	26	27
R10 Tegula	23	25	23	22
R11 Tegula	23	28	23	23
R12 Tegula	24	22	24	24
R13 Tegula	29			29
R14 Tegula	27	29	26	24
R15 Tegula	24	25	24	23
R16 Tegula	24		22	26
R17 Tegula	24	26	23	27
R18 Tegula	23	27	21	19

Table 26. Sherd count used in Table 25				
Fabric and form	Overall	Fortress	Colonia	Environs
R1 Tegula	155	20	88	47
R2 Tegula	191	153	45	8
R3 Tegula	194	40	107	47
R4 Tegula	1		1	
R5 Tegula	121	2	117	2
R6 Tegula	243	33	146	64
R7 Tegula	25	2	17	6
R8 Tegula	116	74	25	17
R9 Tegula	968	209	517	242
R10 Tegula	848	29	691	128
R11 Tegula	557	36	367	154
R12 Tegula	11	1	7	3
R13 Tegula	1			1
R14 Tegula	32	15	9	8
R15 Tegula	122	8	99	15
R16 Tegula	8		5	3
R17 Tegula	16	2	12	2
R18 Tegula	5	1	3	1

Table 27. Tegulae thickness in relation to flange height			
Thickness of tegula in mm	Number of examples with a flange	Number of examples where the height of the flange is less than the thickness of the tegula	Column 3 as a percentage
11	2	0	0
12	1	0	0
13	12	0	0
14	18	0	0
15	41	0	0
16	47	2	4
17	78	8	10
18	152	28	18
19	168	42	25
20	188	46	24
21	158	51	32
22	165	72	44
23	159	87	55
24	152	100	66
25	163	102	63
26	78	51	65
27	99	56	57
28	109	61	56
29	74	48	65
30	76	47	62
31	51	39	76
32	41	27	66
33	27	23	85
34	40	33	83
35	32	28	88
36	26	24	92
37	19	18	95
38	12	12	100
39	6	6	100
40	3	3	100
41	6	6	100
42	3	3	100
43	2	2	100
47	3	3	100
49	1	1	100

The difference between the thickness of the tegulae and the flange-height was present on 2,181 sherds, and ranged from 4-51mm, with an average difference of 24mm. Nationally flange-heights are usually double the thickness of the tile, typically being

50mm high (Brodribb 1989, 13). The tegulae from the present study fit the national picture with an average thickness of 25mm and average flange-heights of 48mm in size, which is almost double the average thickness of the tegulae. It has been observed that occasionally tegulae have a flange-height that is less than the thickness of the tegula (Brodribb 1989, 13; Ward 199, 15). In the case of the present study 46.6 percent of the tegulae with surviving flanges had a flange-height that was less than the thickness of the tegula, which is far more than 'occasional', though in the majority of cases the measurements concerned were less than 3mm different to the thickness of the tegula concerned.

A total of 337 upper cutaways and 580 lower cutaways were recorded in the present study, though seventy-five of the lower cutaways were too fragmentary to determine the original form. The lower cutaways have been matched to Warry's (2006, 4) typology, and the lower cutaways recorded in the present study were in five different forms (A2, B6, B62, C4 and C5), with an additional four examples where the form did not match Warry's typology and was termed 'other', two of these were irregular, the third had the entire corner of the tile cut away on a diagonal and the fourth had a diagonal cutaway along the entire length of the basal arris, though this could simply represent heavy trimming of the edges (Figure 69). The location of the various cutaway forms is given on Figures 66-8, but for ease of legibility the location of the various forms of lower cutaway in the central area is given on Figures 66-7, while Figure 68 shows the lower cutaway forms with examples in the wider study area. The associated sherd count is given in Table 4. The evidence for the various cutaway forms by zone is given on Table 28 and Figure 70.

The Group A^{Warry} cutaways account for 9.5 percent of the total number of cutaways. Only two tiles had both a Group A^{Warry} lower cutaway and a legionary stamp, which was a Legio IX stamp in both cases, hinting that this type of cutaway may pre-date c. AD 120 in York. The Group A^{Warry} lower cutaways in the fortress were largely associated with a baths building in the Swinegate area, which was constructed prior to AD 100 (Monaghan 1997, 1061, 1064), again suggesting an early date for this cutaway form.

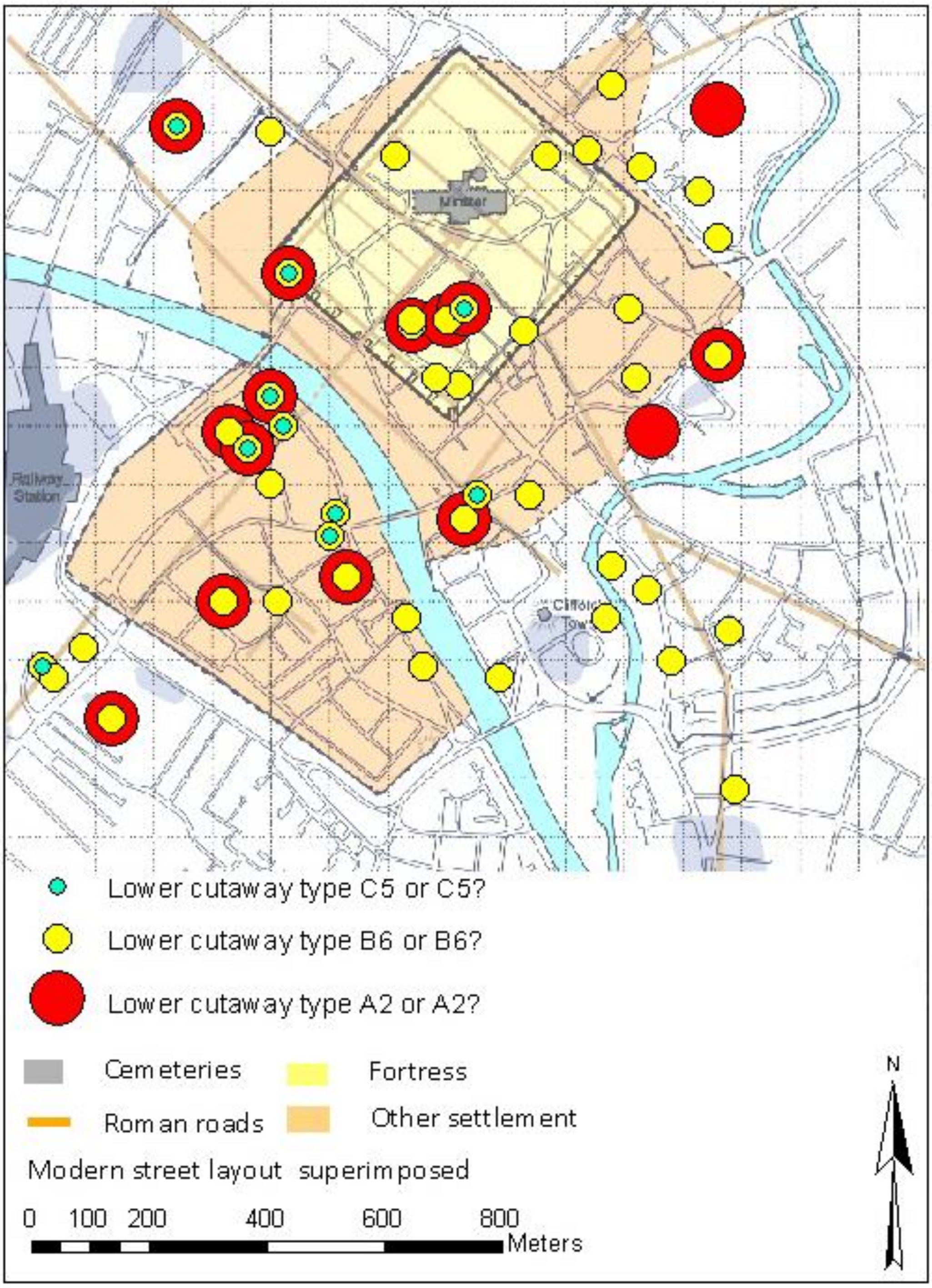


Figure 66. Location of lower cutaways Types A2, B6 and C5 within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

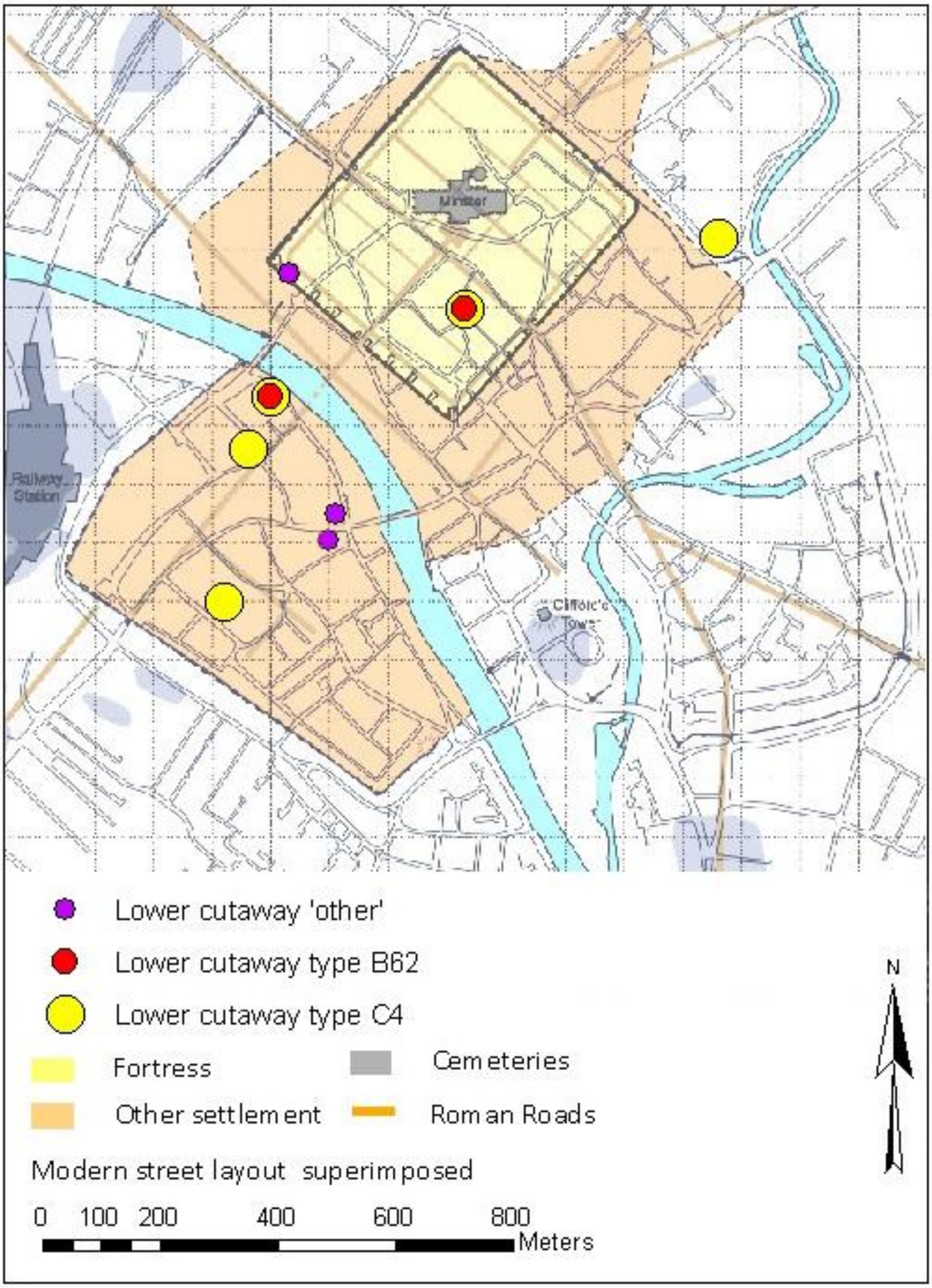


Figure 67. Location of lower cutaways Types C4, B62 and 'other' within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

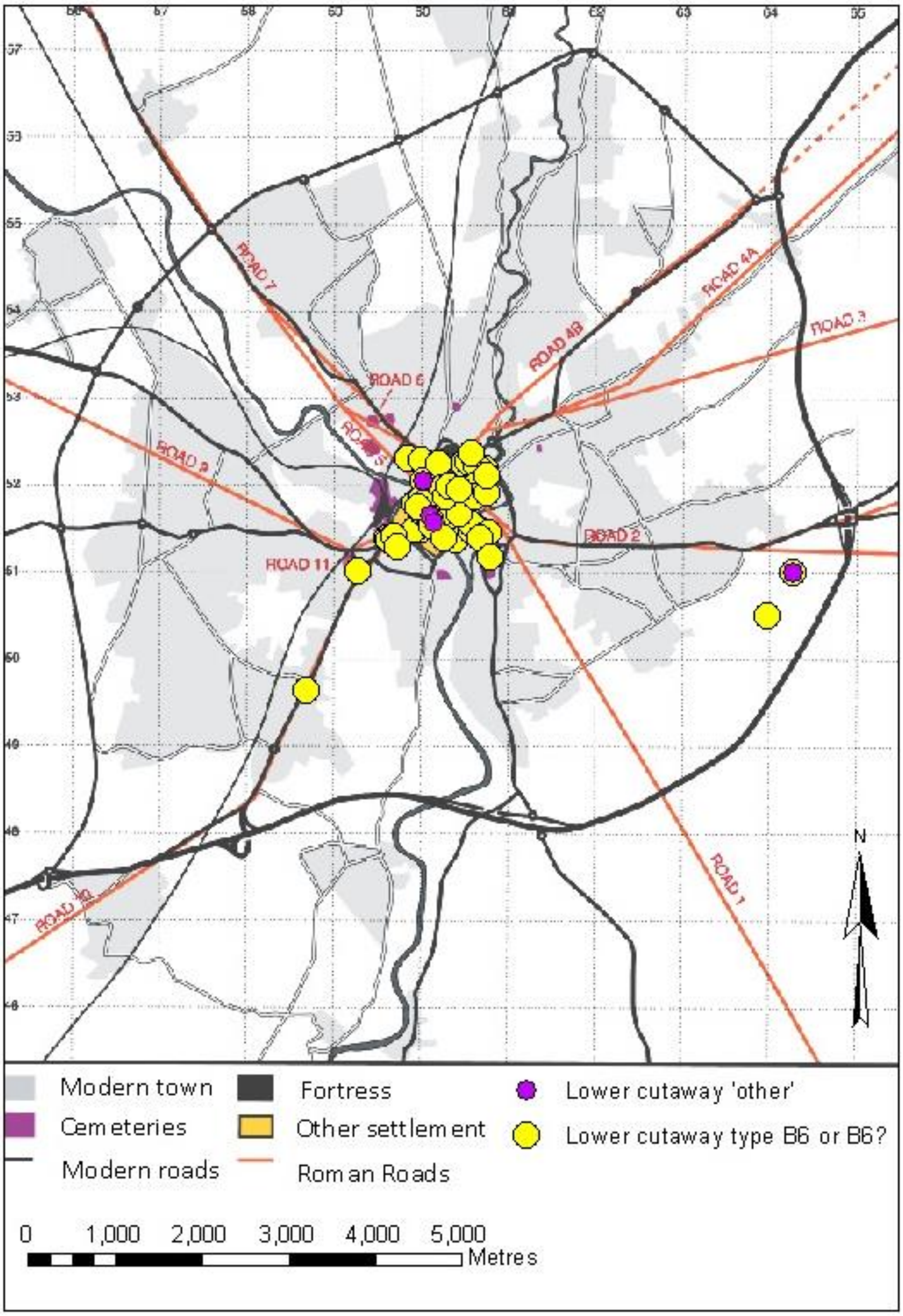


Figure 68. Location of lower cutaways Types B6 and 'other' within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Figure 69. Tegula with either heavy trimming along the arris or an unusual lower cutaway, 1-9 Micklegate Context 6076, ©YAT

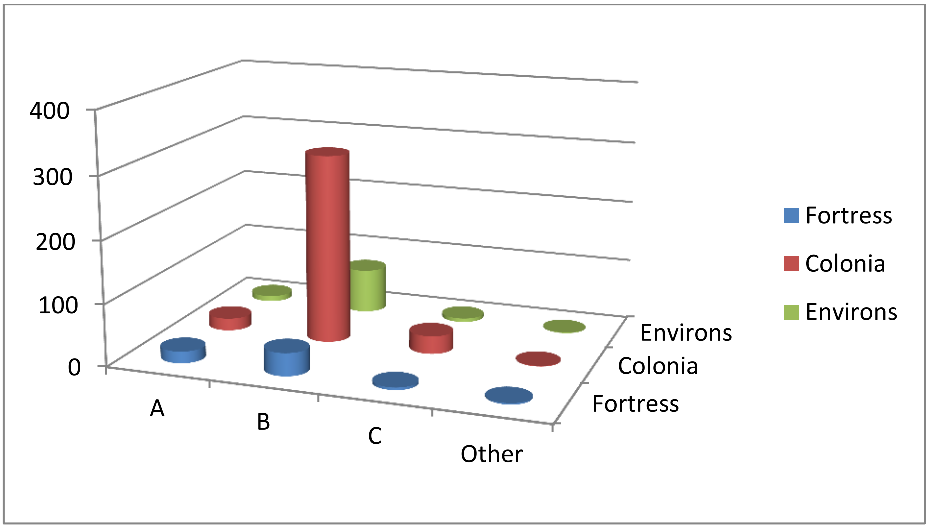


Figure 70. Lower cutaway forms in terms of sherd count in relation to zone

Table 28. Lower cutaways in relation to zone by sherd count				
Cutaway form	Overall	Fortress	*Colonia*	Environs
A2	48	19	20	9
B6 and B62	414	37	305	72
C4 and C5	39	4	29	6
Other	4	2	1	1

Eight of the Group A^{Warry} cutaways from the fortress were in post-Roman contexts at the Site of St Leonard's Hospital, these probably originated as material dumped to raise the fortress rampart, which was disturbed by later medieval activity. The remaining Group A^{Warry} cutaways in the fortress were from the Swinegate/Little Stonegate area, and relate to the legionary bath house, which was constructed by AD 100 (Monaghan 1997, 1061, 1064). The Group A^{Warry} cutaways from the area south-west of the river Ouse were concentrated in the Tanner Row area (24-30 Tanner Row, 5 Rougier Street and Leedhams Garage). The earliest buildings on these sites post-dated AD 120 (Monaghan 1997, 1106-08), and given that the Group A^{Warry} cutaways may pre-date AD 120 (see p226) this may suggest that these tiles were dumped in the area, rather than being related to any structural activity. A sherd from 64-74 Skeldergate in the *colonia* was also dumped, and was related to levelling and terracing on the site (Johnson 2000, 111-12). The only remaining sherd from the *colonia* was from the Ideal Laundry site on Trinity Lane, which was clearly residual, as only late Roman deposits were reached during the excavation, though there was evidence of large scale dumping of building demolition debris on the site (Finlayson 1997, 1019). All nine of the Group A^{Warry} cutaways in the environs were on sites where dumping had taken place prior to the mid-second century, and they were not therefore indicative of early building activity.

The Group B^{Warry} cutaways accounted for 82 percent of the cutaway sherds. Betts (1985, 159, 168) in his survey of tile in York, also noted that the Group B^{Warry} cutaways were the commonest form present, and that these cutaways were associated with the two largest sizes of tegulae (Group A^{Betts} and Group B^{Betts}). The Group A^{Betts} tiles were associated with both Legio IX and Legio VI stamps, while the Group B^{Betts} tiles were only associated with Legio VI stamps, clearly showing that the Group B^{Warry} cutaways were used by both legions. Unfortunately, no Group B^{Warry} cutaways in the present study were associated with legionary stamps, making it impossible to confirm Betts' observation.

Thirty-seven Group B^{Warry} cutaways were present from ten sites in the fortress, four of these sites related to the fortress ramparts, suggesting that the sherds in question represent material dumped to raise ramparts. Eleven Group B^{Warry} cutaways were found in association with the legionary baths at Swinegate. This site yielded Legio IX stamped tegulae, suggesting a tiled roof was present from the outset. A further eleven Group B^{Warry} cutaways were from Little Stonegate, suggesting that a stone barracks block built in the mid-second century (Macnab 2001, 327) had a tiled roof. A Group B^{Warry} cutaway was found at 23 Ogleforth, the site of another barracks of unknown date (Hunter-Mann, 2005, 10). Three Group B^{Warry} cutaways were found at Purey Cust Hospital, which is known to be the site of a Roman building dating to AD 100-125 (Pearson 1986, 17).

In the case of the area south-west of the river Ouse, Group B^{Warry} cutaways were present at a number of sites with buildings of mid-second century and later date: 24-30 Tanner Row (114 examples); Leedhams Garage/Wellington Row (ninety-three examples); 1-9 Micklegate (forty-seven examples); and 5 Rougier Street (twenty-eight examples). At 24-30 Tanner Row, the earliest buildings were of timber, dating to AD 160 or later, though there were later stone buildings at the site (Monaghan 1997, 1106). Detailed stratigraphic analysis would be required to determine which of the buildings present had tiled roofs. The main building at Wellington Row was built c. AD 150 (Monaghan 1997, 1109), and though Ottaway (1993, 74), interpreted this building as having a stone roof, the half a tonne of roofing tile fragments (including the abundant Group B^{Warry} cutaways) from the site would suggest that this building must have had a tile roof at some stage. At 1-9 Micklegate there was a structure dating to c. AD 175, together with two later large-scale structures (Monaghan 1997, 1099, 1102). The quantity of roofing tile at the site indicates that at least one of these buildings had a tiled roof. At 5 Rougier Street there was a building with stone pillars dating to AD 160 or later (Monaghan 1997, 1107), which was associated with abundant tile, suggesting a tile roof was present. The George Hudson Street site, though very small, yielded a hypocausted building dating to the second or third century (McComish 2001, 34), and the presence of a tiled roof in association with such a building might be expected. Two Group B^{Warry} cutaways from the North Street Sewer Chamber site, may relate to a badly robbed out second century riverside wall (Finlayson 1997, 707-8), but equally these could represent dumped material.

In addition to the sites above, there were a number of sites south-west of the river Ouse which produced up to four Group B[Warry] cutaways, but these were not associated with Roman buildings. A sherd from Albion Wharf probably represents dumping (Monaghan 1997, 1127), while four examples from 64-74 Skeldergate probably related to dumping to create terraces on the site (Johnson 2000, 111-12). Three sherds from the Ideal Laundry site on Trinity Lane were resultant from the dumping of building demolition deposits (Finlayson 1997, 1019), though earlier Roman buildings are known on this site (RCHM 1962, 52). Sherds from the City Mills on Skeldergate (Finlayson 1997, 851) and Trinity Lane Car Park both occurred residually in deposits of medieval date (Kemp 1981, 4).

The only site in the environs to have yielded a significant number of Group B[Warry] cutaways was the Heslington East site, with twenty-one examples suggesting a tiled roof was present at the site. Group B[Warry] cutaways were present on a number of other sites with Roman buildings in the environs, but the number of examples at each site was so low it is unclear if the roofs of the buildings were tiled or not. The buildings in question were an undated building at the Parliament Street Sewer (Brinklow et al. 1986, 30), an undated building at land off St Andrewgate (Finlayson 1997, 881), a stone building dating to AD 160 or later at 16-22 Coppergate (Monaghan 1997, 1077), and a stone building of late second century date at 42-50 Tadcaster Road, Dringhouses (Ottaway 2011, 352). Unfortunately, for each of these sites it was not possible to examine the total volume of roofing tile to determine if this was indicative of tiled roofs; the Parliament Street work was a watching brief so did not generate much tile (Brinklow 1986, 29); the excavation at St Andrewgate only reached twelfth century levels, though Roman deposits were observed in other works at the site (Finlayson 1997, 881); in the case of 16-22 Coppergate most of the tile was transferred to the Yorkshire Museum many years ago and has not formed part of the present study; while the 42-50 Tadcaster Road site had been severely truncated in the 1960s removing most of the material evidence from the site (Ottaway 2011, 353).

Numerous other sites in the environs each produced up to three Group B[Warry] cutaways, and many of these sites were associated with dumping, as at numbers 14-

20, 16-20, 28-40 and 35-41 Blossom Street (see p399), numbers 38/41/50 Piccadilly and Adams Hydraulics (see p416-7 and p429), County Hospital Fossgate (Finlayson 1997, 448), Jewbury (Finlayson 1997, 446), 2 Clifford Street (Johnson 1999, 23), 2 St Maurice's Road (Lilley 1992b, 22), and 26-28 Marygate (Finlayson 1997, 567-8). Other Group B^{Warry} cutaways were from sites where the Roman deposits were of a non-structural nature, as at 28-29 High Ousegate (Macnab and McComish, 2004), George Street/Margaret Street Car Park (Macnab 1998, 36), and the Mount School (Evans 2003, 6). Fawcett Street (Mason 2003, 16) yielded plough soils of Roman date. There were also sites where the Roman tile occurred residually in contexts of later date, as at land adjacent to the Female Prison of York Castle (Evans 1998, 29), St Wilfrid's School Monkgate (Finlayson 1997, 627) and 1-2 Tower Street (Finlayson 1997, 1104-5). The Roman deposits encountered on the Training Excavation in St Marys Abbey probably related originally to layers of Roman dumping and cobble surfaces (Kendall 2005, 59).

The Group C^{Warry} cutaways account for 8 percent of the total number of lower cutaways, and were almost entirely from the *colonia* and the environs rather than from the fortress. Only four examples were present in the fortress, three from the site of the legionary baths at 12-18 Swinegate, while the fourth example occurred residually in a post-Roman context at the St Leonard's Hospital site.

In the *colonia* Group C^{Warry} cutaways were present at 24-30 Tanner Row, 1-9 Micklegate and Leedhams Garage/Wellington Row in sufficient quantity to suggest the presence of tiled roofs; significant buildings were constructed at all three sites between the mid-late second century and early third century, to which these tiles could have related (Monaghan 1997, 1102, 1106, 1108-9). The single Group C^{Warry} cutaway seen at the Ideal Laundry site on Trinity Lane in the *colonia* was residual (Finlayson 1997, 1019). The sites with Group C^{Warry} cutaways in the environs were either associated with dumping, 14-20 Blossom Street (see p399), and 26-28 Marygate (see p439), or in the case of 28-29 High Ousegate were from Roman deposits of a non-structural nature (Macnab and McComish, 2004).

None of the Group C$^{\text{Warry}}$ cutaways in the study had legionary stamps, due to the fragmentary nature of the tile examined. Betts (1985, 159, 170) survey of York noted that the Group C$^{\text{Warry}}$ cutaways were associated with the smallest size of tegulae in York (Group C$^{\text{Betts}}$). Betts interpreted these small tegulae as being of Legio VI manufacture on the basis of similarly sized stamped examples from York Minster, but raised the possibility that some of the smaller tegulae may be of civilian manufacture,

No Group D$^{\text{Warry}}$ cutaways were seen in the present study. Although beyond the scope of the present study, the author has examined the collections of Roman tile at York Minster, which also lack Group D$^{\text{Warry}}$ cutaways. Four of the tegulae had non-standard lower cutaways, and although the number of sherds was small, these were all thin (Figure 5), which might suggest that they are of later Roman date.

A comparison of lower cutaways in relation to tegula thickness (Table 29) showed that the Group A$^{\text{Warry}}$ cutaways were on average the thickest, followed by Group B$^{\text{Warry}}$, then Group C$^{\text{Warry}}$, with the small number of non-standard forms being the thinnest. If this reduction in thickness is a reflection of the decreasing size of tegulae over time, which has been noted in other studies (Betts 1985, 172; Warry 2006, 56), then it would imply that the Group A$^{\text{Warry}}$ cutaways are the earliest form, and the Group C$^{\text{Warry}}$ cutaways together with the non-standard cutaways are of a later Roman date. Table 29 shows that the range of thicknesses was far greater for Group B$^{\text{Warry}}$ cutaways than for any other group, but this is probably just a reflection of the greater number of Group B$^{\text{Warry}}$ cutaways present.

Table 29. Lower cutaway forms in relation to tegulae thickness

Cutaway form	Number of examples	Thickness range in mm	Average thickness in mm
A2	28	20-41	31
B6/B62	303	11-47	25
C4/C5	35	18-34	23
Other	3	20-25	22

A comparison of flange-heights in relation to cutaway forms (Table 30, Figure 71) showed that the Group A$^{\text{Warry}}$ cutaways had the largest flanges on average, followed by Group B$^{\text{Warry}}$ and the small number of non-standard forms, then the Group C$^{\text{Warry}}$

cutaways. Assuming that flange height was in relation to overall tegula size, this suggests that Group A^{Warry} tiles were the largest and therefore the earliest, followed by the Group B^{Warry} tiles, with the Group C^{Warry} tiles being the most recent.

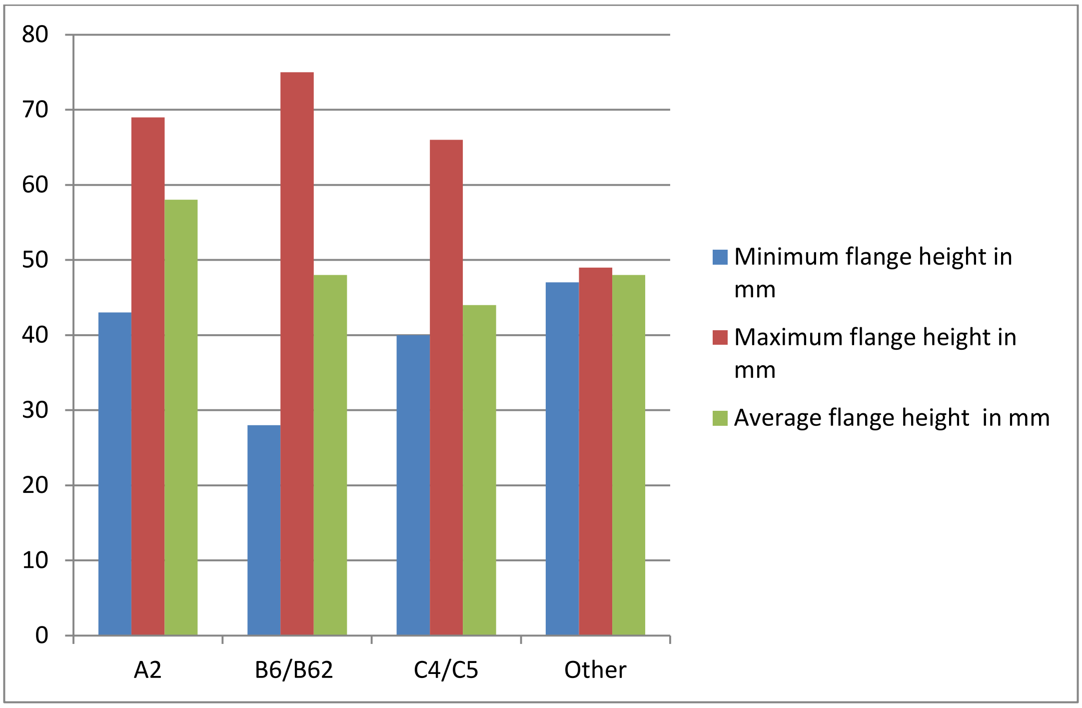


Figure 71. Minimum, maximum and average thickness of flange-heights in mm in relation to lower cutaway forms

Table 30. Lower cutaways in relation to flange height			
Cutaway form	Number of examples	Flange height range in mm	Average flange height in mm
A2	24	43-69	58
B6/B62	256	28-75	48
C4/C5	31	40-55	44
Other	2	47-49	48

Lower cutaways were present in fabrics R1-R3, R5-R12, R14-R15 and R17 (Table 31). The lack of examples in fabrics R4, R13 and R18-R19 is a reflection of the rarity of these fabrics. All of the lower cutaway forms were present on numerous fabrics, the only exceptions being types B62^{Warry} and 'Other', though this probably reflects the rarity of these types of cutaway. Group B^{Warry} cutaways clearly dominate irrespective of fabric. There is an association between Group A^{Warry} cutaways and fabric R9, and C^{Warry}

cutaways and fabric R10. Given that tile dimensions suggest that the Group A$^{\text{Warry}}$ cutaways are earlier than the C$^{\text{Warry}}$ cutaways (see p 235-6) this would suggest that fabric R9 is earlier than fabric R10.

Table 31. Lower cutaway types by sherd count in relation to fabric

Fabric	Overall	A2	B6	B62	C4	C5	Other
R0	2		2				
R1	18		16		2		
R2	14	4	9		1		
R3	28	1	26			1	
R5	13		12		1		
R6	36	2	29		2	3	
R7	2	1	1				
R8	7	1	4			2	
R9	171	31	132	2		3	3
R10	112	2	94		1	14	1
R11	73	4	64		2	3	
R12	1		1				
R14	2	1	1				
R15	21		17			4	
R17	3		3				

Features relating to manufacture were seen on a number of the tegulae in the present study. Finger or thumb prints were recorded on six tegulae resulting from the tiles being lifted while wet. Three tegulae had incised lines on the surface of uncertain function, while one had three stab marks on the upper surface. Finger drawn smoothing lines were present on two examples, one of which was in the form of wavy lines. Three sherds of possible tegulae had incised keying lines in a diamond pattern on the base, which is an unusual feature. Two tegulae had knife trimming on the edge of a flange.

Eighteen of the tegulae in the present study were pierced by nail-holes, representing 0.1 percent of the total volume of tegulae examined. The rarity of nail-holes within the present study confirms the picture previously seen in York, where few nail-holes were observed and those recorded were on Group C$^{\text{Betts}}$ tegulae (Betts 1985, 163-4). Only one tegula with both a nail-hole and a complete breadth was present in the current study, the breadth of the tegula was 322mm placing it in Group C$^{\text{Betts}}$. The tile was in a deposit of fourth century date.

The nail-holes in the present study ranged from 6-11mm in size with an average size of 8mm, and this is comparable to the 9-10mm diameter range recorded as typical for York by Betts (1985, 164). Most of the nail-holes in the present study were pressed through while the clay was still wet, but four had been chipped out after the tile was fired. The fragmentary nature of the examples in the present study makes it impossible to determine the original position of the nail-holes on the tegula. On the only example with both a nail-hole and a surviving breadth, the hole was placed centrally at the top of the tile, which is the usual position (Brodribb 1989, 10). It has been suggested that the military mortared tegulae into place rather than nailing them (Warry 2006, 103), and although there are few examples in the present study they would seem to confirm this observation, with no nail-holes being found in the fortress, twelve being from the *colonia* and six from the environs. There was also one sherd with three small holes or stab marks on the upper surface, only one of which fully penetrated the thickness of the tile (Figure 72); the function of these holes is uncertain, but they occurred near the top corner of the tile, two in the position of the upper cut away, which may suggest that they were intended as nail-holes.

Figure 72. Front and reverse of tegula with holes, some of which are blind, George Hudson Street, Context 1067, © YAT

An analysis of complete tegulae in Britain in 1979 showed that 71 percent had a signature of which 41 percent had concentric arcs, with the remainder being of more complex design (Brodribb 1979b, 215-7). In York 88 percent of the Group A$^{\text{Betts}}$ tegulae, 54 percent of the Group B[Betts] tegulae and all of the Group C[Betts] tegulae recorded by Betts (1985, 197) had signatures, while Warry (2006, 90) stated that 80 percent of the complete tegulae he recorded had signatures. In contrast, only sixty-four tegulae in the present study had signatures, representing 0.3 percent of the total volume of tegulae examined; this is because the present study comprises highly fragmented material, whereas the other three studies concentrated upon complete tiles.

Twenty signatures in the present study were illegible, but the remainder were in designs 1, 2, 2a, 3, 4, 5 and 8 as defined by Betts (1985, 192-4). The dominant forms were semi-circular (designs 1, 2, 2a, 3 and 4) in keeping with the pattern observed nationally. There were too few examples of any given signature to enable meaningful comparisons of signature to fabric or zone (Table 32). One of the Type 1 signatures in the present study was positioned near the flange at the base of the tile, which is unusual, as signatures were normally position centrally at the basal end of the tile.

Table 32. Sherd count for signature types on tegulae overall and by zone

Signature type	Overall	Fortress	*Colonia*	Environs
1	13		12	1
2	12	3	5	4
2a	2		2	
3	3	1	1	1
4	2	1	1	
5	4	1	2	1
8	1		1	
Other	4		2	2

Five tegulae in the present study had legionary stamps, representing 0.5 percent of the total volume of tegulae by weight. One of the stamps was illegible, but two related to the Legio IX and were matched to the national typology as 2463.12 and possibly 2462.9, and the remaining two related to the Legio VI being identified as types 2460.39 and possibly 2460.21, all of which have been previously recorded in York (Collingwood and Wright 1992, 152-173). One of the legionary stamps was from the fortress, but four were in the *colonia*, showing that military produced tegulae found their way into civilian sites. Too few legionary stamps were present to enable any meaningful comparisons with fabric or zone. No graffiti were present on the tegulae in the study.

A number of the tegulae had marks on the upper surfaces resultant from animals or humans walking across the tegulae while they were drying, these included three smudged paw prints, seventeen dog's paw prints, one goat hoof print, one unidentified hoof print and seven hob-nail boot prints. Thirty tegulae had rain marks on the upper surface, and a further two had hail-stone marks, showing that some tegulae were dried in the open air.

Two tegulae had glaze on the surface. The first of these, with a speck of what appeared to be glaze, was from a levelling deposit associated with mid-third century pottery at the Adams Hydraulics site in the environs (Context 11032); this deposit probably represents clearing out of kiln waste from the legionary kilns at Peasholme Green. The second tegula with glaze was from the Leedhams site at Wellington Row, and had an area of clear glaze 40x30mm in size adjacent to the flange. This sherd was in a dump or build-up deposit dating to AD 388 or later (Figure 73). Glaze is not normally associated with Roman ceramics, but given that both sherds were within Roman contexts the presence of glaze cannot be explained as re-use in the medieval period, it is unclear therefore why these sherds are glazed.

Figure 73. Tegula with glaze from Leedhams Garage, Context 71852, ©YAT

Twelve tegulae had reduced cores. A small number of tegulae (fifty-seven examples) were overfired, while one tegula was underfired. The low number of over- or under-fired examples shows that the tegulae were carefully manufactured.

Tegulae were present in all fabrics showing that they were a routine part of production, and the weight in each fabric together with the associated sherd count is given in Table 33.

Table 33. Total weight in grams of tegulae in relation to fabric, with the associated sherd count		
Fabric	Weight in grams	Sherd count
R0	5600	17
R1	67683	254
R2	106180	296
R3	89101	356
R4	50	1
R5	39031	156
R6	94042	286
R7	12260	50
R8	58690	172
R9	487964	1632
R10	327061	968
R11	252490	632
R12	4870	15
R13	1075	2
R14	20970	54
R15	50762	163
R16	4425	14
R17	7640	17
R18	2150	7
R19	250	1
R99	3835	8

4.1.17 Tegula mammata

Tegula mammata are tiles with clay nibs on one face. It is possible that such tiles developed as a response to the problems of damp. Their use was recommended by Vitruvius in his chapter devoted to the insulation of facings in damp places, and the basement rooms of the house of Livy and the *domus Tiberiana,* on the Palatine in Rome, have walls lined with tegulae mammatae, possibly to counter rising damp (Adam 1994, 269).

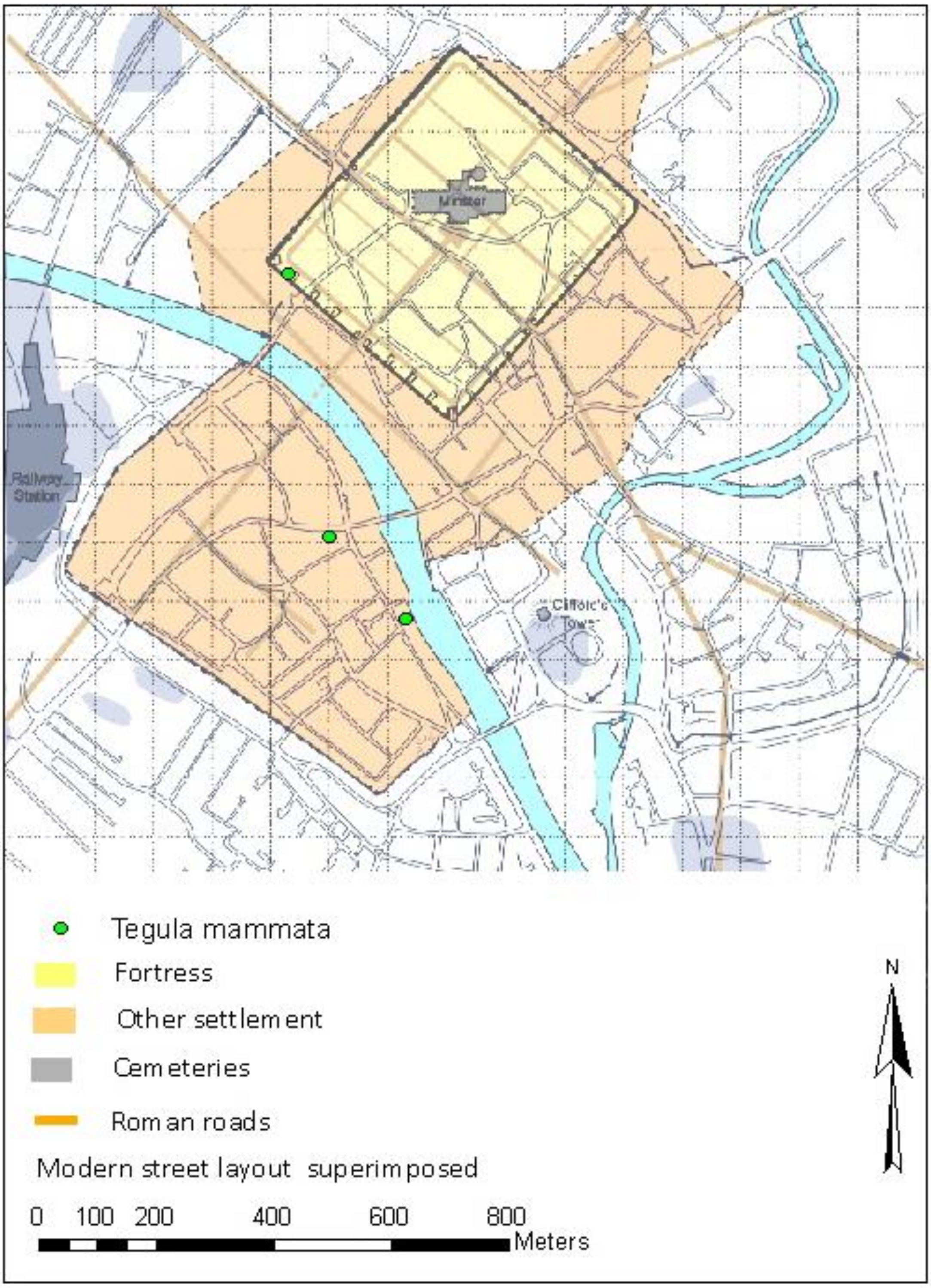


Figure 74. The location of tegula mammata within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Such tiles are rarely seen *in situ*, at Beauport Park tegula mammatae were used in the floor with the mammatae facing down to anchor the tile into the mortar below (Brodribb 1979a, 146). It has also been suggested that tegula mammata could have been used in kilns to provide space for air to circulate during the firing process (Brodribb 1979a, 147). The tegulae mammata were manufactured in the same way as other bricks, with the mammatae being pressed onto the upper smoothed surface.

Four examples of tiles with mammatae were present in the current study (Figure 74), accounting for 0.034 percent of the total volume of tile. Brodribb recorded tegula mammata at fifty sites across Britain, though most were in the south-east, and noted two types. The first, Type A, had round shallow mammatae with an average diameter of 44mm and average height of 17mm, and these were interpreted as keying aids for tiles to be set into floors, while Type B had conical mammatae with basal diameters averaging 57mm, and heights averaging 60mm, which were interpreted as tiles designed to provide a lining for the interior elevation of walls, thereby creating a cavity wall (Brodribb 1989, 62). Unfortunately all the mammatae had been broken off the tiles in the present study, making it impossible to link the sherds to Brodribb's types. The examples were a sherd in fabric R6 from the *colonia* which was 14mm thick, one from the fortress in fabric R11 which was 36mm thick, one in fabric R14 from the fortress which was 27mm thick and one in fabric R15 from the *colonia* which was 25mm thick. Too few examples were present to compare the surviving dimensions to either fabrics or location.

4.1.18 Tessera

Tesserae are small square or rectangular pieces of differing coloured stone, tile or glass, used in mosaic floors. The earliest forms of mosaics, *lithostroton*, were made in Greece using differently coloured pebbles, and floors of this type date from the sixth century to the third century BC (Johnson 1995, 5: Adam 1994, 233). One of the finest extant examples of such a floor is the Scylla Mosaic in the House of Dionysos in Paphos, Cyprus, dating to the late fourth to early third century BC (Daszewski and Michaelides 1988, 16-8). At the end of the fourth century BC it was realised that splitting pebbles in half meant a flatter surface could be achieved for the flooring, and this subsequently developed into the shaping of various materials into cubes, *tesserae*, for use in floors (Adam 1994, 233). There were three kinds of mosaic flooring made of tesserae, *opus tessellatum* comprising simple geometric patterns, elaborate patterns called *opus musivium*, and the finest quality were *opus vermiculatum* which were made using exceptionally small tesserae that were of sufficient quality to imitate paintings, this was usually only used for the small central panels of floors, the *emblemata* (Johnson 1995, 8; Adam 1994, 234).

In order to achieve the various colours in mosaics different types of stone were used, giving a typical palette of colours of white, cream, grey, black, pink and brown, while tile was used for reds and oranges, and glass could be used where blues and greens were required, such as in a peacock's tail depicted at Bignor (Johnson 1995, 10). A wide range of locally available materials could be used in any given mosaic, as in a site at 15-23 Southwark Street, London, which had tesserae in white clunch, tile, buff coloured pottery, greensand stone and glass (Cowan 1992, 152), together with stone originally identified as Wealden shale but later re-identified as Kimmeridge cementstone (I. Betts pers. comm.). Simpler tessellated floors used a more limited palette, as at Piddington villa, where tile and limestone tesserae were used to provide contrasting colours (Ward 1999, 45). The size of tesserae varied dependent upon the quality of the floor, with examples from mosaics in Britain ranging from 4-12.5mm square in size, while those in coarser tessellated pavements ranged from 12-38mm in size, and they were often somewhat irregular in shape, as noted at Piddington villa (Ward 1999, 45).

Mosaic and tessellated pavements have been found at several sites in York and its environs. Within the fortress Drake, writing in 1736, recorded that a tessellated pavement had been found in the Bedern area (RCHM 1962, 43). In the environs of the fortress a tessellated pavement was found in 1813 at Clifton Grove to the north-west of the fortress, while a second tessellated pavement was found at St Maurice's Road north-east of the fortress (RCHM 1962, 65), and both a mosaic and tessellated floor were present at 21-33 Aldwark to the south-east of the fortress (Brinklow et. al. 1986, 35). Mosaic pavements are known from three sites in the *colonia*, one close to

Micklegate bar, and two sites at Toft Green (RCHM 1962, 53, 57). Several sites around the *colonia* have yielded evidence of mosaics. A mosaic pavement was found in 1871 near the entrance of St Mary Castlegate (RCHM 1962, 59). A fragment of a tessellated pavement was found in a Roman dump to the north-west of the *colonia*, at the approaches to Scarborough Bridge (RCHM 1962, 63), which may have originated from a nearby building. A mosaic pavement was found in Acomb 2km west of the *colonia* in the nineteenth century (RCHM 1962, 64), and a tessellated pavement was found in the mid-nineteenth century at the junction of Cherry Street and Clementhorpe to the south-west of the *colonia* (RCHM 1962, 62), while a mosaic was unearthed at the same site in the 1970s (Brinklow et al. 1986, 59-60).

There were eighty-eight tesserae in the present study, representing 0.02 percent of the total volume of tile recorded. Only one of the tesserae was from the fortress, twelve were from the *colonia* and seventy-five were from the environs, largely to the south-east of the fortress (Figure 75). Three of the tesserae were from the sites of baths, the first from 12-18 Swinegate was associated with the legionary baths, while the second from Station Rise would have originated from the large public baths in the *colonia*, and the third sherd was from a baths at 1-9 Micklegate. The presence of a tessellated pavement in such contexts is unsurprising, given that baths were elaborate buildings.

The sites in the *colonia* with tesserae included a small site (just 2.3m square) at George Hudson Street, and the presence of a tessera is suggestive of a tessellated pavement in association with a hypocaust excavated at the site. A single tessera at the North Street Sewage Discharge Chamber is the result of dumping behind a riverside wall. Two tesserae were recovered from the large excavations at Leedhams, but the small number of examples present is not suggestive of a tessellated floor, given the size of the excavations. The six tesserae from 58-9 Skeldergate were all found in the backfill of a well, which contained abundant building demolition material, implying dumping from high status buildings nearby.

Two excavations in the environs each produced large numbers of tesserae, 21-33 Aldwark (twenty-eight examples), and 2 St Maurice's Road (thirty-five examples). At

21-33 Aldwark there was a tessellated floor, which comprised a polychrome panel and a chequerboard design, in what had been a corridor of a Roman building, this building also contained a mosaic (Brinklow et. al. 1986, 35). The St Maurice's Road sherds probably originated from a tessellated pavement found on the site in 1911, which measured 1.5m by 1m in size and was made from coarse red tesserae twenty-five millimetres square (RCHM 1962, 65).

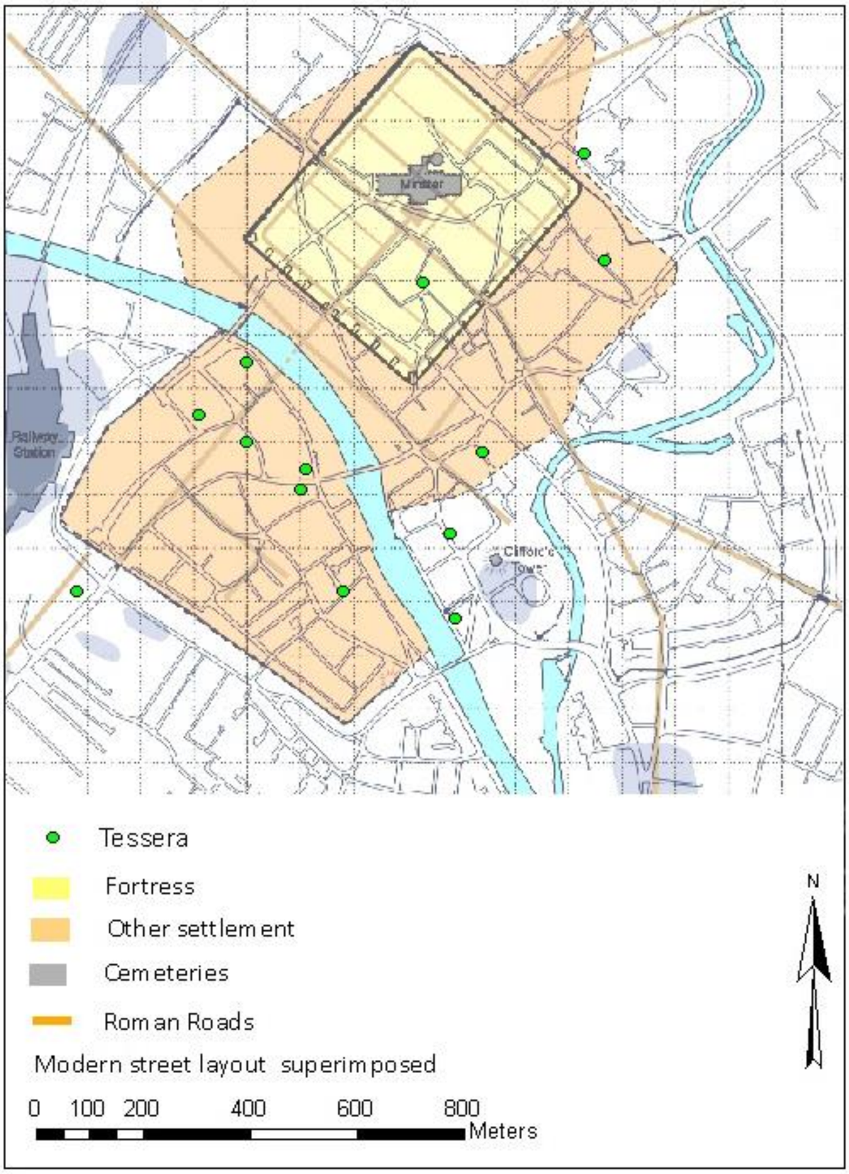


Figure 75. The location of tesserae within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Three other sites in the area between the fortress and the rivers Ouse and Foss produced tesserae, but none in sufficient quantity to indicate tessellated floors in the area, suggesting that the sherds are the result of casual loss or dumping, the sites were 16-22 Coppergate, 1-2 Tower Street and 23 Clifford Street. The site at 16-20 Blossom Street, south-west of the *colonia*, is known to have been extensively used for dumping and tesserae on the site are not indicative of flooring nearby.

The tesserae in the present study ranged from 17-38mm in length, with an average length of 26mm (eighty-four examples), the breadths ranged from 12-31mm with an average breadth of 23mm (eighty-four examples), while the thicknesses ranged from 13-27mm with an average thickness of 18mm (eighty-six examples). The size coupled with the slightly irregular shape of many of the sherds suggests that they were from tessellated pavements rather than mosaics.

The tesserae were in eight differing fabrics (Table 34) with the fabrics of four being uncertain. The number of examples in any given fabric in relation to zone was too small for any statistical analysis.

Table 34. Sherd count for tesserae in relation to fabric

Fabric and form	Overall	Fortress	*Colonia*	Environs
R1	5		1	4
R2	1			1
R3	5		1	4
R6	4			4
R9	15		3	12
R10	20		3	17
R11	31		3	28
R14	1			1

4.1.19 Voussoir (Solid)

Voussoir bricks tapered lengthways and were used to form an arch. It should be noted that arches can be made of any type of rectangular brick with tapering mortar joints being used to create the arch. A national survey of Roman tiles recorded sixty-two solid voussoirs from twenty sites across Britain, and these ranged in size from 150x300mm to 400x400mm, the largest at 465mm in length being from Ribchester; 16

percent of the voussoirs recorded had signatures and three stamped examples were present (Brodribb 1989, 44-45). Previously recorded examples from York had no standard size, but averaged 295mm in length, 29mm in width and 30-50mm in thickness (Betts 1985, 180).

There were four solid voussoirs in the present survey (Figure 76) all from the central area of the study zone, accounting for 0.063 percent of the total volume of tile. One example in fabric R1 was from Hungate to the south-east of the fortress and this was up to 75mm thick, the second from the site of St Leonard’s hospital in the fortress, was in fabric R9 and was 39-53mm thick, the third from Wellington Row in the *colonia* was in fabric R11 and was 150mm long, 130mm broad and 32-45mm thick, while the fourth in fabric R15 from 26-28 Marygate, to the north-east of the fortress, was 25-34mm thick. The only complete example from the present study (from Wellington Row) was smaller than the average size recorded by Betts, but given that there was no standard size for such bricks this is hardly surprising. No features relating to manufacture were present due to the small number of tiles and their fragmentary nature.

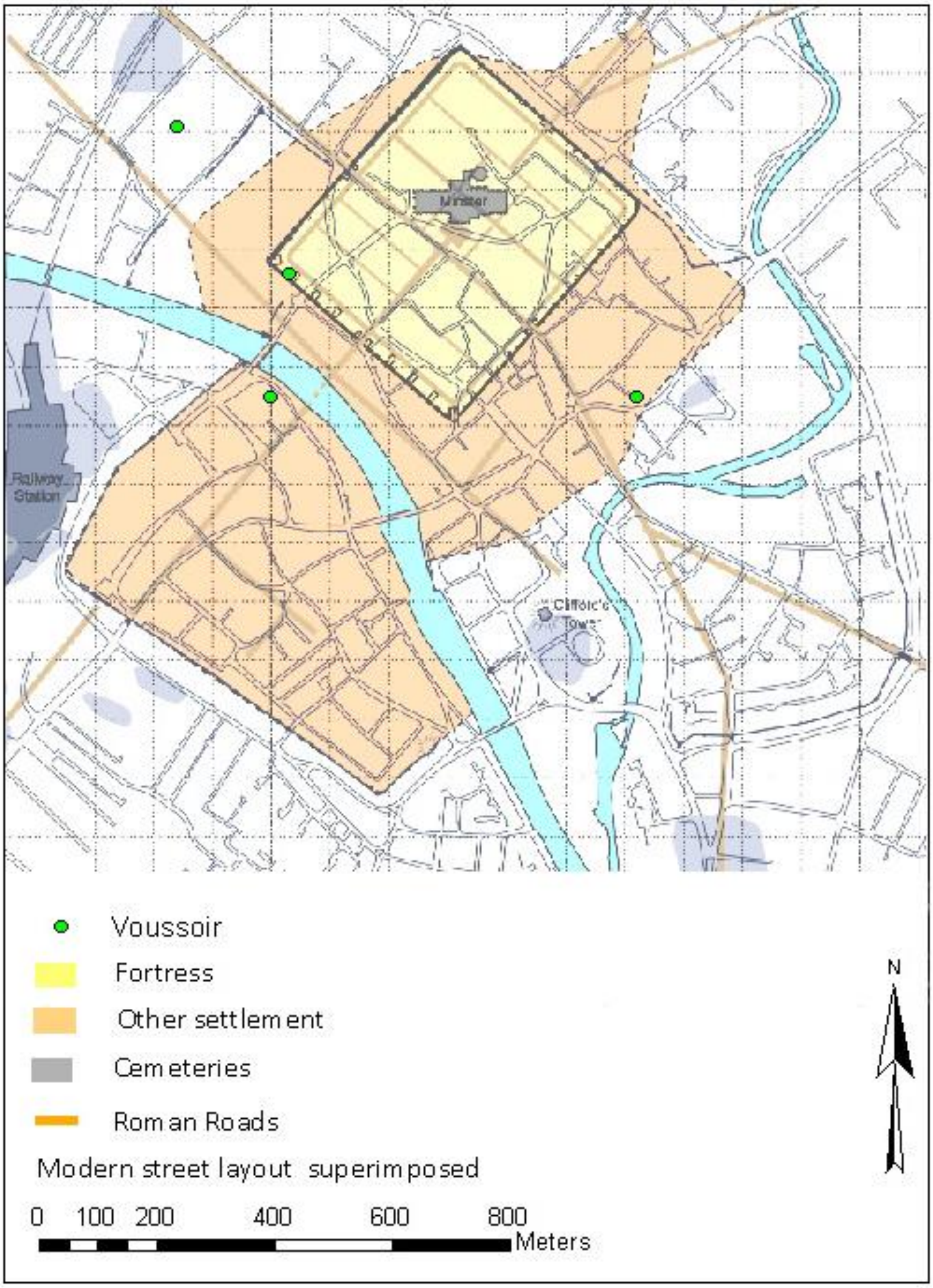


Figure 76. The location of voussoirs within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

4.1.20 Voussoir (hollow)

Hollow voussoirs, *tubuli cuneati* (Mason 1990, 217), resemble box flue tiles but as they were designed to be used in vaulted roofs two of the sides of the tile are open, rather than the top and base as with box flues (Brodribb 1989, 78). Hollow voussoirs could have been used to allow hot air to circulate through vaulted bath-house roofs, thus increasing the efficiency of the system and reducing fuel consumption, but equally they could have been used to reduce the weight of a roof (Williams 1971, 184).

Nationally such tiles are rare, though examples are known from baths at Silchester, Godmanchester, Reculver, Binscombe, Petersfield and Darneth (Williams 1971, 184). No hollow voussoirs were seen by Betts (1985) in his survey of tiles from York, though a Legio IX stamped example from the Roman baths on St Sampson's Square, York, was found in 1931, and a second example, also stamped Legio IX, was found in 1955 (Collingwood and Wright 1992, 171 and 173). No examples of this form were recorded in the present study.

4.2 Chronological variations in tile

Virtually none of the tile in the present study originated from *in situ* structures. A search was made of the YAT gazetteer to determine which sites had masonry/tile structures present, and the archives for these sites were then examined to determine the date of the structures in question, but most of the sites proved to be problematic. In the case of the B.H.S. site, Feasegate, (site code 1981.2) none of the tile bonding courses seen within the fortress walling were sampled. No pottery was found in association with an *in situ* hypocaust pilae seen in repairs to the Swinegate Roman sewer (site code 1990.20) preventing the close dating of the structure. The site of the Former Presto Supermarket on George Hudson Street (Site code 817) had a tile wall and floor, but these were not closely dated, only being classed as second or third century in date. The site at 12-18 Swinegate yielded a bessales in a flue structure, but the archive report does not have detailed pottery dating available. At the St Anthony's Hall site (site code 5007) there was an upside down imbrex used as a drain (G. Dean, pers. comm.), while at the Heslington East excavations (site codes HE08, HE09, HE10 and HE11) there were the remains of an *in situ* hypocaust, but for both these sites the post-excavation work was insufficiently complete at the time of writing for detailed pottery dating and/or phasing to be available. The only two sites with closely dated *in situ* remains were 28-40 Blossom Street (site code 5244) and 1-9 Micklegate (site code 1988.17). At 28-40 Blossom Street there was a small group of underfired bricks used as post-packing which dated to A.D. 200-280, but these bricks were a non-standard form of tile and therefore contribute little to the question of tile dimensions in relation to chronology. At 1-9 Micklegate there was a group of rectangular bricks acting as bonding within a limestone drain, but again these were of non-standard sizes. Clearly, there are insufficient closely dated *in situ* tiles to enable any analysis of chronological change in relation to dated buildings, and in the absence of such evidence analysis focussed on tile size and the presence of nail-holes.

4.2.1 Tile size

The analysis of chronological change to the sizes of tile was undertaken using the sites selected for detailed stratigraphical analysis (see Appendices 8-13). Only three forms, flue, imbrex and tegula, had sufficient numbers of phased sherds to enable any analysis of changes to dimensions over time (Table 35 with the associated sherd count on Table 36), and these forms could only be analysed in terms of thickness, as there were insufficient length and breadth measurements present to enable any analysis. As can be seen from Table 36 the sherd counts for thickness measurements were low in some cases, making any conclusions tentative. In the case of the flue tiles (Figure 77) the examples from the fortress are consistently the thickest, followed by the colonia then the environs, irrespective of phase. The thickness of the flue tiles overall was constant over time (Figure 80). No clear pattern was seen comparing the thickness of imbrex or tegula to zone over time (Figure 78-9), but overall imbrices did show a slight reduction in thickness over time, and tegulae showed a dramatic reduction in thickness (Figure 80). While the thickness of both tegulae and imbrices clearly reduces over time, there is always sufficient variation in thickness at any given time that thickness alone cannot be used to date individual sherds.

Table 35. Average thicknesses for flue, imbrex and tegula from the sites selected for detailed stratigraphic analysis (Appendices 8-13)				
Date	Zone	Flue	Imbrex	Tegula
AD 71-120	Fortress		20.1	20
	Colonia		20.4	36
	Environs		22	17
	Overall		20.6	33.5
AD 120-200	Fortress	21	16.4	22.5
	Colonia	20	19.4	27.8
	Environs	15.6	18	29.1
	Overall	19.2	18.9	28.2
AD 200-280	Fortress	21	22	21.3
	Colonia	20.3	17.9	26
	Environs	19.3	17.8	25
	Overall	19.7	17.9	25.4
AD 280-410	Fortress		19.4	
	Colonia	19.9	18.1	22.8
	Environs	16.7	18.5	24
	Overall	18.4	18.3	23.2

Table 36. Sherd count for Table 35				
Date	Zone	Flue	Imbrex	Tegula
AD 71-120	Fortress		7	1
	Colonia		12	12
	Environs		4	1
	Overall		23	14
AD 120-200	Fortress	1	8	2
	Colonia	13	126	47
	Environs	11	44	29
	Overall	25	178	78
AD 200-280	Fortress	1	1	3
	Colonia	6	239	84
	Environs	12	131	91
	Overall	19	371	178
AD 280-410	Fortress		5	
	Colonia	37	187	105
	Environs	32	85	55
	Overall	69	277	160

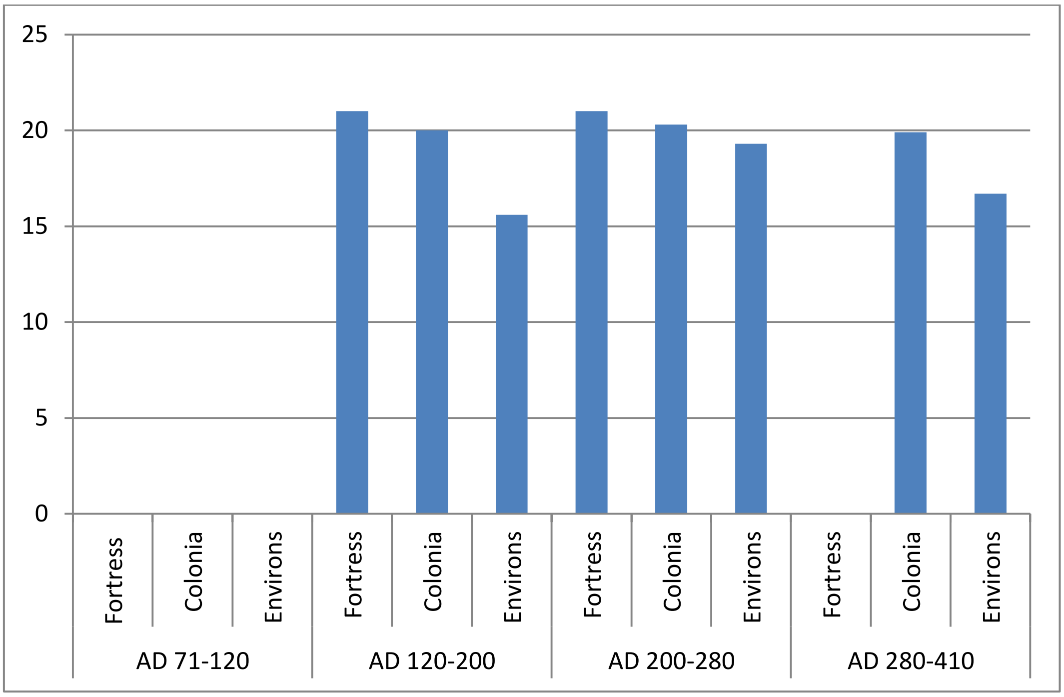


Figure 77. The average thickness of flue tiles in mm in relation to date and zone, for the sites selected for detailed stratigraphic analysis in Appendices 8-13

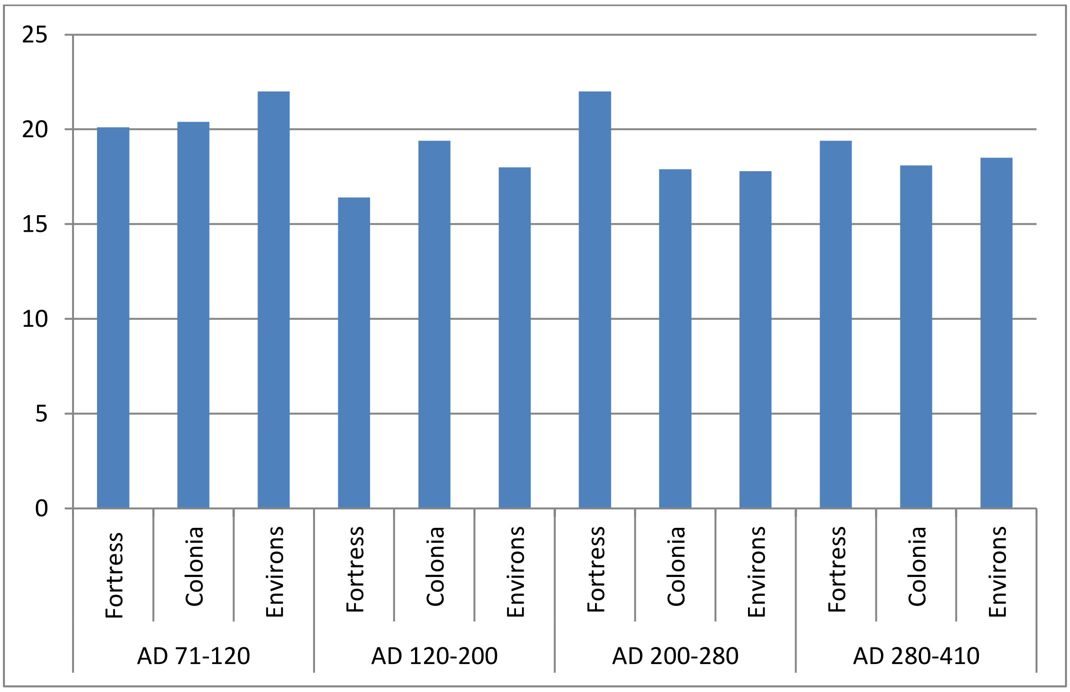


Figure 78. The average thickness of imbrex in mm in relation to date and zone, for the sites selected for detailed stratigraphic analysis in Appendices 8-13

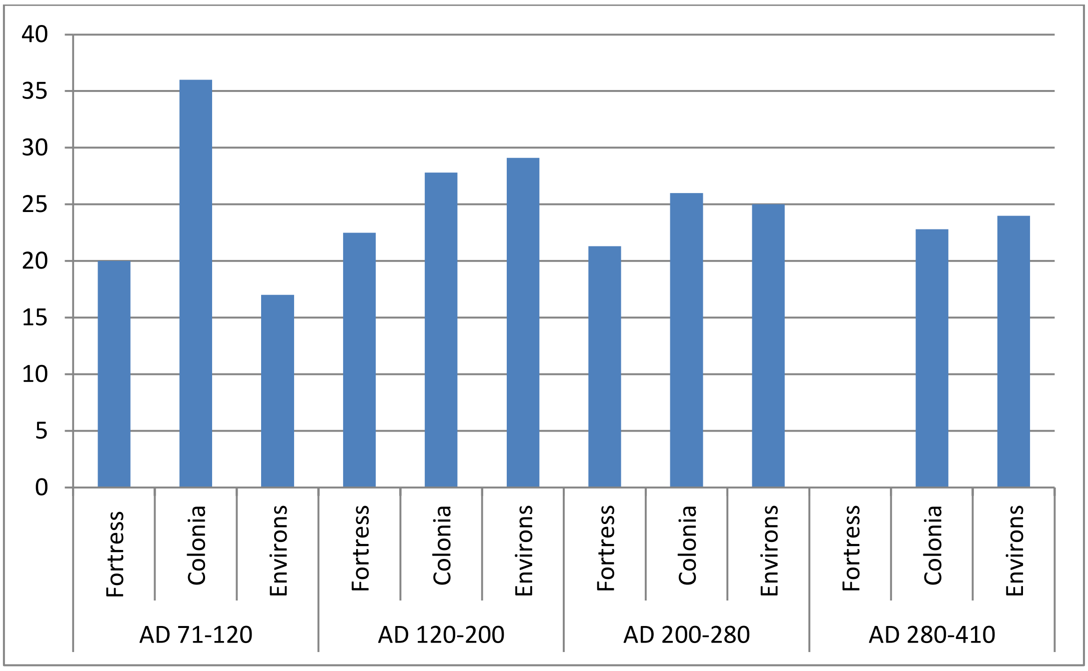


Figure 79. The average thickness of tegula in mm in relation to date and zone, for the sites selected for detailed stratigraphic analysis in Appendices 8-13

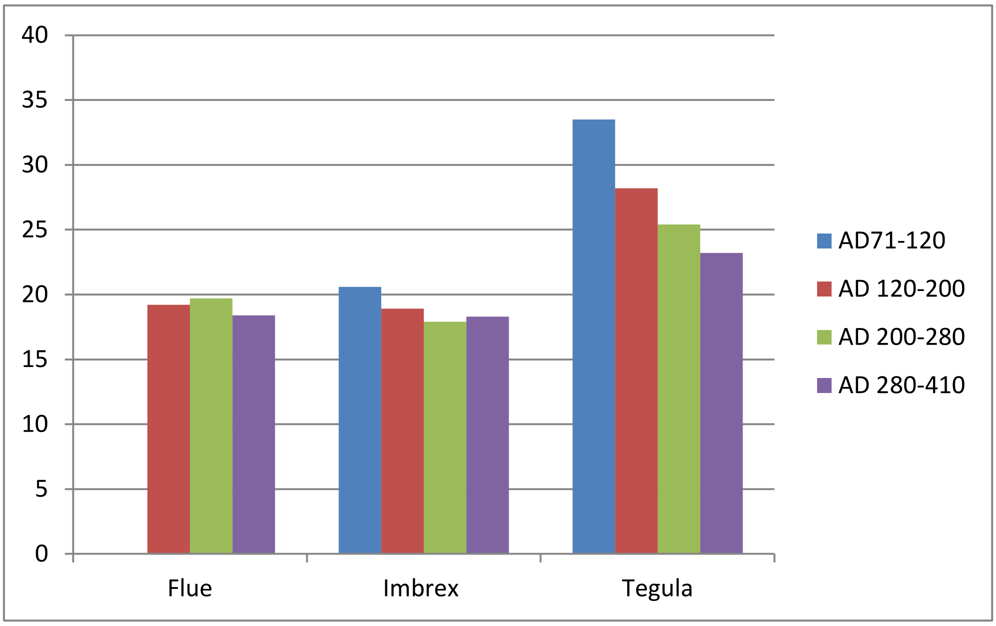


Figure 80. The average thickness of flue, imbrex and tegula in mm in relation to date, for the sites selected for detailed stratigraphic analysis in Appendices 8-13

4.2.2 Tegulae with nail-holes

Although the number of tegulae with nail-holes in the present study is small (Table 37), there is an indication that most of these sherds were of later Roman date. Comparing the average thickness of the tegulae with nail-holes, to the average thickness of phased tegulae, clearly places the tegulae with nail-holes at the thinner end of the spectrum, almost matching the thickness seen in late Roman tegulae.

Table 37. The average thickness of tegulae by date, and the average thickness of tegulae with nail-holes by location and overall; with the associated sherd count

	Average thickness	Sherd count
AD 71-120	33.5	14
AD 120-200	28.2	78
AD 200-280	25.4	178
AD 280-410	23.2	160
1-9 Micklegate	25.3	4
24-30 Tanner Row	21	4
Ideal Laundry, Trinity Lane	22	1
Wellington Row	24	3
Heslington East	20.8	6
Tegulae with nail-holes	22.4	18

Three examples of tegulae with nail-holes were from 24-30 Tanner Row, and these were in contexts of second-third century date, with a fourth sherd occurring residually in a deposit of third-fourth century date (M. Whyman pers. comm.). Two of the tegulae with nail-holes were from Wellington Row and were in deposits dating to AD 280-410 which represented the demolition of an earlier building, suggesting that the tegulae with nail-holes were of late third century date at the very latest. A tegula with a nail-hole which occurred residually in a fourth century pit at 1-9 Micklegate had a Legio VI stamp, and cannot therefore post-date the mid-third century, when the practice of stamping tiles died out. A further four sherds from 1-9 Micklegate and Wellington Row occurred residually in post-Roman contexts. Six tegulae with nail-holes at Heslington East were in context 1046 which was dated as third-fourth century, and contexts 444, 943 and 1063 dated as late fourth century (C. Neal pers. comm.). There is a link between tegulae with nail-holes and fabric, with sixteen of the eighteen sherds occurring on fabrics (R6 and R10-R11) identified as being of second to third century date, and only one being associated with a fabric (R9) interpreted as being of first to second century date (see p318). (The remaining tegulae with a nail-hole was a one off in terms of its fabric and is therefore classed as R99). The site stratigraphy and fabrics suggest that the tegulae with nail-holes were most likely to be of later Roman date, though even at this date they were rare.

4.2.3 The increasing use of stone for roofing and hypocaust pilae

The evidence of the present study, coupled with published data, would seem to suggest that a switch from the use of ceramic roofing tiles, to the use of stone roofing tiles, took place in York from the mid-second to early third centuries. A switch from the use of ceramic to stone hypocaust pilae may also have occurred.

Published data list the following evidence for the use of tile from the late second century onwards: a stone-built mausoleum south-west of the *colonia* at 35-41 Blossom Street, dating to AD 225-250, was interpreted as having had a tile roof (Ottaway 2011, 297, 299-300); a late second to early third century building in Spurriergate/High Ousegate was interpreted as having had a tile roof (RCHM 1962, 59); the two surviving pilae in a baths building dating to c. AD 225 at Bishophill were of tile (Carver et al. 1978, 24, 41-2; Monaghan 1997, 1126); a furnace at this Bishophill site was associated with both Legio IX and Legio VI tiles, though the flue of the furnace had a sandstone roof and it was unclear how this furnace related to the baths on the site as it may have post-dated them (Carver et al. 1978, 39).

In the present study there are structures incorporating tile which date from the late second century. The sites at 1-9 Micklegate, 5 Rougier Street, Wellington Row and 24-30 Tanner Row, all of which had buildings that post-dated AD 160 (Monaghan 1997, 1102, 1106-9), together with a site at George Hudson Street with a building of second or third century date (McComish 2001, 34), each produced sufficiently large quantities tile to suggest that tiled roofs were present. In all of these cases the legionary kilns would still have been in use when these structures were built.

There are a number of Roman stone roofed buildings in York dating from the mid-late second century onwards. At 8 High Ousegate there was a compact layer of thin sandstone roofing slabs from a demolished or collapsed building (Brinklow et al. 1986, 21), although this deposit could not be dated with any precision, nearby stone buildings were dated as late second or early third century (Ottaway 1999, 140). An intra-mural building of mid-second to mid-fourth century date, close to Tower SW5, was associated with scattered thin sandstone slabs, one of which was pierced for use as roofing material (Sumpter and Coll 1977, 77, 88). The use of stone roof tiles was also seen at 21-33 Aldwark, where an *opus signinum* floor of fourth century date lay on a bedding of broken sandstone tiles, implying that a stone roof had been present in the area; in addition, a possible kitchen building at the site was associated with stone roof tiles (Brinklow et al. 1986, 43-44).

Evidence of stone roofing was also seen on sites in the present study. The major building at Wellington Row was substantially altered in the late second to early third centuries, and abundant stone roofing slabs from the site suggest that the building was re-roofed in stone at that time. At 16-22 Coppergate a mid-third century stone building was associated with stone roofing tile (Ottaway 2011, 208), while at the Heslington East site there was a roof of elongated hexagonal stone-tiles, dating to the late fourth century (Dr C. Neal pers. comm.).

The stone tiles used in York are made from micaceous sandstone split along the bedding planes, sourced from the Elland area west of Leeds. Tiles and flooring of this stone were widely distributed across the Vale of York in the Roman period, for example at the Roman villa at Dalton Parlours 21.5km south-west of York which dates to c. AD 200-370 (Wrathmell and Nicholson 1990, 164), reaching as far as the villas at Rudston and Harpham in the East Riding, and Hibaldstow in north Lincolnshire (Carver et al. 1978, 41). Clearly transporting these stone tiles over considerable distances (by water and road) was routine, and did not affect the viability of the stone roofing industry in terms of transport-costs.

Evidence of the use of stone hypocaust pilae in York came from the backfill of a Roman timber-lined well in Skeldergate, which contained three stone hypocaust pilae, together with two sandstone roof slabs, that presumably originated from nearby buildings; these fragments were dumped sometime after the fourth century, but the date of the buildings they came from is unknown (Carver et al. 1978, 24, 41-2). Six complete millstone grit hypocaust pilae were also found at York Minster (Phillips and Heywood 1995, 235).

The data above would suggest that both tile and stone roofs were constructed from the late second/early third centuries to the mid-third century, but from the mid-third century onwards stone roofing dominated. This coincides perfectly with the date at which legionary tile production to the south-east of the fortress stopped. The best example of this change is seen in a succession of four buildings excavated at 18 Blossom Street, the earliest three buildings which were of first, second, and late second century date, had tile roofs, while the fourth building at the site which was of third century date had a stone roof (RCHM 1962, 63). Phillips and Heywood (1995, 40, 198), suggested that the *principia* building was roofed in tile throughout the Roman period, on the basis of both the presence of ceramic tile and the lack of stone tiles (Phillips and Heywood 1995, 40, 198). The presence of abundant stone roof tiles on recent excavations at the Minster casts doubt on this interpretation, with at least part of the *principia* having a stone roof by the later Roman period (I. Milsted pers. comm). Given that there is a fifty to seventy year period when both stone and tile roofs were used, it is unclear if the closure of the kilns was caused by a fall in demand due to the increasing use of stone for building purposes, or whether declining tile production stimulated a demand for stone tiles.

It should be noted that another alternative to tile was thatch, and Brinklow (et al. 1986, 72) stated that a thatched roof was a possibility, for an elaborate building of early third to early fourth century date at Clementhorpe.

4.3 Tiles associated with hypocausts and baths

Many forms of tile (bessalis, chimney, flue, parietalis, pedalis, pipes and tegula mammata) were primarily designed for use in the dry-lining of walls, in hypocausted buildings and in baths (Brodribb 1989, 34, 41, 36-7, 58, 72-3 and 84-7). This association is clearly seen in the present study, with the overwhelming bulk of such forms having originated from sites with known baths/hypocausts (Table 38-9). It should be noted that sites 4 and 6-8 in Tables 38-9 were very small excavations, accounting for the low volume of tiles recovered.

Table 39 clearly shows that the overwhelming majority of the forms listed above were from just eight sites, all with known associations to hypocausts and/or baths buildings.

It should also be noted that most of the Lydion bricks, and the bricks of unusual size or shape (classed as 'other' in the present methodology) were also from these sites. Two of the sites in question were definitely baths, firstly Swinegate (excavations at 12-18 Swinegate and two interventions on the adjacent Roman sewer) was the site of the legionary baths (Monaghan 1997, 1064), and secondly Station Rise was the site of the major public baths in the *colonia* (RCHM 1962, 54-6). The site at 1-9 Micklegate was interpreted as a possible baths (Ottaway 1993, 102) and the tile from the present study confirms this (see Table 38). The only one of these baths sites with sufficiently large numbers of pipes to suggest a pipe-lined vaulted roof was 12-18 Swinegate.

The remaining five sites all had hypocausted buildings, or were close to earlier finds of hypocausts: Heslington East; George Hudson Street; Wellington Row; Ideal Laundry; Trinity Lane (near RCHM 1962, 52); and 18a-19 Fetter Lane (near RCHM 1962, 52). The building at Wellington Row was certainly of a scale that a public baths could have been present, however, the remaining sites are far smaller, and these need not necessarily have been baths buildings. Cosh (2001, 222) has made the case for seasonal dining rooms in larger houses, a light airy room for summer, and a heated dining room for winter, and it is possible that the smaller hypocausts in the study may be for such domestic rooms.

The presence of a suite of tile forms associated with hypocausts/baths is of interest, as it offers a potential interpretation for other sites with similar groups of tile, but where no clear evidence of a hypocaust survived. Two sites in the present study fall into this category, 24-30 Tanner Row and 13-15 St Martin's Lane (Table 40). At 24-30 Tanner Row a large stone building was constructed c. AD 225 (Monaghan 1997, 1106), and although no direct evidence of a hypocaust was noted on the site, the number of flue tiles present, together with some evidence of dry-lined walling, and of bessalis which are often associated with pilae, may suggest that there was a hypocaust present. At 13-15 St Martin's Lane an undated Roman building of some sophistication has been observed in two watching briefs (Finlayson 1997, 911-12) and the presence of a small number of flue tiles at this small site may hint at a hypocaust being present.

Table 38. Weight of tile from sites with known hypocausts/baths. Site 1 = Swinegate (three YAT excavations), Site 2 = 1-9 Micklegate, Site 3 = Heslington East, Site 4 = George Hudson Street, Site 5 = Leedhams Garage/Wellington Row, Site 6 = Ideal Laundry, Trinity Lane, Site 7 = 18a-19 Fetter Lane, Site 8 = Station Rise								
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Armchair voussoir?	250							
Bessalis	21175	26725	15050	7750	26725			
Chimney	200		375		675			
Flue	157880	46925	55765	1150	34545	225	425	575
Parietalis	21181	3225			1625		1150	
Lydion	6540	9500						
Pedalis		1875	4100		10800			
Pipe	25099	150			1545			
Rectangular brick unusual size	6500	22410	3575					
L shaped brick		2610						
Brick finished on both sides	700							
Tegula mammata		550						
Sesquipedalis			4650					
Tessera	10	15		25	20			10
Voussoir					1150			

There were a few sites which had more than five flue sherds present, but these were insufficient to suggest a hypocaust, or they were in buildings which presumably lacked such structures, suggesting that the sherds were the result of dumping or casual loss. The six sherds of flue tile in Davygate are unlikely to have originated from a barrack block on the site (Finlayson 1997, 298) and may represent stray loss or dumping. The presence of just four sherds of flue tile in Dringhouses is too low to suggest a hypocaust in the area. At 5 Rougier Street there was a building with stone pillars, which has been interpreted as a granary, though Monaghan (1997, 1107) argues strongly that this was a public building. There are small numbers of flue and pipe sherds from this site (thirteen and two sherds respectively), but these are insufficient to indicate a hypocaust. Flue tiles at the North Street Sewage discharge chamber and 23-28 Skeldergate represent dumping near riverside/wall structures.

Table 39. Weight of tile from sites with known hypocausts/baths as a percentage of the volume of each form present. Site 1 = Swinegate (three YAT excavations), Site 2 = 1-9 Micklegate, Site 3 = Heslington East, Site 4 = George Hudson Street, Site 5 = Leedhams Garage/Wellington Row, Site 6 = Ideal Laundry, Trinity Lane, Site 7 = 18a-19 Fetter Lane, Site 8 = Station Rise

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Total
Armchair voussoir?	100								100
Bessalis	11.3	22.9	12.9	6.7	22.9				76.7
Chimney	14		26.3		47.4				87.3
Flue	44	13.1	15.3	0.32	9.6	0.06	0.12	0.16	82.66
Parietalis	52.2	7.9			4		2.8		66.9
Lydion	24.6	35.8							60.4
Pedalis		11.2	24.4		64.4				100
Pipe	89.2	0.4	0.08		5.5				95.18
Rectangular brick unusual size	20	69	11						100
L shaped brick		100							100
Brick finished on both sides	100								100
Tegula mammata		20							20
Sesquipedalis			100						100
Tessera	0.6	0.9		1.4	1.2			0.6	4.7
Voussoir					22.6				22.6

There were numerous other sites which had one or two sherds of these types of tiles, many of which were in the environs, and the tiles were clearly the result of the dumping of refuse from elsewhere (26-28 Marygate, Adam's Hydraulics, Barbican leisure Centre, County Hospital Monkgate, County Hospital Fossbank, Jewbury, sites on the fortress defences, 14-20 Blossom Street, 28-40 Blossom Street, 35-41 Blossom Street, 89 The Mount, 90 The Mount, 22 Piccadilly, 46-54 Fishergate, various sites in Hungate and St Leonard's Hospital), while material at St Anthony's Hall probably originated as waste from the nearby legionary kilns.

Table 40. Possible evidence of hypocausts at two sites in York, with the weight of the tiles in grams and the number of sherds in parenthesis.

	Bessalis	Flue	Parietalis	Pipe
24-30 Tanner Row	6575 (6)	28915 (164)	8050 (15)	
13-15 St Martin's Lane		835 (9)		

Sherds of flue tiles from other sites probably represent stray finds (108-110 Bootham, Clementhorpe/Terry Avenue, Coppergate watching brief, York Castle, 3 Driffield Terrace, Dixon Lane, Judge's Lodgings Lendal, Purey Cust Nuffield Hospital, 16-22 Coppergate, 21-33 Aldwark, 64-74 Skeldergate, 148 Lawrence Street, Skeldergate City Mills, St Georges Field Car Park, St Maurice's/Newbiggin, St. Georges Church, D.C. Cooks site Lawrence Street, 1 King's Square, 1-2 Tower Street, 112 Micklegate, Rear of 3 Little Stonegate, Theatre Royal St. Leonards Place, 20 Davygate & 9 New Street, Acomb Grange, 62-68 Low Petergate, 2 Clifford Street, 2 St. Maurice's Road, 5-13 Clifford Street, 3 Little Stonegate, 58-59 Skeldergate, 28-29 High Ousegate).

4.4 Tile as an aid to the interpretation of selected buildings

4.4.1 12-18 Swinegate

The portion of the legionary bath-house seen on the excavations at 12-18 Swinegate was built by the Legio IX c. AD 90 (Monaghan 1997, 1059). The tile suggests that this building incorporated box-flues (368 sherds) and while the presence of small numbers of possible parietalis (23 sherds) indicates that such tiles were also used for lining some of the walls. The lack of half-box flues at 12-18 Swinegate suggests that box flues were the norm by the late-first century, confirming earlier observations that half-box flues were largely obsolete by that date (Brodribb 1989, 67). The 436 vaulting pipe sherds from the site suggest that a tunnel vaulted roof was present. The pipes would have both conducted heat through the building and reduced the weight of the vault. The presence of two Legio IX stamped tegulae implies that there was a pitched tile roof above the vault, while four Legio VI stamped imbrices and one Legio VI tegula suggests that this roof was repaired or replaced at a later date. A chimney is suggested by a single sherd of tile. The presence of a lead water pipe (find number 1638) represents the remains of the water supply for the baths.

The flue tiles on the site were of thirteen differing fabrics, while the pipes were in twelve differing fabrics. This suggests that stocks of tile from different firings were kept for use as required, hence multiple fabrics in a single heating system. It also suggests that the production of flues and pipes represented a normal part of any run of production. Given that all of this tile almost certainly originated at the legionary kilns it also suggests that the fabrics seen are a reflection of subtle underlying differences in the clay sources used and/or variations in firing temperature, rather than relating to different producers.

There may be evidence of the use of armchair voussoirs at 12-18 Swinegate, though only one sherd was present, and the identification was by no means certain. Two re-used armchair voussoirs with Legio IX stamps were found on the site of the early fourth century caldarium at nearby St Sampson's Square (RCHM 1992, 170), which was presumably robbed from earlier bath buildings in the area, perhaps confirming that tiles of this type had been present in the Swinegate baths. The fact there were so few armchair voussoir sherds might suggest that they were only used in a small portion of a building such as a strengthening rib.

4.4.2 Wellington Row

A major building dating to c. AD 150 was present in Trench 7 at Wellington Row, in the *colonia*. The original excavator (Ottaway 1993, 74-6) interpreted this building as having a clay oven set against the internal south-western side, and a drain running out of the north-western side. Ottaway further suggested that this building was heavily remodelled c. AD 175 or later, with major extensions on the north-western and south-western sides, and a row of low stone pillars internally, interpreting these pillars as being of a non-structural nature, possibly representing seats.

Whyman (2001) has radically re-interpreted this building, being sceptical that an oven was present in the buildings first incarnation, and interpreting the major rebuilding as having an extension on the north-western side only, together with a hypocaust. The evidence for a hypocaust is compelling, comprising the low stone pillars, interpreted as the basal supports for pilae, together with the robbed out remains of further pilae and two successive flues. Whyman argues that the burnt clay in the earliest incarnation of the building, seen by Ottaway as an oven, was in fact scorching due to a fire in this hypocaust flue. Whyman also identified a complicated series of later alterations, dated by coin-evidence as starting in AD 388-402, and continuing well into the fifth century (Whyman 2001, 292-3).

Clearly, there are two radically differing schemes of interpretation for this building, and the tile was examined to see if it could shed any light onto the building's interpretation. The presence of flue tiles (120 sherds), parietalis (five sherds), bessalis (12 sherds) and pipes (ten sherds), in Trench 7 at the site are suggestive of a hypocaust being present. Looking at the date of the contexts in which these tiles occurred, it is clear that they do not represent residual material dumped on the site prior to AD 150, as no bessalis, parietalis, flue tiles or pipes were present prior to that date, despite the use of the area for the dumping of waste. Flue tiles in Trench 7 appear in contexts dating to AD 120-200 (eleven sherds) and in contexts dated to AD 200-280 (six flue sherds). The number of sherds is very low, and may not therefore suggest any form of heating system at this stage. The contexts dating to AD 280-410 contained better evidence of a hypocaust, in the form of thirty-one flue sherds, two parietalis and one pipe sherd, suggesting that Whyman's interpretation of the site as having a later Roman hypocaust is the correct one. The bulk of the tile usually associated with hypocausts from Trench 7 occurred in post-Roman contexts (seventy-two flue sherds, three parietalis, one pedalis and nine pipe sherds), and although these sherds almost certainly originated from the heating system on the site, the possibility that they represent dumping from elsewhere must be noted.

There were clearly insufficient box flue tiles to indicate that the walls of the Trench 7 building were lined with tile, perhaps suggesting that the box flues were acting as a chimney-flue, drawing heat from an oven or furnace to the roof line above. There were also insufficient pipe sherds to be suggestive of a vaulted roof, indicating that the Trench 7 hypocausted building had a trabeated roof. It is clear that several differing fabrics were present in amongst the flue tiles, suggesting that tiles from multiple sources were used. Given the later Roman date of the building, it is perfectly possible that this is evidence of the re-use of earlier tiles robbed from a number of differing sources.

Ottaway (1993, 74) interpreted The Trench 7 building as being roofed with stone tiles, on the basis of abundant thin stone slabs found during the excavations. There is, however, sufficient evidence that there must have been a tiled roof on the Trench 7 building at some stage, in the form of 0.39 tonnes of roofing tile in Trench 7 (1629 sherds), including seventy-two tegulae with Group B^{Warry} cutaways, eight tegulae with Group C^{Warry} cutaways and a Legio VI stamped imbrex.

Contexts in Trench 7 dating to AD 120-200 yielded eighty-six sherds of imbrex and fifty-three sherds of tegulae, while contexts dating to AD 200-300 yielded 149 sherds of imbrex and sixty-six sherds of tegula, sufficient to suggest that the initial phase of the building, and/or the first major rebuild must have had a tiled roof. The Legio VI tile is of interest as it may imply military involvement in the construction of the building. There were also three tegulae with nail-holes in Trench 7, two in contexts dating to AD 280-410, and one in a post-Roman context, these may represent tiles from the basal row of tegulae on a roof dating to AD 150 or AD 175, or possibly a roofing repair of third century date, when nail-holes were more common.

There were 114 sherds of tegulae and 168 sherds of imbrex in contexts dating to AD 280-410, which presumably represent residual material as tile production had stopped by this stage. The 607 imbrex sherds and 372 tegula sherds in post-Roman contexts are most likely to have derived from the roof of the building, further suggesting the demolition of a tile roof at some stage.

Ottaway reported that numerous thin stone slabs, interpreted as roofing slabs, were present at the site. The IADB was searched to see if any of these had been recorded, and twenty-two fragments were present, all of micaceous sandstone, which is the norm for roofing tiles in York. Thirteen of the stone slabs were in Trench 7 and the remainder in Trenches 5 and 6. One slab in Trench 7 was in a context dating to AD 71-120, while the remainder were in contexts dating to AD 280-410 (five sherds), or in post-Roman contexts (sixteen sherds). Although stone roofs were being built in the late second century they did not become the norm until the mid-third century. The fact that stone slabs were rare on the site prior to the late third century suggests that the stone roof tiles related to the fourth century remodelling of the Trench 7 building, suggested by Whyman, rather than to the AD 175 rebuilding.

One tile tessera and six stone tesserae were found at the site, and these hint at a tessellated pavement, which might be expected given the size and status of the building concerned.

4.4.3 1-9 Micklegate

At 1-9 Micklegate, in the *colonia*, there were traces of a structure dating to c. AD 175 or later, and although virtually all trace of this had been removed by later buildings on the site, the presence abundant tile would suggest that this building had a tiled roof.

A second major Roman building dating to the second quarter of the third century was constructed, but this was almost immediately replaced by a new building, the size of which is suggestive of a public building. Ottaway (1993, 87, 102) tentatively interpreted this third building as a bath-house. This building is unusual in that it was partly demolished and levelled up with its own rubble to form a platform for post-Roman activity, and the deliberate burial of material associated with this building means that it offers a rare opportunity to determine the forms and fabrics used in a single structure, without the picture being confused by later robbing or dumping. The archive report was examined to draw up a list of contexts in Trench 3 Groups 4-5 and Trench 7 Groups 4-6, which related to either the construction of the building or its deliberate demolition/burial. These contexts contained a number of forms usually associated with hypocausts (twelve sherds of bessales, ninety-eight flue tiles, one

Lydion, one tegula mammata, two parietalis and one pedalis); in addition, nine unusually sized and shaped bricks seem to have been deliberately manufactured for use in drains at the site. These tiles seem to confirm Ottaway's interpretation of the building as a baths. Each of the forms with more than one example came in a variety of fabrics, suggesting that tiles from several firings were present. The number of flue tiles is small, indicating that they may have acted as flues for a chimney, there being insufficient sherds to suggest that the entire building was lined with box flues.

The lack of pipe sherds suggests that there must have been a trabeated rather than a vaulted roof. There were 127 sherds of imbrex and 200 sherds of tegulae, which included three Group C^{Warry} lower cutaways, tegulae with a Legio VI stamp, and two tegulae with nail-holes. It has been suggested that nail-holes were more common in the later Roman period (Warry 2006, 103 and 106), and this study suggests that on the basis of thickness the Group C^{Warry} tegulae may be of later Roman date (see p235), which raises the possibility that the third century roof at 1-9 Micklegate was of tile, rather than stone. If the roof was of tile, it must have represented one of the last major tile roofs in York, given that the military kilns ceased production in the mid-third century, after which time stone roofs dominated in York.

4.4.4 24-30 Tanner Row

At 24-30 Tanner Row, in the *colonia*, there was a large stone building constructed c. AD 225 (Monaghan 1997, 1106). No direct evidence of a hypocaust was noted on the site, but the presence of 164 sherds of flue tile, together with fifteen sherds of parietalis, and six bessales (which were usually used in pilae), may suggest that a hypocaust was present at some stage. There is no evidence to suggest that such a hypocaust was associated with a vaulted roof, as no pipes were present, suggesting that the roof must have been trabeated. Tegulae with nail-holes were present, but are so few in number that they may represent tiles from the basal row of tegulae on the roof, rather than indicating that the entire roof was fixed in place using nails.

4.4.5 Heslington East

The Heslington East site, 3km south-east of the fortress, offered by far the best collection of tile for analysis, largely because the site had suffered little if any robbing, and post-depositional damage was minimal in comparison to sites within the centre of York; in addition, the site had a range of structures present which incorporated almost all of the various forms of tile seen in the study. The post-excavation analysis of this site was on-going at the time of writing, but Dr C. Neal kindly provided information relating to the structures on the site, enabling the following observations to be made.

There were no Legio IX stamps, implying that the site was not used prior to the second quarter of the second century. The earliest dated tile at the site was a Legio VI stamped imbrex dating from AD 120 to the mid-third century, though this could have been re-used.

The earliest major structure on the site was a hypocausted building of late third-early fourth century date, while the remainder of the structures on the site were of late fourth century date. All these buildings post-date the closure of the legionary tile kilns in the Aldwark area, and the tiles seen in these buildings could therefore represent either the re-use of tiles from elsewhere, or civilian manufacture of mid-third century or later date. The Heslington East tiles do contain a number of highly unusual sherds, which may indicate that they were not manufactured at the legionary kilns (where highly standardised forms were the norm); the sherds in question were an abnormally short imbrex, a tegula with a non-standard lower cutaway, and a group of short flue tiles (Heslington East Type 1, see p165) which lacked vents and were of poor quality. The flue tiles in particular are of interest as they were associated with a kiln/furnace structure, possibly suggesting that they were manufactured specifically for use in the kiln, thereby explaining their unusual characteristics, if this is indeed the case they would represent a rare example of late fourth century civilian tile production. The presence of iron fragments adhering to many of the tiles associated with this kiln is of interest and may suggest that the kiln/furnace was for metalworking.

The tiles in the hypocaust are of uniform manufacture and fabric (R6), and include rectangular tiles of unusual size designed for the specific purpose of acting as the basal tiles for pilae adjacent to the walls of the building (Figure 81). The uniformity of these tiles suggests that they were made to order representing a single batch of tile, but it is impossible to know if these were manufactured for use at Heslington East, or represent the robbing and re-use of an earlier hypocaust from elsewhere. The box flue tiles from the site (excluding those related to the kiln), presumably also originated from the hypocausted building, and these comprised six differing batches of flue tile, though the dominant two types were probably related (Types 3-4, see p165-6). This could imply that the building was constructed using flue tiles of Types 3-4, with later repairs using flue tiles from other sources, or that the structure had been built using flue tiles robbed from several different buildings.

Figure 81. The hypocaust at Heslington East, with pilae at the room edges standing on rectangular tiles, and those in the centre of the room standing on pedalis, © YAT.

A late fourth century timber framed building, with a stone roof, was present at the site. The roof comprised elongated hexagonal micaceous sandstone tiles capped by a row of imbrices at the ridge line (McComish 2011, 10), one of which was exceptionally short. This is the only conclusive evidence for the use of both stone and tile on a single roof in the study. The use of stone tile on this building may imply that it had a steeply pitched roof (see p64). At Dalton Parlours villa 21.5lm south-west of York there were both hexagonal stone roof tiles and exceptionally short imbrices (Betts in Wrathmell and Nicholson 1990, 164, 166). As this pattern is similar to that seen at Heslington East, it raises the possibility that short imbrices were associated with the ridge-lines of stone roofed buildings. The use of both stone and ceramic tiles on a single roof is also known from Sparsholt (Perring 2002, 121).

4.5 The location of tile kilns in York

Although the presence of wasters and dumps in the Peasholme Green and Aldwark area, to the south-east of the eastern corner of the fortress, shows that the legionary kilns were located nearby, the actual kilns have never been located. The only known Roman kiln site in York was at Apple tree Farm Heworth, though the kilns seen were for pottery not tile (see p61).

Wasters were usually of no use for construction purposes, and were therefore dumped close to the point of production, as with the examples from the Peasholme Green and Aldwark area. The distribution of wasters was therefore examined to determine if there were any other possible kiln sites in the study area. There were only five wasters in the study, representing 0.02 percent of the total volume of tile, which says something of the quality of tile used in construction. Of these five wasters, three were at the Adams Hydraulics site, which was a known dumping ground for tiles from the legionary kilns, a fourth sherd was in the legionary baths in Swinegate and the fifth sherd was at 1-9 Micklegate; both these sites had major Roman buildings, which implies that two of the wasters were deemed fit for use. The wasters do not therefore suggest the location of any other tile kilns in the study area.

In addition to the wasters, eight warped tiles, thirty-three blown tiles, 257 overfired tiles and two cracked tiles were also present in the study, but these would all have been useable in construction, so their location would not indicate the presence of a kiln.

4.6 Method of manufacture

There are no differences in the methods of manufacture seen at military or civilian tileries, the only differences being in the distribution of their products (McWhirr 1979a, 97). The location of tile production was dependent upon the availability of suitable clays, temper (usually sand), water, fuel, markets and transportation links (Swan 1984, 3). Tile production was a seasonal occupation with clay being dug in autumn and left to overwinter, allowing the clay to be broken down by frost-action. The winter would be the ideal time to collect the wood necessary for firing the kilns, as the trees would lack leaves (Warry 2006, 121). The clay was turned in spring and any temper required could be added at this stage. Evidence from graffiti in Britain suggests that tiles were manufactured in summer or autumn, with a graffito from Cirencester mentioning July, examples from London, Holt and Caerleon mentioning August, one from Gorhambury mentioning the Kalends of September which is in the latter half of August, one from Silchester mentioning the Kalends of October which is the 26th September and one graffito from Farningham possibly representing a date between the 14th and 23rd of November, but this interpretation is less certain (Collingwood and Wright 1993, 96-9).

It seems that an individual worker could make in the region of 200 tiles in a day. There are graffiti on tegulae from Italy that refer to two men making 440 tiles in a day, and a list of four men making 220 tiles each in a day, while a graffito from Regensberg refers to 110 tiles, which may represent a half day’s work (Warry 2006, 119). A graffito from Silchester stated that 199 tiles had been made, at Holt there were three tiles marked CC, CCL and CCIV, at Bignor there was a tile with a graffito CCI, while at Cansiron Farm, Hartfield, Sussex, a graffito gave the two numbers CCXV or CCXX and CCXIIII (Collingwood and Wright 1993, 98, 104-5; Rudling et al. 1986, 195). It is unclear why there are two numbers on the Hartfield tile but possibly one represents a correction. There are graffiti from Cirencester, Chester, Wroxeter and Holt which bear the numbers CCCXVIII, CCCC, D and DLXXXXV, that is 319, 400, 500 and 595 respectively (Collingwood and Wright 1993, 106), possibly representing the daily output for two or three men. These can be compared to a graffito from Siscia, in the province of

Pannonia, which recorded that two workmen made 440 bricks on the 28th July (Tomlin 1979, 233). The production rate for box flues may have differed as a graffito from Leicester records that 'Primus has made sixty' (Collingwood and Wright 1993, 94).

Any peg or nail-holes were normally pierced through the tiles before firing. A few tiles at Cansiron Farm, Hartfield, Sussex, have a small sub-conical hole pushed into one of the sides near a corner, the function of which is unknown (Rudling et al. 1986, 195). Signatures were best drawn while the clay was still soft, but in contrast stamps were best applied when the tile was leather-hard, so as to avoid smudging. Where tiles have overlapping signatures and stamps, the signature was always applied first (Brodribb 1979b, 211-3). In the case of imbrices the stamp was usually applied after the clay had been placed over the curving former, but an example from Bishophill, York, has been noted where the stamp was applied before the clay was placed over the former resulting in a distorted stamp (Betts 1985, 165). Most military stamps are in relief with relatively few incuse stamps (Warry 2006, 88). In contrast almost half of the dies used by civilian tilers, and all but one of the Gloucester municipal dies, are incuse (Warry 2006, 88). Knife trimming and the application of tally marks would also be undertaken when the tile was leather-hard (Brodribb 1979b, 213).

Following manufacture the tiles would be laid out to dry, this was an important stage of the process as insufficient drying could cause tiles to shatter when fired. In view of the climate, drying would be best done under a shelter, and it has been suggested that the rarity of rain marks on tiles indicates that most were dried undercover (Brodribb 1979b, 215). Furthermore, tiles laid under direct sunlight to dry would be more prone to cracking; the rarity of cracked tiles might also suggest that most tiles were dried under cover (Warry 2006, 16), possibly in open sided sheds similar to the medieval hacksteads used for drying bricks (Cherry 1991, 190). There is some evidence for the use of racks for drying, as at Piddington villa the presence of a dog's claw marks on the edge of an imbrex suggests that the tiles were dried on a rack with the dog reaching up and marking the tile (Ward 1999, 78), while marks on the edges of some tegulae may indicate the use of drying racks (Warry 2006, 35). It has been suggested that after several days of drying, tegulae were turned onto their sides to complete the drying process, and some tegulae are laterally concave suggesting that they may have been turned onto their sides before being sufficiently dry (Warry 1006, 9, 34).

Other tiles were clearly laid directly on the ground to dry, as the downward side is imprinted by plants or seeds (de la Bédoyère 2000, 61), and the frequent presence of animal paw-prints shows that animals were able to walk across drying tiles. A tenth of military produced tiles have hob-nail boot impressions on the upper surface, but similar marks are relatively rare on civilian tiles, and while this may suggest that the civilians were more careful not to walk over drying tiles, a more likely explanation is that the officer in charge could have been testing the hardness of the tiles, to determine if they were ready for firing (Warry 2006, 16).

Once the tiles were sufficiently dry they were fired. All known Roman tile kilns in Britain were square or rectangular, and have a firing chamber with cross-walls supporting arches carrying the floor of the kiln (McWhirr 1979a, 98), and they are in general larger than pottery kilns (Swan 1984, 87). Tile kilns have robust flooring systems with multiple lateral cross-walls, reflecting the weight of the load to be borne (Swan 1984, 87). This style of kiln derived from Graeco-Roman types, and was often used on the continent for heavy items which required slow firing, such as mortaria and amphorae, as well as tile (Swan 1984, 89). Both the cross-walls and floor were pierced by vents to allow the circulation of heat, and a stoke-hole was connected to the firing chamber by a flue (Swan 1984, 98). It is possible that kilns were built from green tiles then fired empty, with any necessary repairs being carried out to correct any cracks, prior to full production (McWhirr 1979a, 99). There was no standard size for tile kilns but a firing chamber three by two metres in size would be typical (Warry 2006, 119). It has been estimated that a kiln of this size could accommodate about 1440 tegulae, representing 168 square metres of roofing area (Warry 2006, 120). Where stoke-holes were dug into clay, drains were inserted to keep the stoke-hole dry, such as the drains of inverted imbrex seen in kilns at Muncaster and near St Albans (McWhirr 1979a, 100). Kiln walls would probably have needed to be 1-2m high to create a sufficient draught within the kiln (McWhirr 1979a, 100). Most kilns were built into the side of a hill to create a good up-draught, and although in most cases the walls do not survive, there is little if any evidence of doors leading into kilns suggesting that they were loaded via a hole in the roof (McWhirr 1979a, 99). It is unclear how kilns were roofed; the kiln at Muncaster reportedly has evidence of corbelling 900mm above the kiln floor, but this could simply represent the partial collapse of the kiln wall (McWhirr 1979a, 99). After loading the kiln would be sealed and fired to a temperature of about 1000°C, before being allowed to cool, and then being unloaded (McWhirr 1982, 34). Estimates as to the length of time required to load, fire, cool, and unload kilns range from around eight days to several weeks (Warry 2006, 129).

The various stages of manufacture described above can be seen in a tile-making workshop at Itchingfield, Sussex, where a building is interpreted as having a clay-store, pugging pit, working area and external drying floor, with a probable brick-clamp approximately 50m away (Green 1979a, 193), while at Cansiron Farm, Hartfield, Sussex there were buildings interpreted as a possible open sided drying shed and a workman's hut, to either side of a tile kiln (Rudling et al. 1986, 195).

4.7 Data-tables for Appendix 4

Table 41. Average length for each form overall and by fabric, no examples for fabrics R4-R5, R8, R12-R13 and R16-R19

Form	Overall	R1	R2	R3	R6	R7	R9	R10	R11	R14	R99
Bessalis	212	238			200	210	216	201	215		
Flue	191		185	211	219				205		
Imbrex	370						441	290	374		
Lydion	402							369	410		410
Parietalis	274						273				
Pedalis	305								305		
Tegula	520						520		520		
Tessera	26	26	26	26	21		24	26	26	26	

Table 42. Number of sherds used to calculate the average lengths in Table 41											
	Overall	R1	R2	R3	R6	R7	R9	R10	R11	R14	R99
Bessalis	13	1			5	1	2	1	4		
Flue	10		3	2	3				7		
Imbrex	2						1	1	2		
Lydion	3							1	1		1
Parietalis	1						1				
Pedalis	1								1		
Tegula	2						1		1		
Tessera	1		1							1	

Table 43a. Average breadths for each form overall and in relation to fabric, no examples in fabrics R4, R5, R13, R18 and R19								
Form	Overall	R1	R2	R3	R6	R7	R8	R9
Bessalis	181	218		206	203	187	220	209
Flue	185		230	163				
Imbrex	165							147
Lydion	192			295				
Parietalis	160							160
Pedalis	276							
Pipe	41				44			49
Opus spicatum	57							
Tegula	318	353			322			
Tessera	26	22	23	24	21			21
Voussoir	131							

Table 43b. Average breadths for each form overall and in relation to fabric, no examples in fabrics R4, R5, R13, R18 and R19								
Form	R10	R11	R12	R14	R15	R16	R17	R99
Bessalis	202	215	202		201	188	210	
Flue	172	144					107	
Imbrex	144	185						
Lydion		275						270
Parietalis								
Pedalis	269	281						
Pipe	36	40		72	40			
Opus spicatum						57		
Tegula	200	380			302			
Tessera	24	23		20				
Voussoir		131						

Table 44a. Number of sherds used to calculate the average breadths in Table 43, no examples in fabrics R4, R5, R13, R18 and R19

Form	Overall	R1	R2	R3	R6	R7	R8	R9
Bessalis	67	5		3	10	1	1	5
Flue	36		1	5				
Imbrex	8							2
Lydion	3			1				
Parietalis	1							1
Pedalis	5							
Pipe	31				6			3
Opus spicatum	1							
Tegula	6	2			1			
Tessera	80	5	1	5	3			15
Voussoir	1							

Table 44b. Number of sherds used to calculate the average breadths in Table 43, no examples in fabrics R4, R5, R13, R18 and R19

Form	R10	R11	R12	R14	R15	R16	R17	R99
Bessalis	23	14	1		2	1	1	
Flue	7	8					1	
Imbrex	2	4						
Lydion		1						1
Parietalis								
Pedalis	2	3						
Pipe	10	1		1	10			
Opus spicatum						1		
Tegula	1	1			1			
Tessera	20	30		1				
Voussoir		1						

Table 45a. Average thickness for each form overall and by fabric

Form	Overall	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
Antefix	26										
Bessalis	40	37		54			30	32	45	49	37
Chimney	12									13	18
Flue	20	20	23	21	17	20	19	20	23	20	19
Imbrex	19	18	20	19	17	19	18	18	20	19	18
Lydion	41			38						35	49
Mammata	26						14				
Parietalis	35		38				37		36	35	35
Pedalis	40										36
Pipe	12	12	15	13		12	13	18	19	12	11
Opus spicatum	36										
Tegula	25	26	27	25	20	27	23	23	26	27	23
Tessera	18	19	16	15			20			18	19
Voussoir	45	75								45	

Table 45b. Average thickness for each form overall and by fabric

Form	R11	R12	R13	R14	R15	R16	R17	R18	R19	R99
Antefix	26									
Bessalis	42	35			34	38	30			
Chimney	18				12					
Flue	20	22	18	21	18	21	20		22	
Imbrex	18	19	16	18	18	18	19	19	18	19
Lydion	33									62
Mammata	36			27	25					
Parietalis	37			37	30					
Pedalis	43									
Pipe	13			13	12					11
Opus spicatum						36				26
Tegula	23	24	29	27	24	24	24	24		
Tessera	18			19						
Voussoir	34				25					

Table 46a. Number of sherds used to calculate the averages in Table 45							
Form	Overall	R1	R2	R3	R4	R5	R6
Antefix	1						
Bessalis	73	5		5			10
Chimney	13						
Flue	1259	47	135	120	1	18	95
Imbrex	5622	387	133	607	8	204	414
Lydion	6			1			
Tegula mammata	4						1
Parietalis	57		3				4
Pedalis	5						
Pipe	456	4	3	11		1	148
Opus spicatum	1						
Tegula	3623	155	191	194	1	121	243
Tessera	83	5	1	5			4
Voussoir	4	1					

Table 46b. Number of sherds used to calculate the averages in Table 45							
Form	R7	R8	R9	R10	R11	R12	R13
Antefix					1		
Bessalis	1	2	8	23	14	1	
Chimney			2	1			
Flue	26	37	197	252	182	11	2
Imbrex	155	105	1378	1214	637	22	2
Lydion			1	1	2		
Tegula mammata					1		
Parietalis		4	28	11	3		
Pedalis				2	3		
Pipe	4	1	73	58	21		
Opus spicatum							
Tegula	25	116	968	848	557	11	1
Tessera			15	20	32		
Voussoir			1		1		

Table 46c. Number of sherds used to calculate the averages in Table 45							
Form	R14	R15	R16	R17	R18	R19	R99
Antefix							
Bessalis		2	1	1			
Chimney		10					
Flue	33	79	6	4		4	10
Imbrex	27	277	3	27	11	5	6
Lydion							1
Tegula mammata	1	1					
Parietalis	1	3					
Pedalis							
Pipe	7	124					1
Opus spicatum			1				
Tegula	32	122	8	16	6		8
Tessera	1						
Voussoir		1					

Appendix 5 Fabrics

The siting of tileries is closely linked to the availability of suitable clay sources, simply because clay is the heaviest of the materials required for production, and transport costs were expensive. Raw clay will therefore be moved the least distance of all the materials used in manufacture, such as fuel.

Clay is readily available in York and its immediate hinterland. The nature of the geological deposits in the York area are summarised by Betts (1985, 24-7). York is above Bunter Sandstone, which is sealed by a series of strata, including boulder-clay deposited as part of the terminal glacial moraine, and York sits upon this moraine. To the south of the moraine was an extensive lake, known as 'Lake Humber', within which a mixture of sands and gravels, together with lacustrine clays were deposited, with the sands and gravels were deposited at the margins of the lake, while the clays were resultant from the gradual silting of the lake. In parts of York the lacustrine clays overlap the boulder-clay of the moraine. More recent strata comprise fluvial deposits resultant from early river systems, deposits of wind-blown sand, and younger fluvial deposits within incised river channels.

In the case of Roman York it was the lacustrine clays that were particularly valuable for brick and tile manufacture. A perfect example of this lacustrine clay was the natural seen at Dixon Lane, which comprised pale-pink, finely laminated, clay, with absolutely no inclusions. The legionary kilns in the Aldwark area and the Roman kiln site at Apple Tree Farm, Heworth, both sit on the lacustrine clay beds (Betts 1985, Figure 1).

5.1 Fabric descriptions

The YAT fabric series used in the present study has been developed over a number of years, initially being created by S. Garside-Neville, and subsequently being added to by J. M. McComish. The fabric descriptions have recently been enhanced in the light of research by Dr A. Finlay of the Department of Earth Sciences of the University of Durham. The fabric descriptions are given in Table 47, and the thin-section photographs in the table are courtesy of Dr A. J. Finlay. The fabrics are described in Table 47 in terms of colour, the level of sorting (well sorted, moderately well sorted and poorly sorted), the number of vesicles present (in terms of frequent, moderate, occasional or rare), the volume of quartz present (in terms of frequent, moderate, occasional or rare), the angularity of the quartz (in terms of angular and sub-angular) and any other inclusions present.

The fabrics are numbered R1 to R19; in addition, R0 is used for small sherds, typically weighing less than ten grams, which are too small for the fabric to be accurately determined; large numbers of such sherds are often retrieved from the processing of environmental soil samples, therefore sites where soil samples have been extensively processed have larger quantities of fabric R0 present. The term R0 is also used in cases where an assessment of the fabric would damage the object. For example, four tesserae in the present study were designated R0, as creating a fresh break in order to assess the fabric would have caused severe damage to the artefacts in question. The term R99 is used for 'one off' sherds that do not fall into any of the other fabric identifications, each sherd of R99 is unique, differing from any other sherd in the collection, and the R99 sherds may simply represent the accidental inclusion of additional material, such as dust, organic matter or lime, into a single tile during manufacture.

Quartz was by far the dominant inclusion in the clay matrix, irrespective of fabric, with all other inclusions being insignificant in terms of volume. The dominance of quartz and almost total absence of any other inclusions within tiles in York, was noted in earlier work by Betts (1985, 53, 63). As virtually no other inclusions are present in the fabrics recorded in the present study they are largely differentiated by the size, shape and frequency of the quartz grains, while the volume of vesicles present and the level of sorting, including the presence of white silty-bands within the clay matrix, are also key factors in the visual identification of the various fabrics recorded.

It is unclear if any of the quartz seen was deliberately added during manufacture as a temper, as this would be difficult to distinguish when the clay source itself could have contained abundant quartz. The shape of the quartz grains is largely determined by the method of water-transportation, with larger quartz tending to be abraded and rolled resulting in rounded grains, while smaller quartz is carried in suspension and tends to be more angular in shape (Betts 1985, 52). Betts' (1985, 58) analysis of tile fabrics in York determined that most of the quartz was sub-angular or sub-rounded, this observation is matched in the present study, where most quartz grains were recorded as sub-angular with smaller quantities of angular grains, while none of the quartz was recorded as rounded, suggesting that it was carried in suspension to the place of deposition.

Although relatively few inclusions were present in the fabrics quartzite, mica, grog, organic matter, sandy patches, lime, chalk and clay pellets were all noted. None of these inclusions is indicative of tiles being imported into York from elsewhere, indeed the presence of mica in the lacustrine clays of the York area has been noted before (Betts 1985, 35). The inclusions of grog and organic matter may suggest the use of temper, though they could equally represent accidental inclusions of such material into the clay matrix. The sandy patches and silty-streaks seen may be a reflection of the underlying lamination of the original clay source.

The presence of high numbers of vesicles suggests that the clay was subjected to mixing, but relatively little compaction during manufacture. Many of the larger vesicles are elongated, while the smaller vesicles tend to be rounded (irrespective of fabric) and there is often calcite precipitation into the vesicles, which occurred during firing.

The overwhelming bulk of the Roman tile is fired to an even light red or light orange colour, there are, however, a few fabrics which have reduced cores, caused by the exclusion of oxygen during the firing process, notably fabrics R6 and R9. The red colour of the tiles is due to the presence of iron oxides within the clay, these oxidise during firing, with full oxidisation occurring at 800°C (Betts 1985, 42).

All the fabrics are consistent with manufacture from locally sourced clay (Finlay pers. comm.). The total weight in grams for each fabric in the study is given on Table 48, together with the weight as a percentage of the overall volume of tile, and this is illustrated on Figure 82. The two most dominant fabrics are R10 and R9, each accounting for almost a quarter of the tile examined, while R11 accounts for 11 percent of the tile, and fabrics R3 and R6 each account for between 5-10 percent of the tile recorded, with the remaining fabrics being rare.

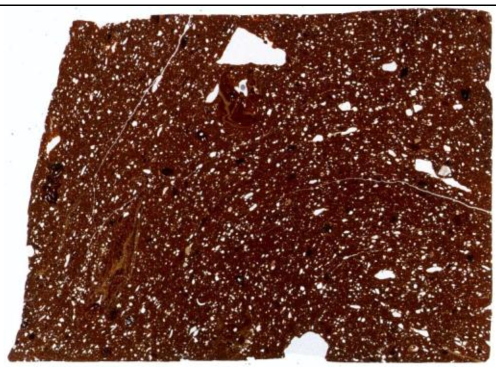
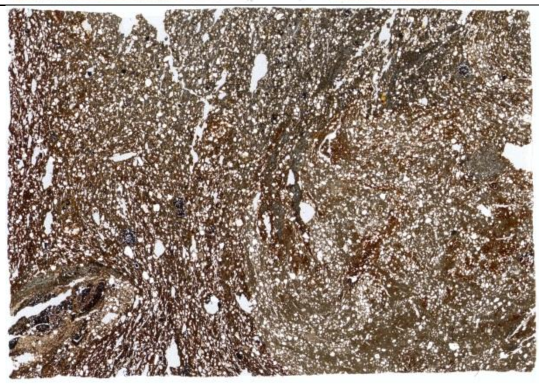
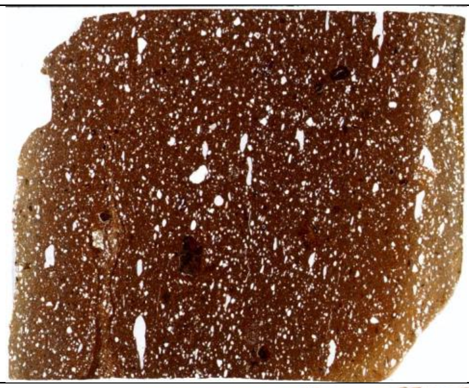
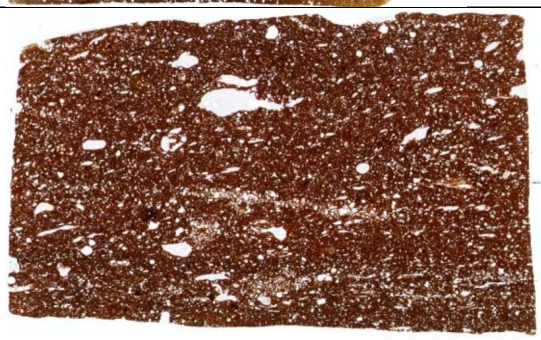
Table 47a. Fabric descriptions	
Fabric	Photograph of thin section
R1 Light red fabric. Poorly sorted streaky fabric, very frequent vesicles, moderate quartz content with the quartz mainly sub-angular though 20% is angular quartz. Occasional mica and grog.	
R2 Light red fabric. Moderately well sorted slightly streaky fabric, rare vesicles, moderate quartz with the quartz mainly sub-angular with 12% angular quartz. Occasional small clay pellets with voids around them and darker patches of differential reduction.	
R3 Light red fabric. Poorly sorted, moderate vesicles, moderate quartz content, with the quartz mainly sub-angular though 20% is angular quartz. Some calcite precipitation into vesicles.	
R4 Light red fabric. Moderately well sorted, frequent vesicles, moderate quartz, with the quartz mainly sub-angular though 20% is angular quartz.	

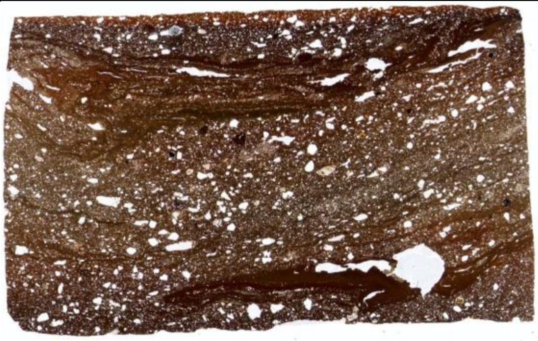
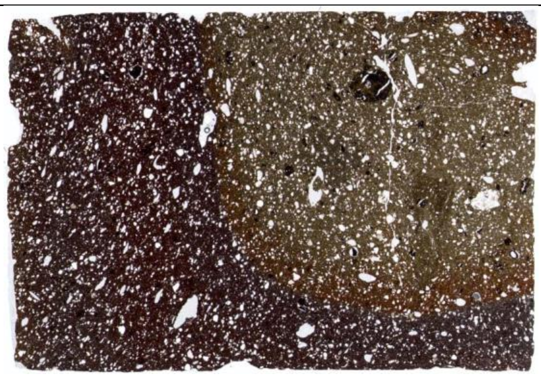
Table 47b. Fabric descriptions	
Fabric	Photograph of thin section
R5 Light orange fabric with reduced pale grey cores. Well sorted, moderate vesicles, occasional quartz, with the quartz mainly sub-angular though 20% is angular quartz. Occasional grog and calcite precipitation into vesicles.	
R6 Dark grey-red fabric. With dark grey reduced cores Well sorted, rare vesicles, very frequent quartz with the quartz mainly sub-angular though 20% is angular quartz. Occasional quartzite, mica, grass/straw and ?grog	
R7 Light red fabric with reduced pale grey cores. Poorly sorted, rare vesicles, moderate quartz content with the quartz mainly sub-angular though 20% is angular quartz. Calcite precipitation into vesicles, occasional clay pellets and grog. This fabric is notably streakier and less well sorted than the other fabrics.	
R8 Light red fabric. Poorly sorted, occasional vesicles, moderate quartz, with the quartz mainly sub-angular though 20% is angular quartz. Some large vesicles and possible grog.	

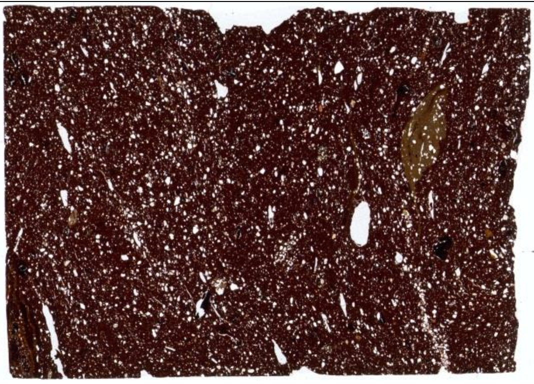
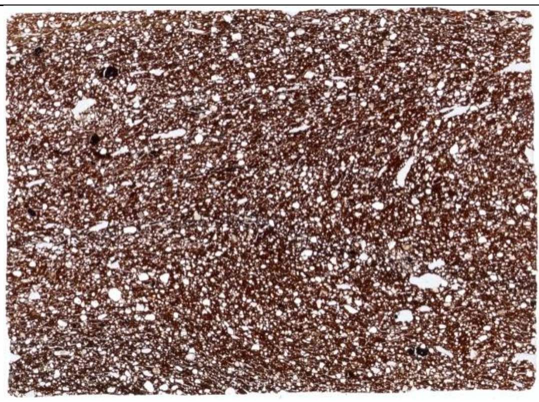
Table 47c. Fabric descriptions	
Fabric	Photograph of thin section
R9 Dark red fabric. Poorly sorted, moderate vesicles, moderate quartz content, quartz mainly sub-angular though 20% is angular quartz. Rare grog, occasional darker grey patches of differential reduction, rare sandier patches. When used on bricks/tegulae R9 is usually very highly fired dark red fabric with a reduced core, though when used for imbrices it usually lacks the reduced core. Almost 'waxy' consistency.	
R10 Light red fabric. Well sorted, moderate vesicles, very frequent quartz content, with the quartz round to sub-angular. Rare calcite precipitation into air pockets. This fabric, together with fabric R11, is the most carefully sorted of all the fabrics in the series.	
R11 Light orange fabric. Well sorted, rare vesicles, occasional quartz content with the quartz mainly sub-angular though 20% is angular quartz. Rare lime and coal, occasional sandy patches and rare calcite precipitation into air pockets. This fabric, together with fabric R10, is the most carefully sorted of all the fabrics in the series.	

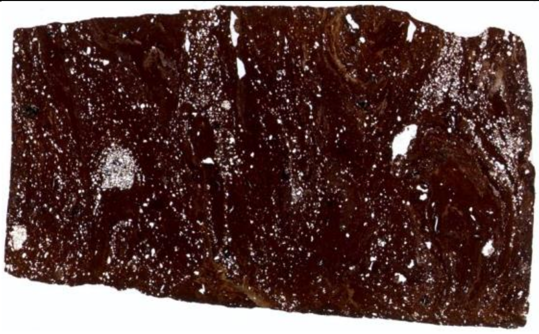
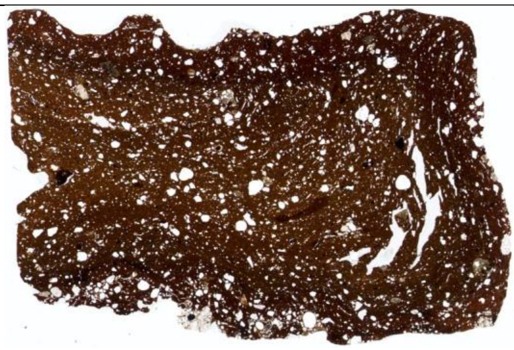
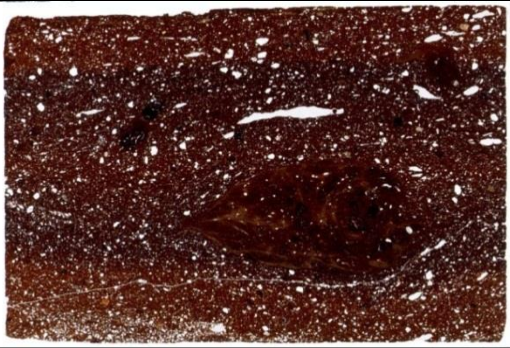
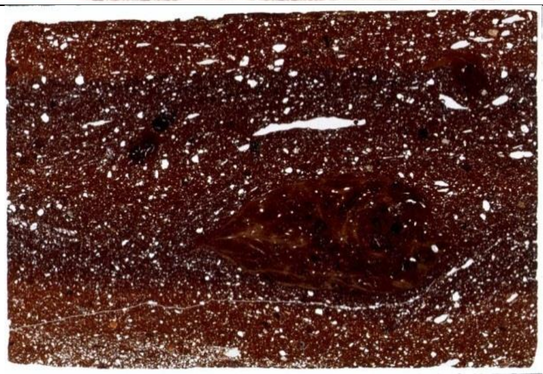
Table 47d. Fabric descriptions	
Fabric	Photograph of thin section
R12 Dark red fabric with grey reduced cores. Well sorted, occasional vesicles, occasional quartz content with the quartz mainly sub-angular though 20% is angular quartz. Occasional mica and grog	
R13 Light red fabric. Poorly sorted, very frequent vesicles, moderate quartz content, with the quartz mainly sub-angular though 20% is angular quartz. Occasional grass/straw voids and calcite precipitation into vesicles	
R14 Light red fabric. Well sorted, occasional vesicles, occasional quartz content with the quartz mainly sub-angular though 20% is angular quartz. Occasional grog, calcite precipitation into vesicles and mica.	
R14 continued - Rare chalk and grass/root like void. A large clast inclusion on a thin sectioned example of R14 was eye shaped which is resultant from the clay being dragged in two directions possibly by rolling during the preparation of the clay for tile manufacture.	

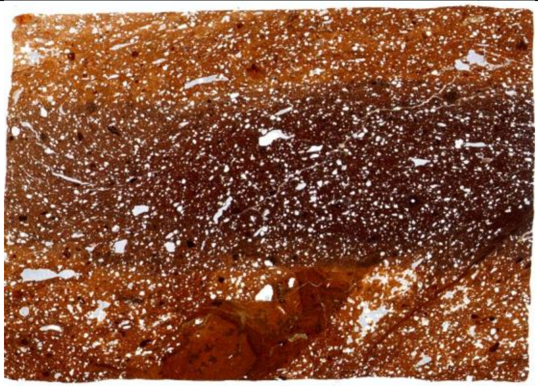
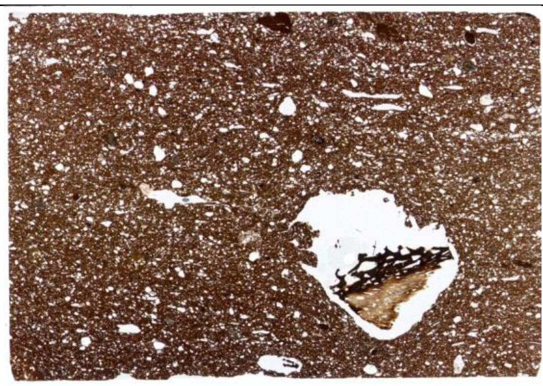
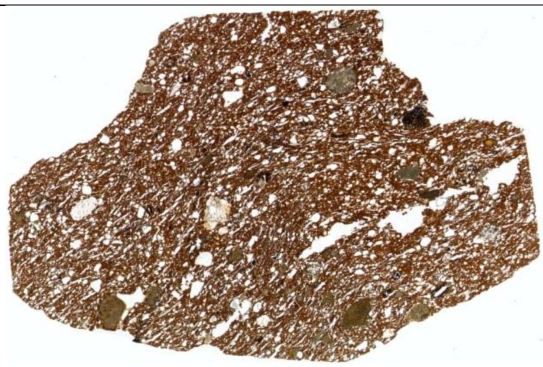
Table 47e. Fabric descriptions	
Fabric	Photograph of thin section
R15 Light red fabric. Poorly sorted, occasional vesicles, moderate quartz with the quartz mainly sub-angular though 12% is angular quartz. Rare mica and grog. Large vesicles.	
R16 Light red fabric. Poorly sorted, frequent vesicles, moderate quartz content, with the quartz mainly sub-angular though 20% is angular quartz. Rare lime, clay pellets and grog. Rare whiter areas possibly the result of differential reduction.	
R17 Light red fabric. Moderately well sorted, frequent vesicles, moderate quartz, with the quartz mainly sub-angular though 20% is angular quartz. Occasional lime.	
R18 Light red fabric. Moderately well sorted, very frequent vesicles, moderate quartz, with the quartz mainly sub-angular though 20% is angular quartz. Moderate chalk up to 2.6x1.4mm. Occasional quartzite.	

Table 47f. Fabric descriptions	
Fabric	Photograph of thin section
R19 Light red fabric. Moderately well sorted, occasional vesicles, moderate quartz with the quartz mainly sub-angular though 20% is angular quartz. Rare calcite precipitation into vesicles up to 1.4x1mm.	

Table 48. Fabric by weight and as a percentage of the total volume of tile		
Fabric	Weight in grams	Weight in grams as a percentage of the total volume of tile
R0	445895	5.49
R1	398827	4.91
R2	314454	3.87
R3	560045	6.90
R4	2925	0.04
R5	171181	2.11
R6	469185	5.78
R7	117830	1.45
R8	198077	2.44
R9	1969933	24.27
R10	2006065	24.71
R11	1014289	12.49
R12	36070	0.44
R13	3535	0.04
R14	55755	0.69
R15	261788	3.22
R16	10735	0.13
R17	39855	0.49
R18	20085	0.25
R19	4370	0.05
R99	17160	0.21

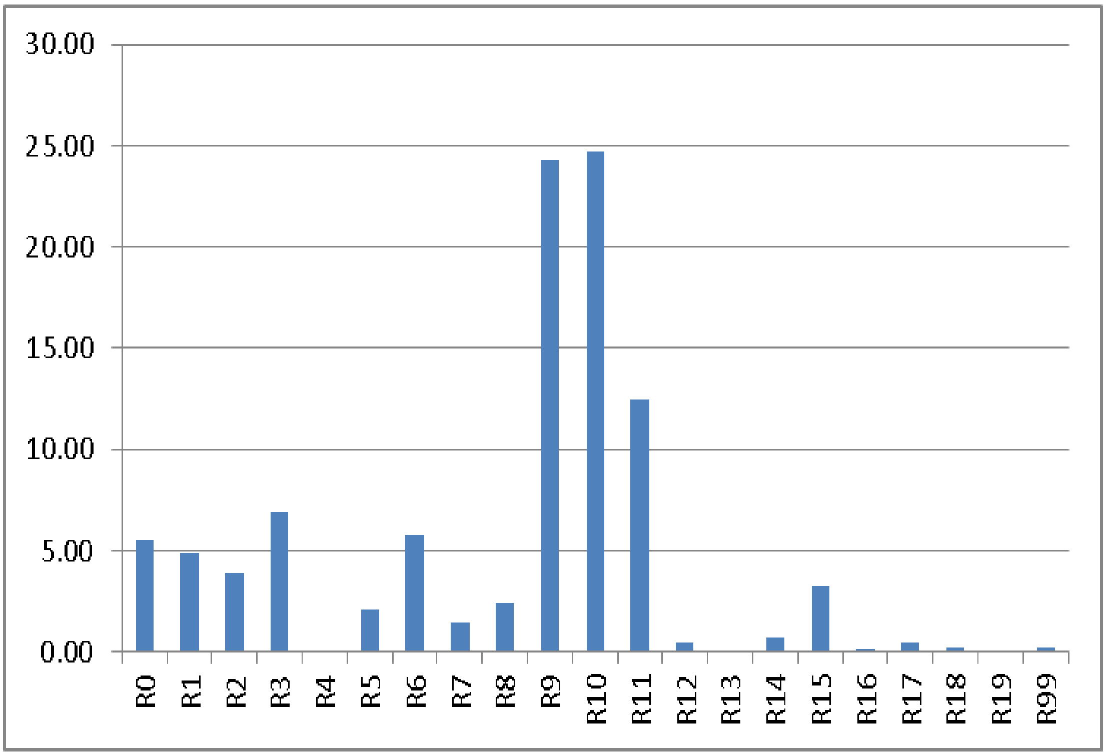


Figure 82. Weight in grams of each fabric as a percentage of the total weight of tile examined

5.1.1 Fabrics in relation to form

The total weight in grams of each fabric in relation to form is given on Table 49. Table 49 shows that even comparatively rare forms, such as antefix or chimney sherds, were made from a variety of fabrics. There is no clear evidence that any specific fabric was reserved for the manufacture of a specific form of tile.

Table 49a. The total weight in grams of each form in relation to fabric						
Form	R0	R1	R2	R3	R4	R5
Antefix						
Bessalis		5900		5275		
Chimney						
Flue	2020	10235	60665	34195	100	4185
Imbrex	2051	55295	40225	91468	1350	29900
Lydion				4600		
Mammata						
Other			1025			
Parietalis			1550			
Pedalis						
Pipe	425	330	275	545		10
Rbrick	435734	257619	104510	334746	1425	98055
Opus spicatum						
Sesquipedalis						
Tegula	5600	67683	106180	89101	50	39031
Tessera	65	65	24	115		
Voussoir		1700				

Table 49b. The total weight in grams of each form in relation to fabric						
Form	R6	R7	R8	R9	R10	R11
Antefix						175
Bessalis	15600	2225	2000	14200	33350	30175
Chimney				225	75	575
Flue	18615	5280	12405	62317	57295	57680
Imbrex	69855	22193	24970	216593	189771	117479
Lydion				2025	9500	5425
Mammata	250					600
Other	3575			800	25020	6500
Parietalis	2175		4725	21631	7000	1875
Pedalis					3350	13425
Pipe	10110	455	135	3315	3434	1745
Rbrick	254883	75417	95152	1158443	1349814	519680
Opus spicatum						
Sesquipedalis						4650
Tegula	94042	12260	58690	487964	327061	252490
Tessera	80			310	395	665
Voussoir				2110		1150

Table 49c. The total weight in grams of each form in relation to fabric						
Form	R12	R13	R14	R15	R16	R17
Antefix					75	
Bessalis	1575			3275	1575	1375
Chimney				550		
Flue	4300	175	10625	13790	1460	825
Imbrex	4290	200	6380	34062	375	5650
Lydion						
Mammata			1350	550		
Other				500		
Parietalis			850	775		
Pedalis						
Pipe			1485	5815		
Rbrick	21035	2085	14065	151584	2525	24365
Opus spicatum					300	
Sesquipedalis						
Tegula	4870	1075	20970	50762	4425	7640
Tessera			30			
Voussoir				125		

Table 49d. The total weight in grams of each form in relation to fabric			
Form	R18	R19	R99
Antefix			
Bessalis			
Chimney			
Flue		825	1650
Imbrex	1725	845	1975
Lydion			5000
Mammata			
Other	5460		
Parietalis			
Pedalis			
Pipe			50
Rbrick	10750	2450	4650
Opus spicatum			
Sesquipedalis			
Tegula	2150	250	3835
Tessera			
Voussoir			

5.1.2 Fabrics in relation to zone

The total weight in grams of each fabric overall and in relation to the three zones of the study area is given on Table 50, while distribution maps for the individual fabrics are given in Appendix 5.1.3. All the fabrics were present in all three zones of the study area. It is clear, therefore, that no individual fabric was used exclusively in any given zone, the only exception being the rare fabric R19 which was only present in the *colonia* and the environs.

Table 50. The total weight in grams for each fabric in the study area overall and within the fortress, *colonia* and environs

Fabric	Overall	Fortress	*Colonia*	Environs
R0	445895	13989	231374	75132
R1	398827	65555	230040	103232
R2	314454	257885	38910	17659
R3	560045	101330	335932	122783
R4	2925	250	1900	775
R5	171181	3060	157766	10355
R6	469185	53767	272990	142428
R7	117830	21050	77260	19520
R8	198077	153447	25975	18655
R9	1969933	517954	962686	489293
R10	2006065	63096	1717539	225430
R11	1014289	87420	633314	293555
R12	36070	7930	21935	6205
R13	3535	285	2400	850
R14	55755	42575	5460	7720
R15	261788	19145	227578	15035
R16	10735	2750	3675	4310
R17	39855	6995	26920	5940
R18	20085	950	2975	16160
R19	4370	0	4020	350
R99	17160	5975	7160	4025
Total	8118059	1550808	4987809	1579412

5.1.3 Distribution maps for the fabrics in the present study

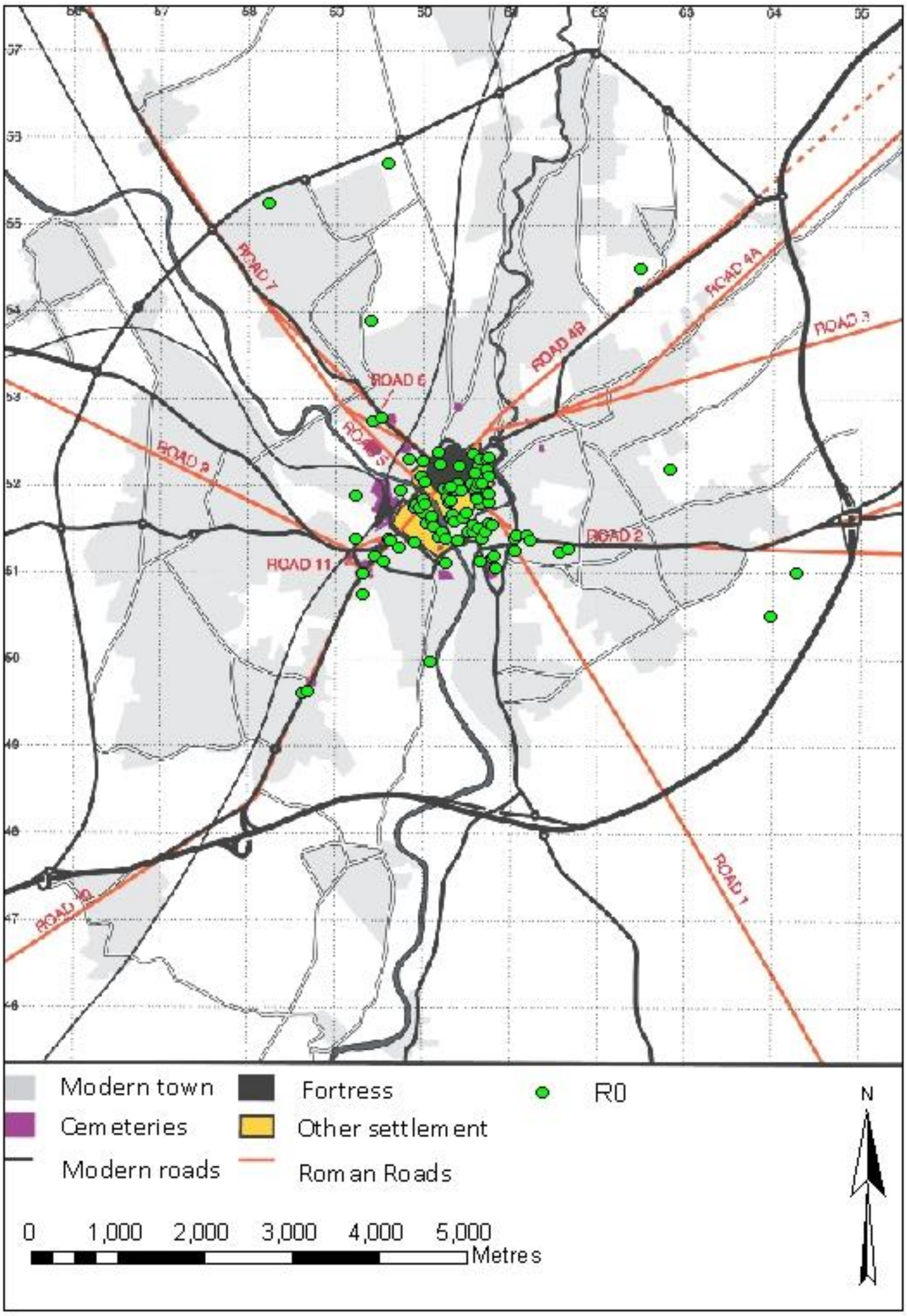


Figure 83. The location of Fabric R0. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

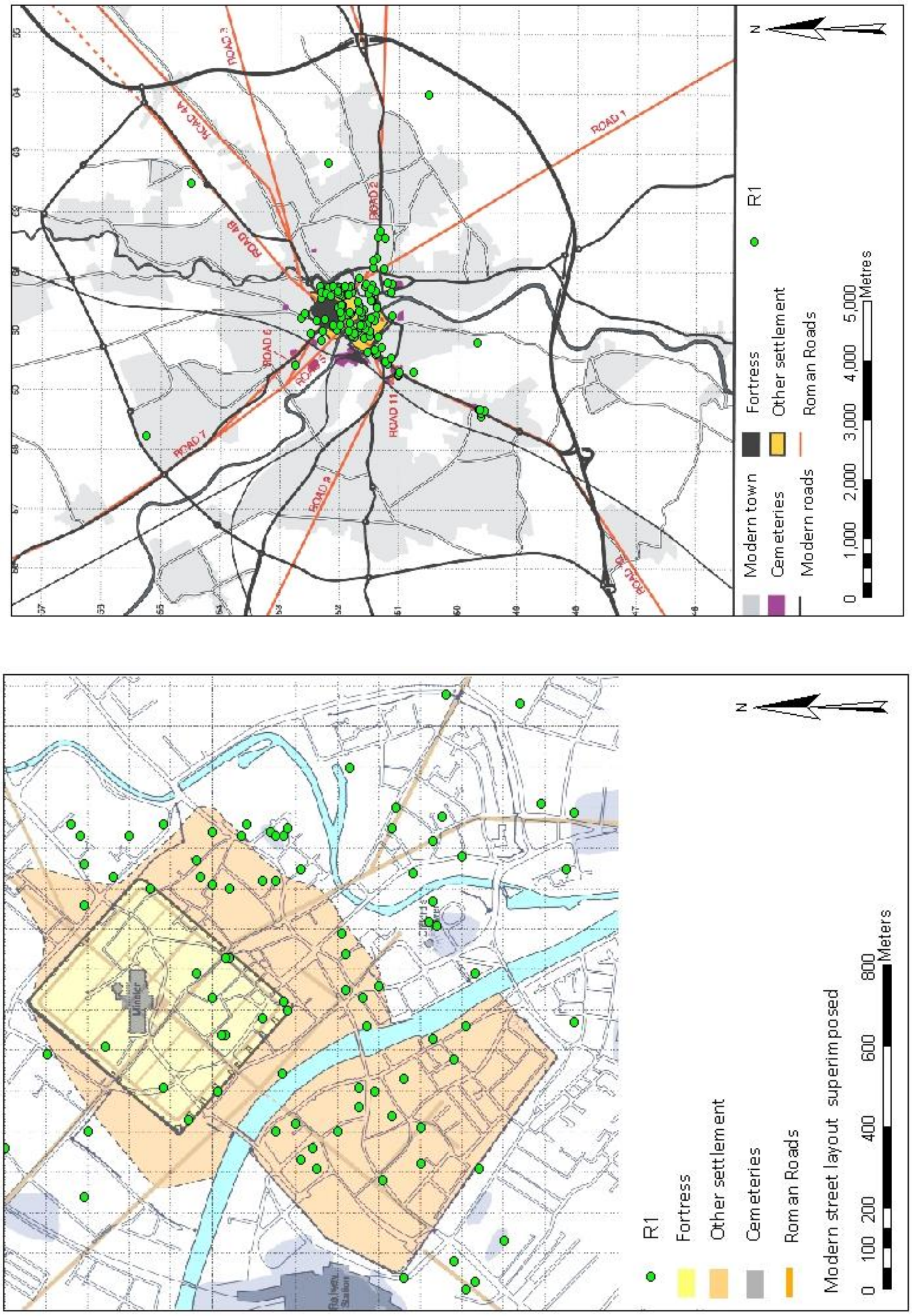
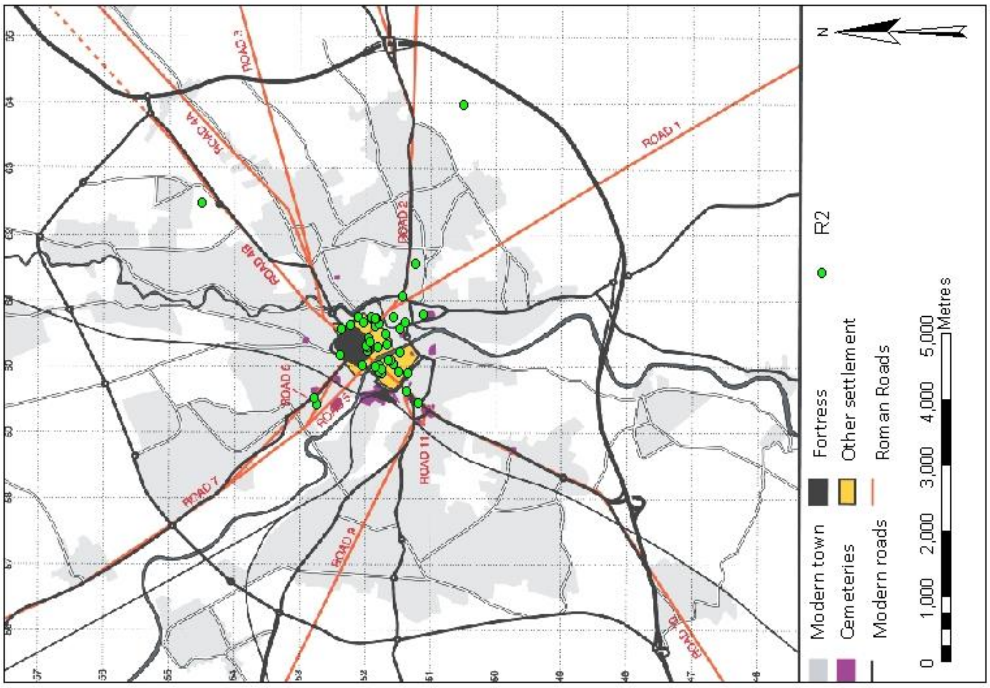


Figure 84. The location of Fabric R1. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).



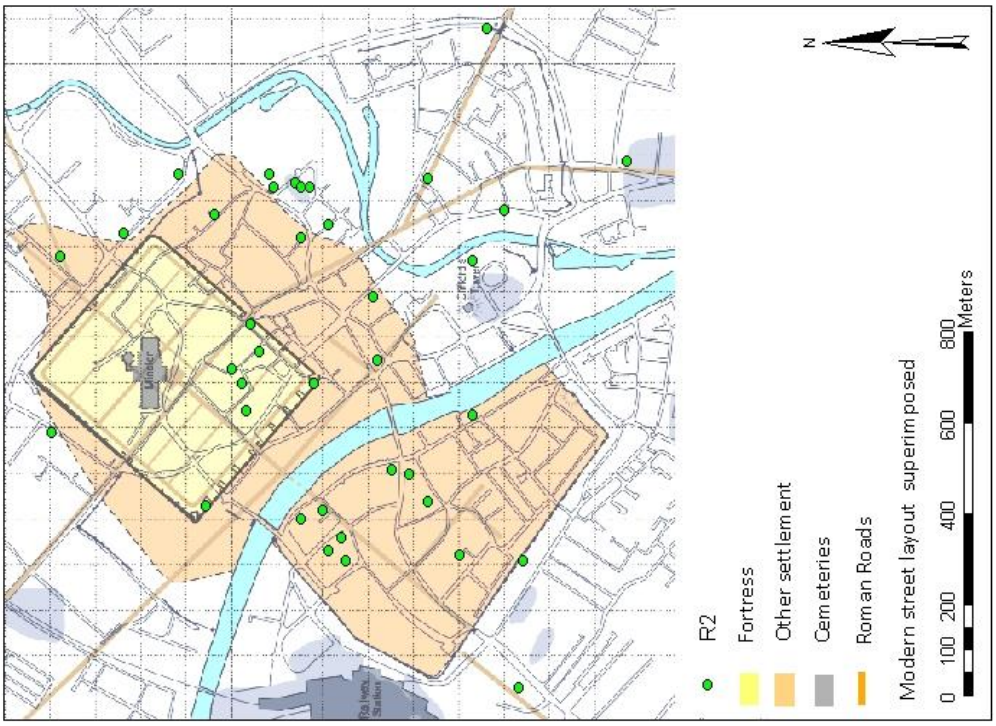


Figure 85. The location of Fabric R2. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

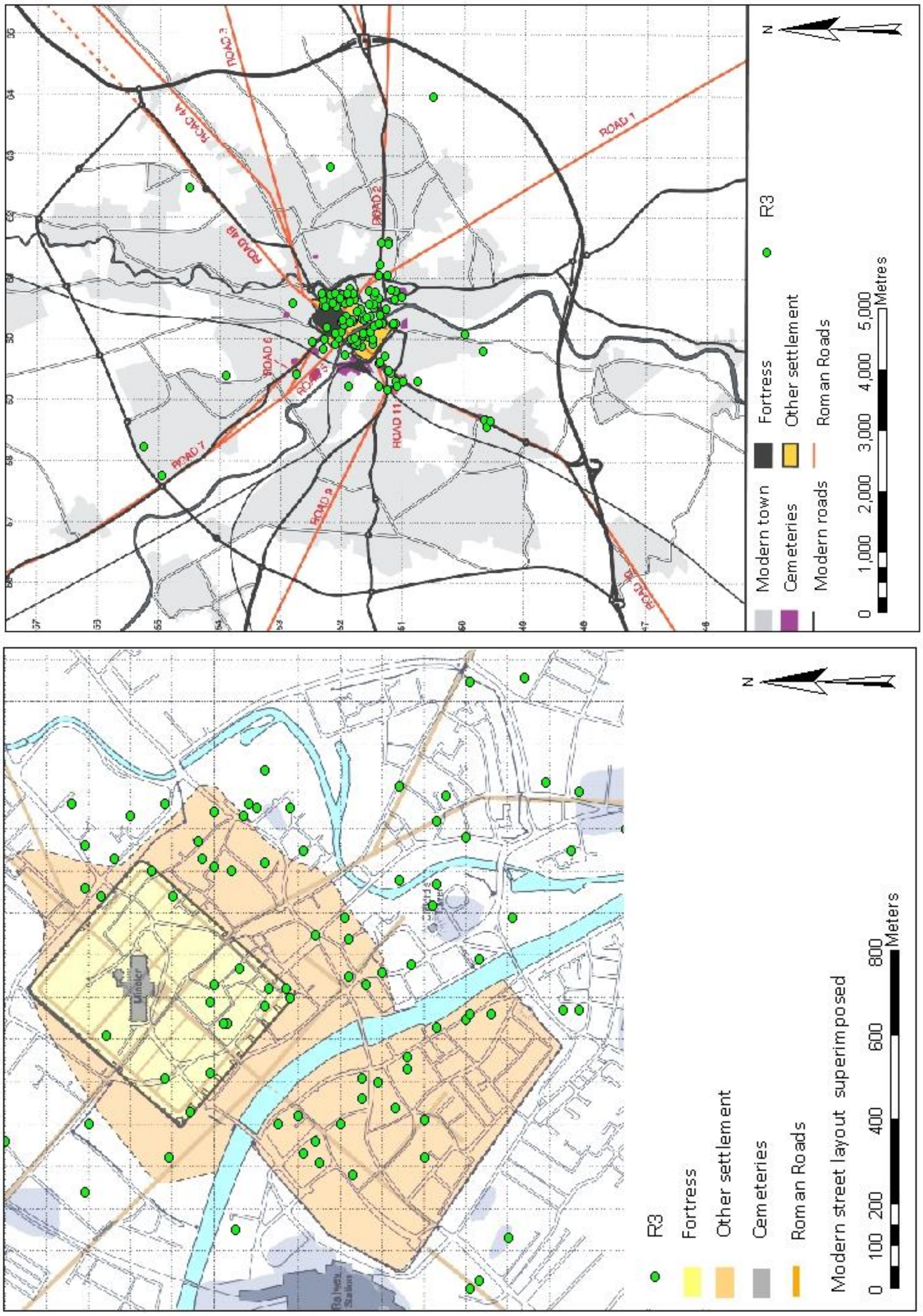


Figure 86. The location of Fabric R3. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

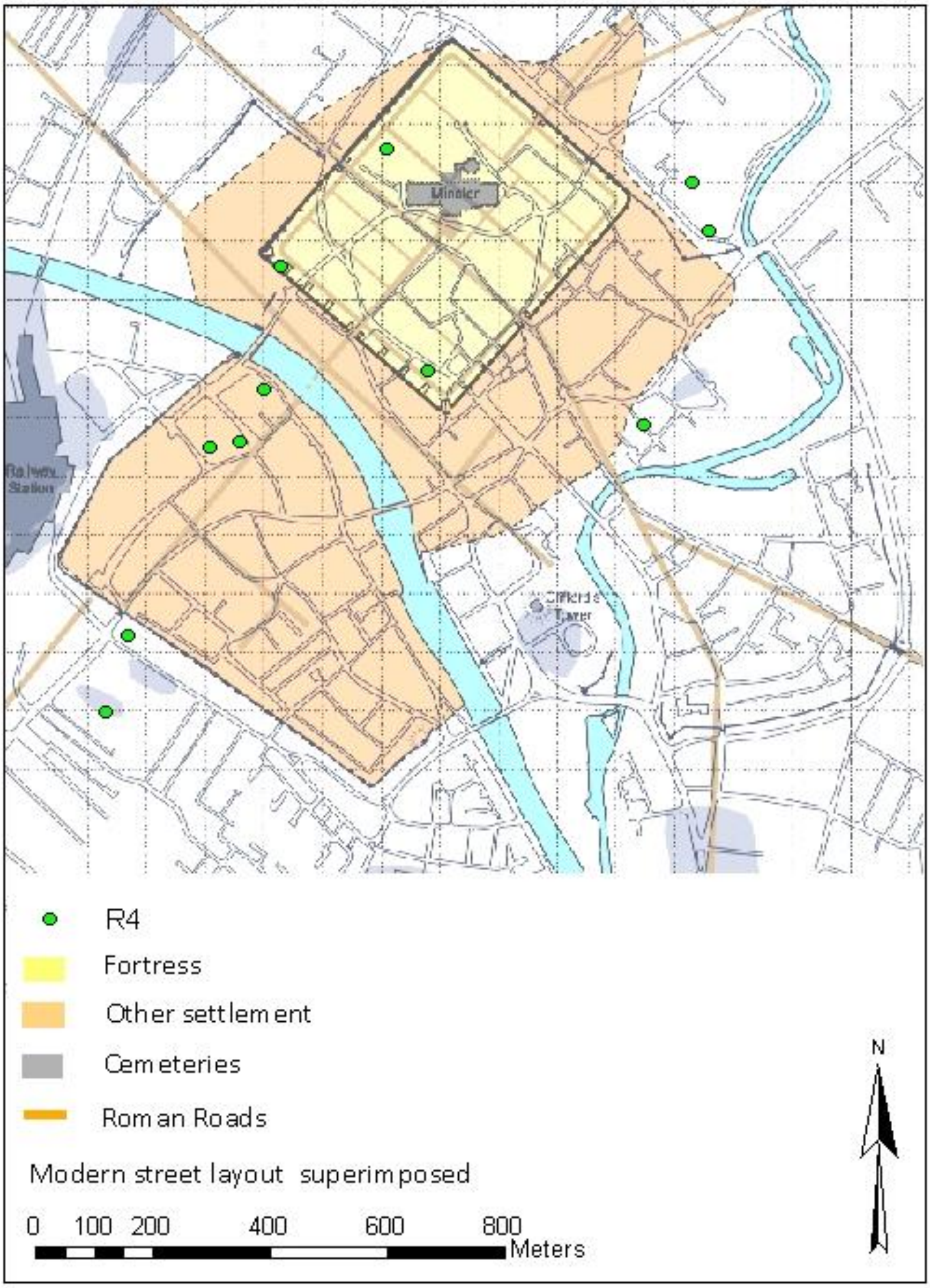


Figure 87. The location of Fabric R4. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

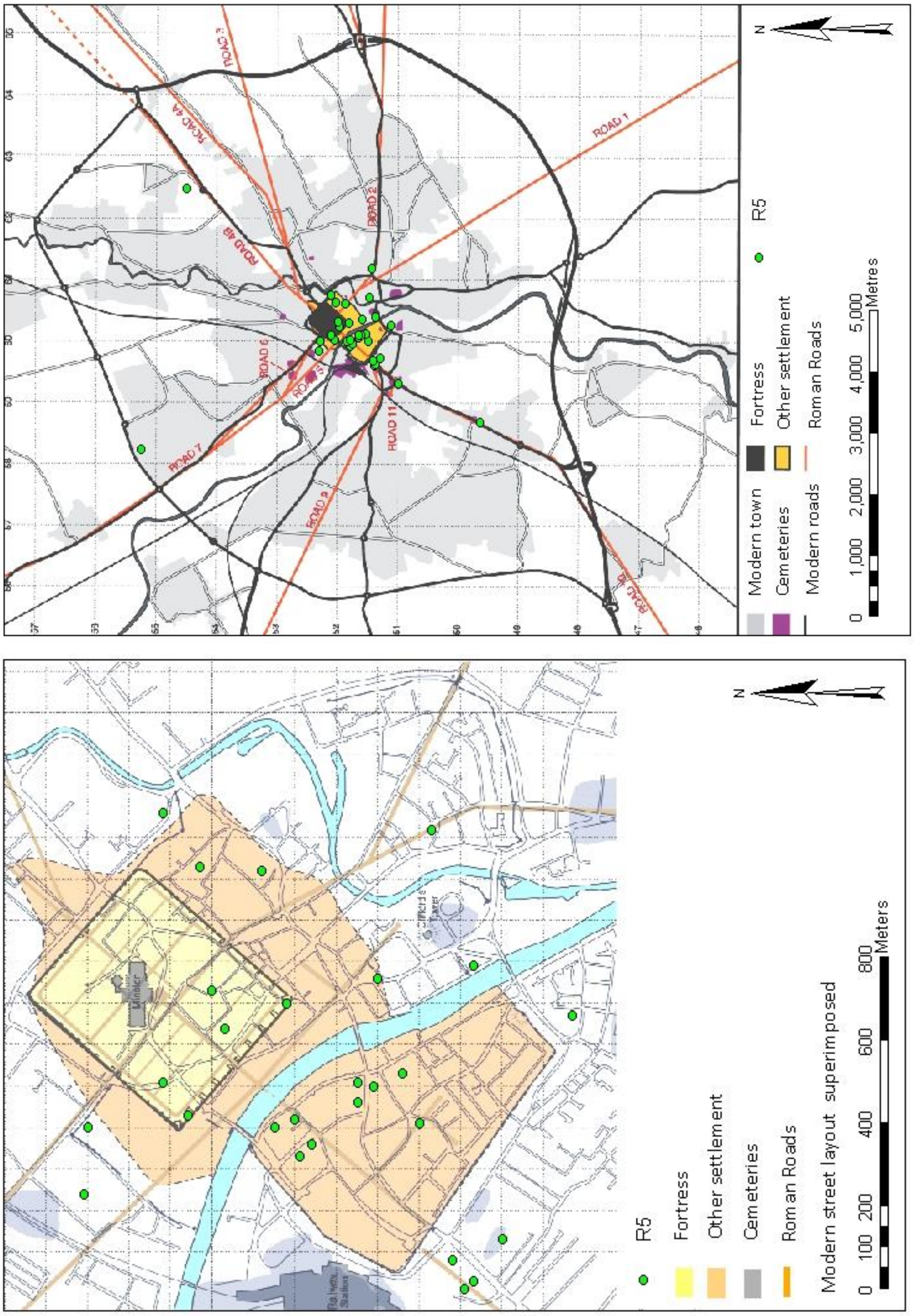


Figure 88. The location of Fabric R5. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

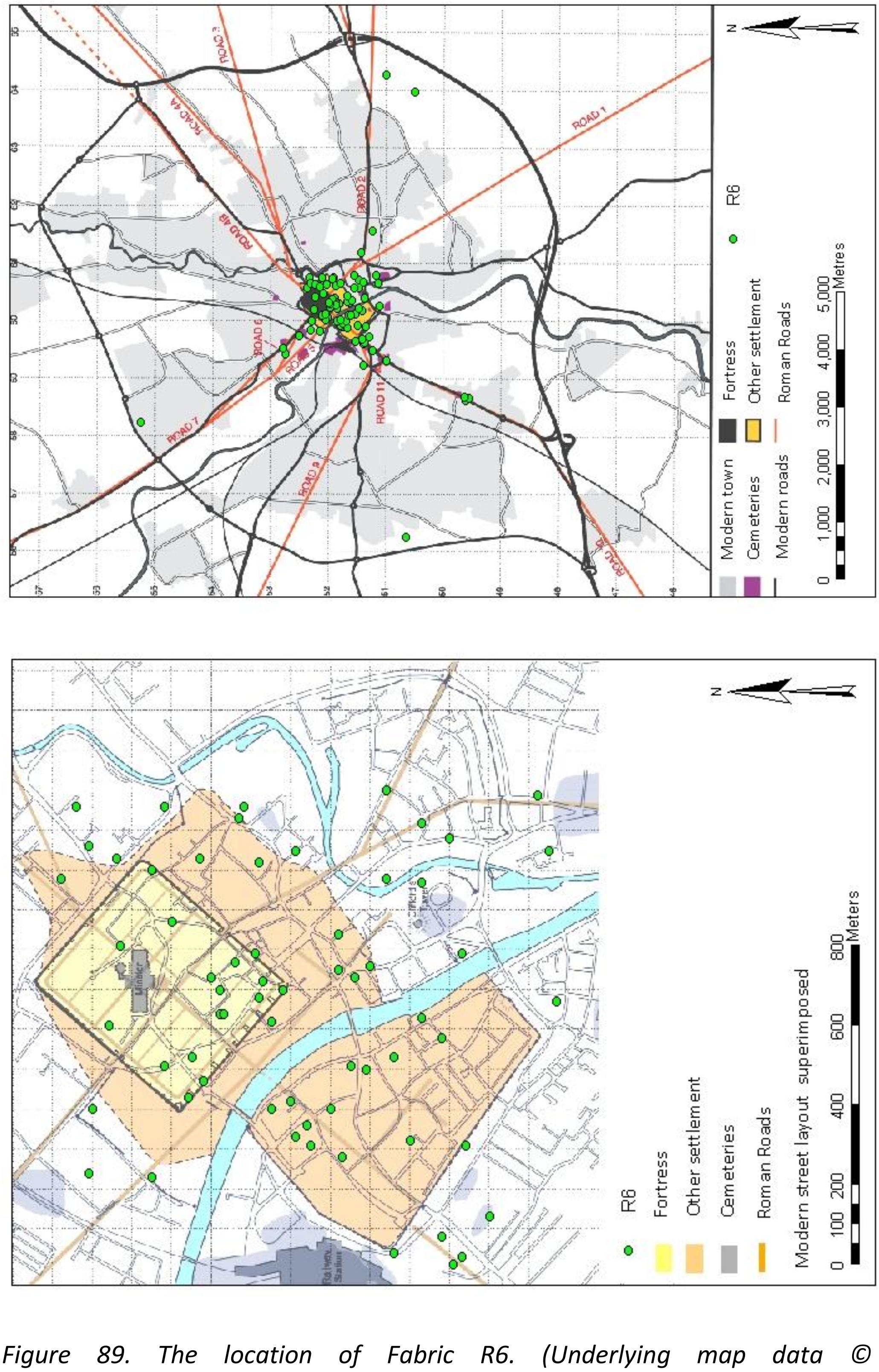
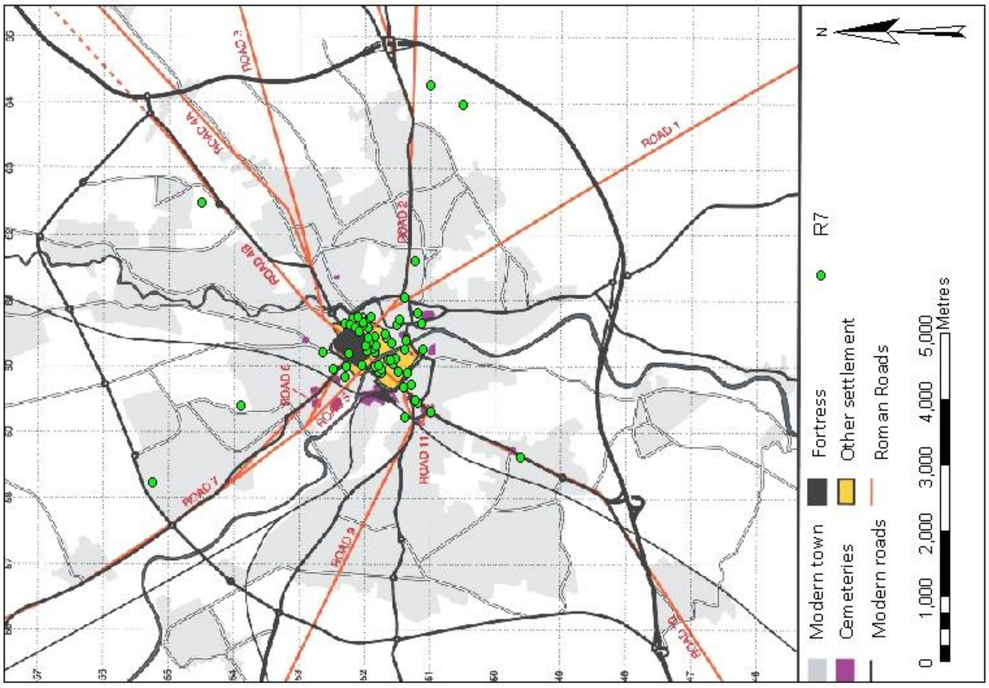


Figure 89. The location of Fabric R6. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).



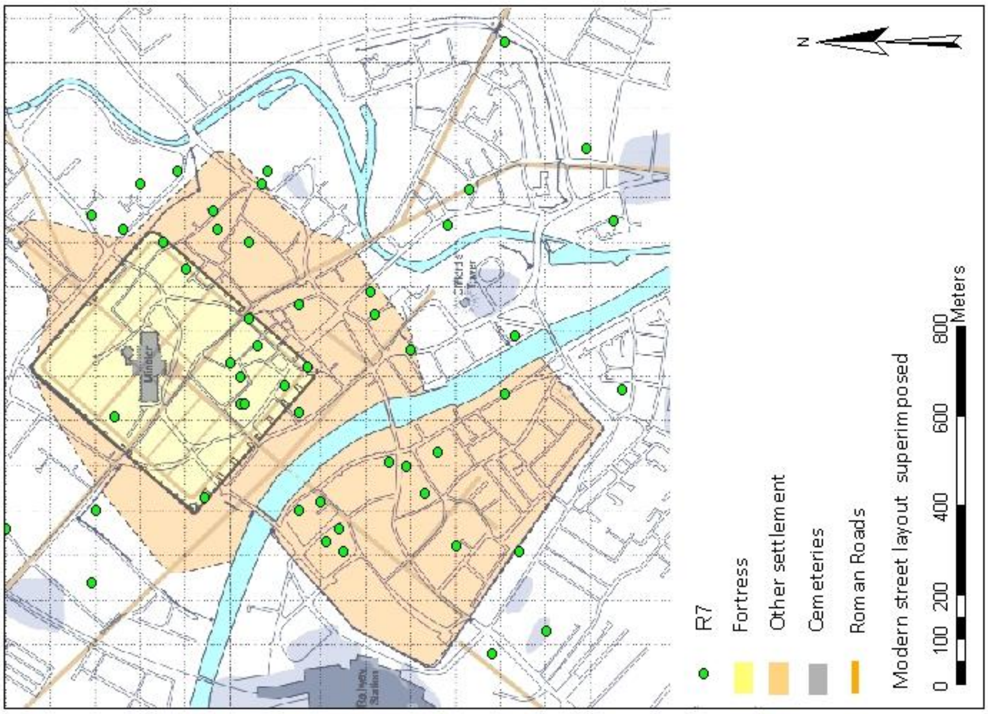
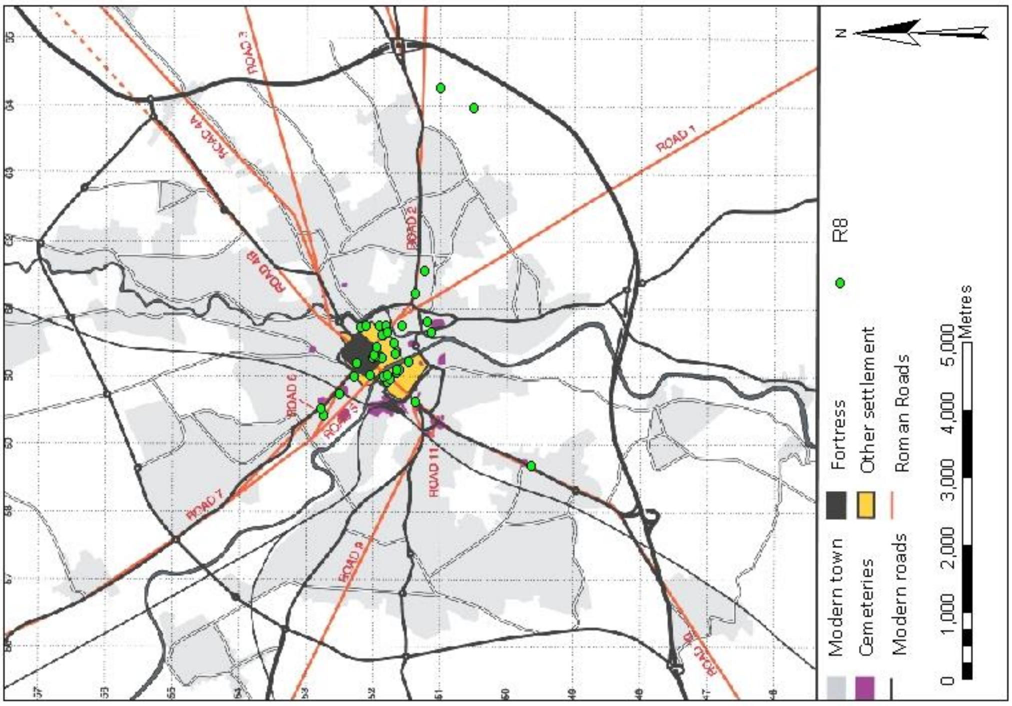


Figure 90. The location of Fabric R7. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).



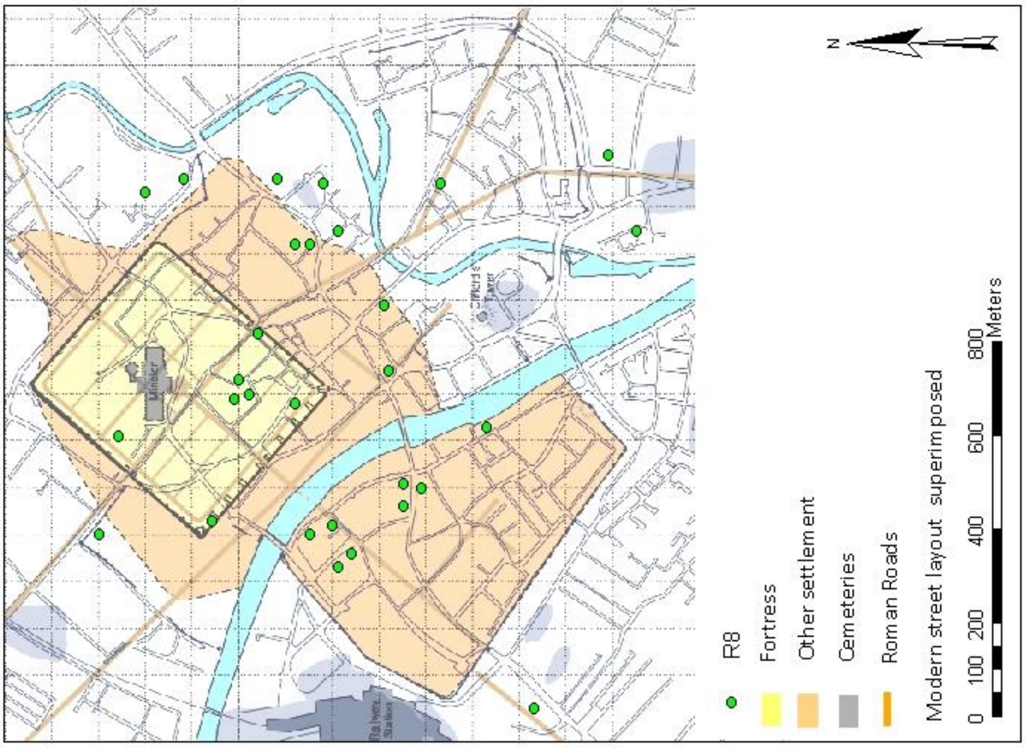
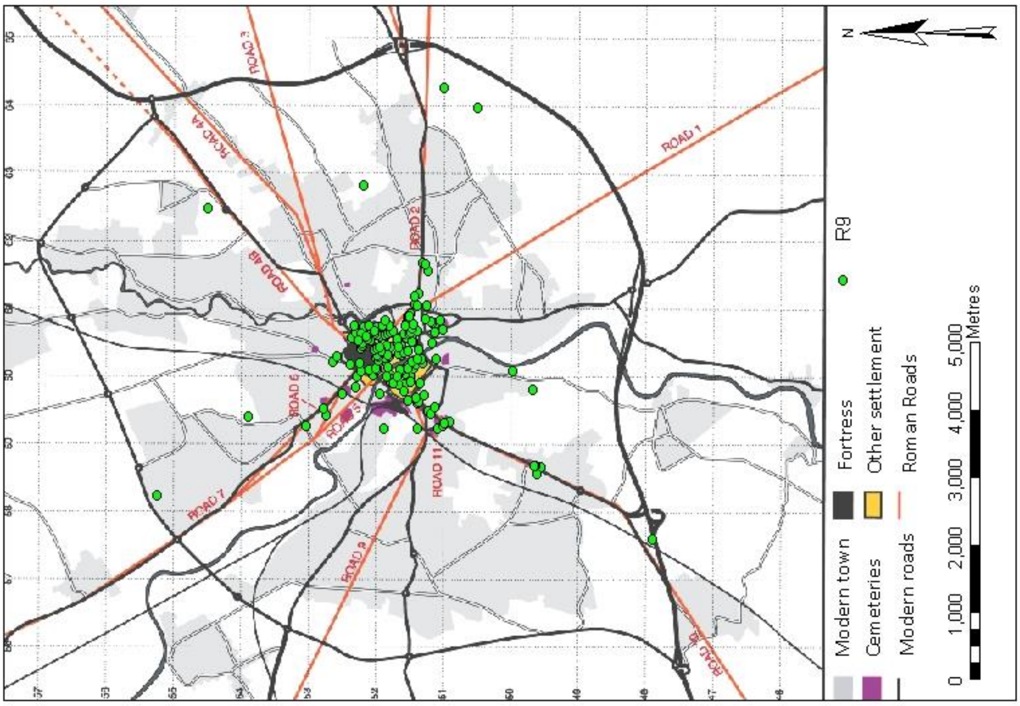


Figure 91. The location of Fabric R8. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).



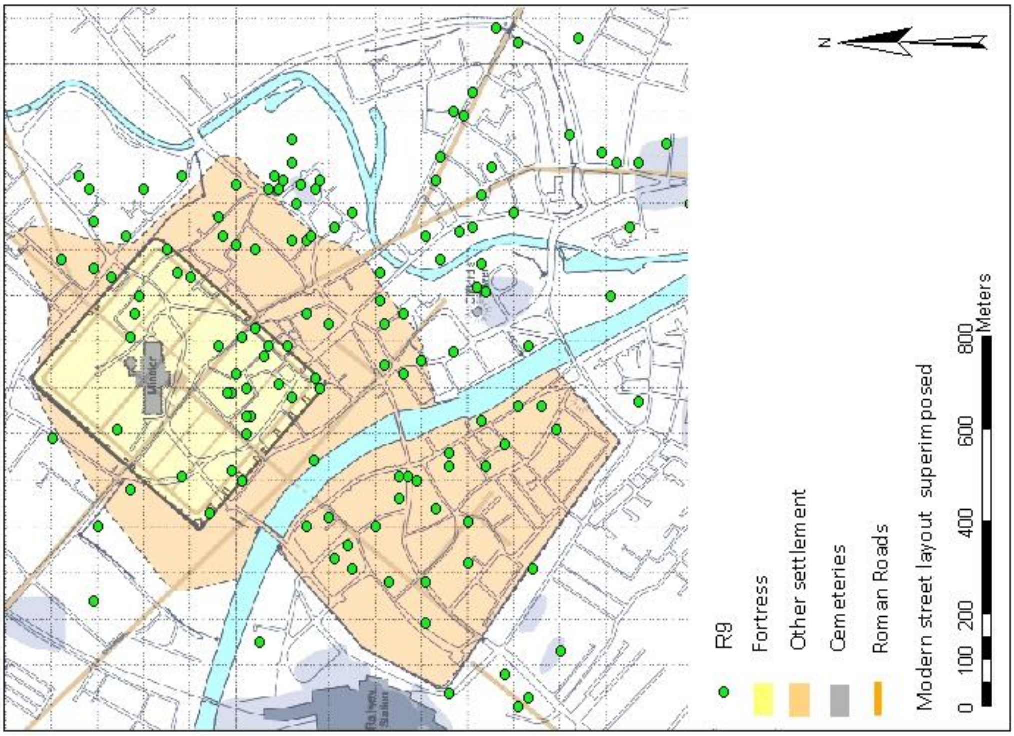
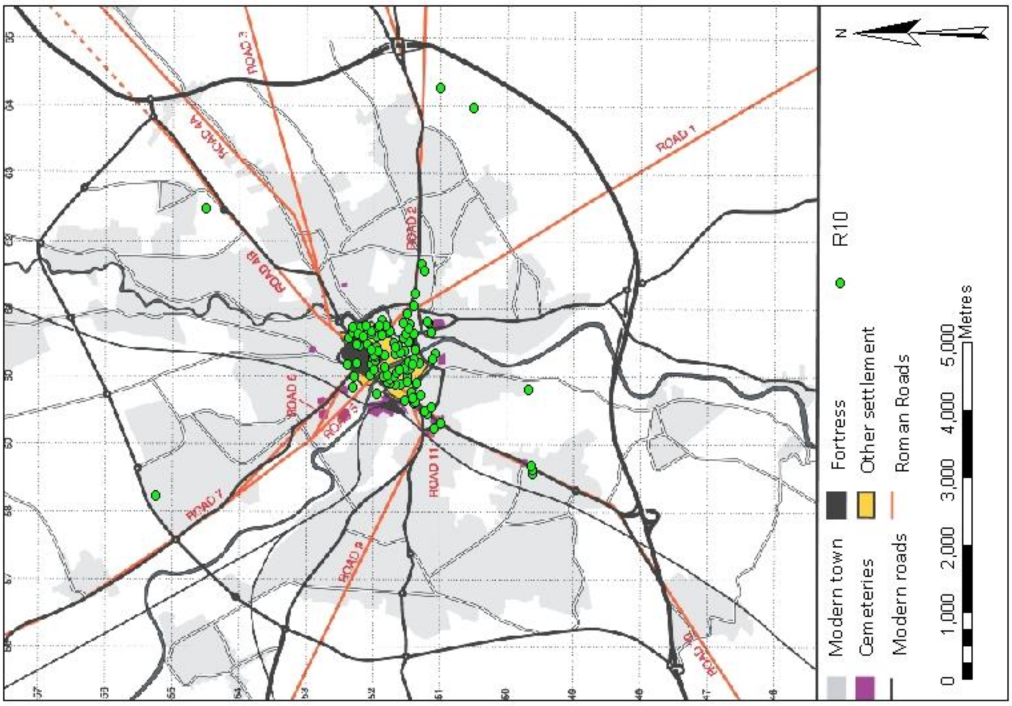


Figure 92. The location of Fabric R9. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).



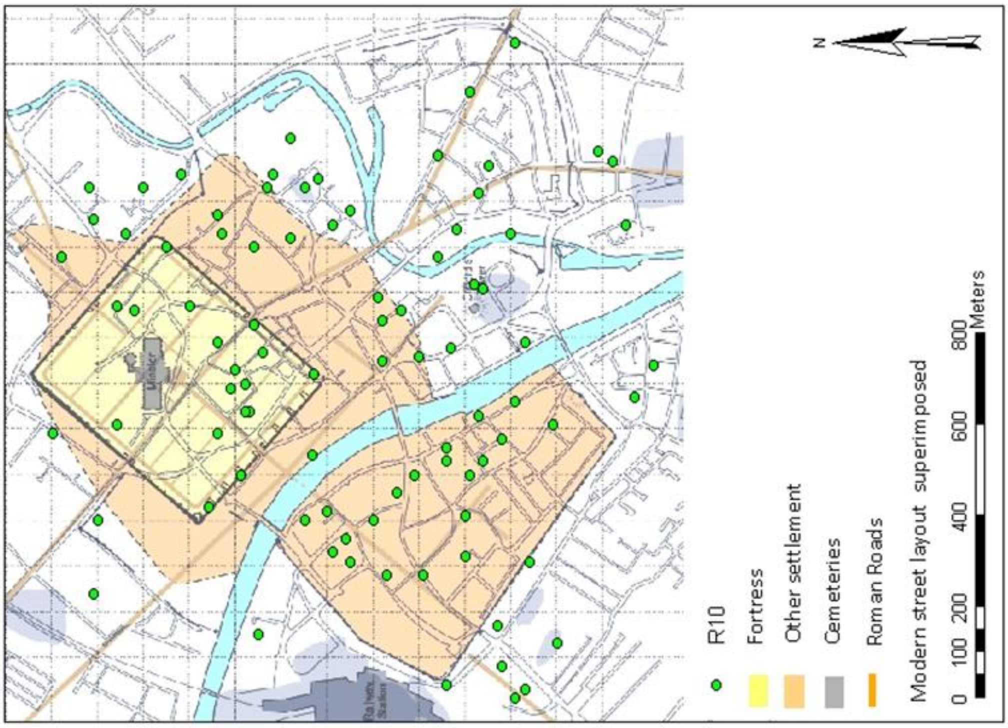
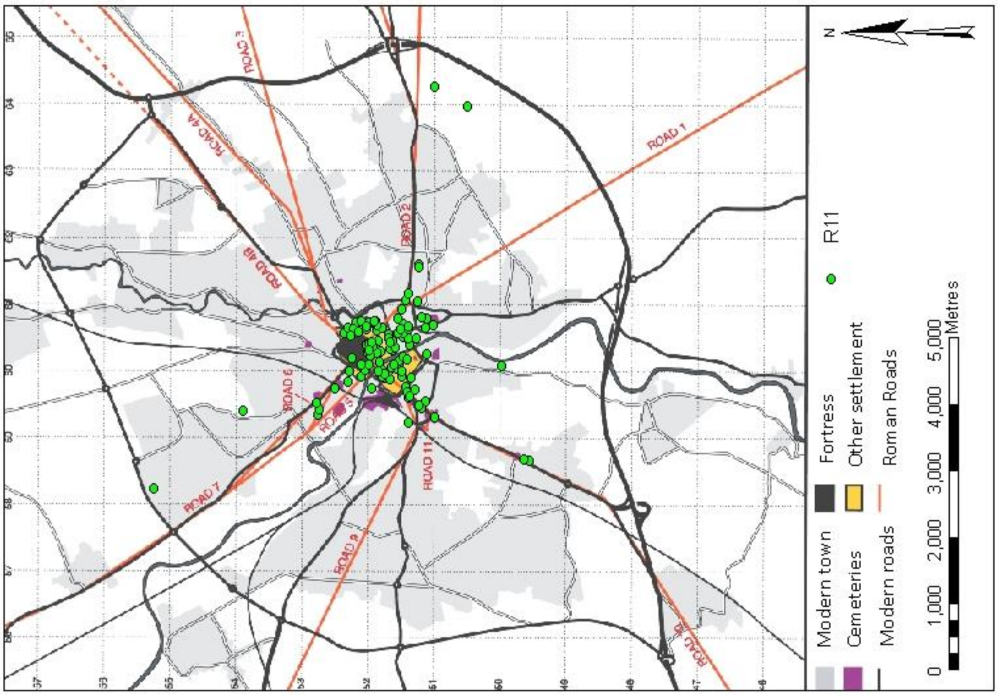


Figure 93. The location of Fabric R10. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).



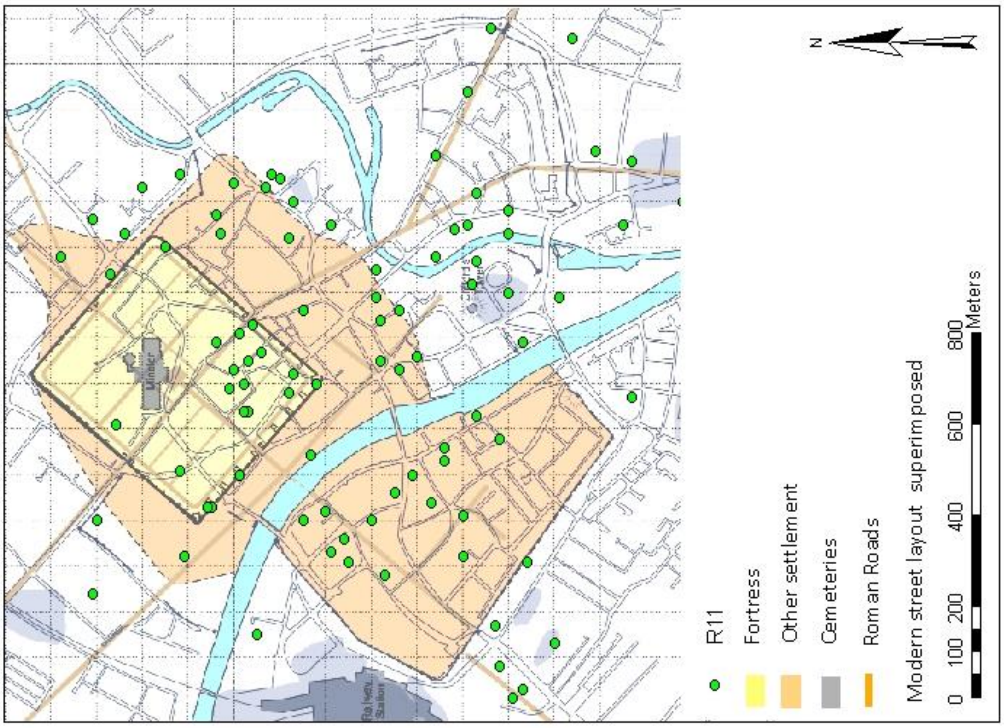


Figure 94. The location of Fabric R11. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

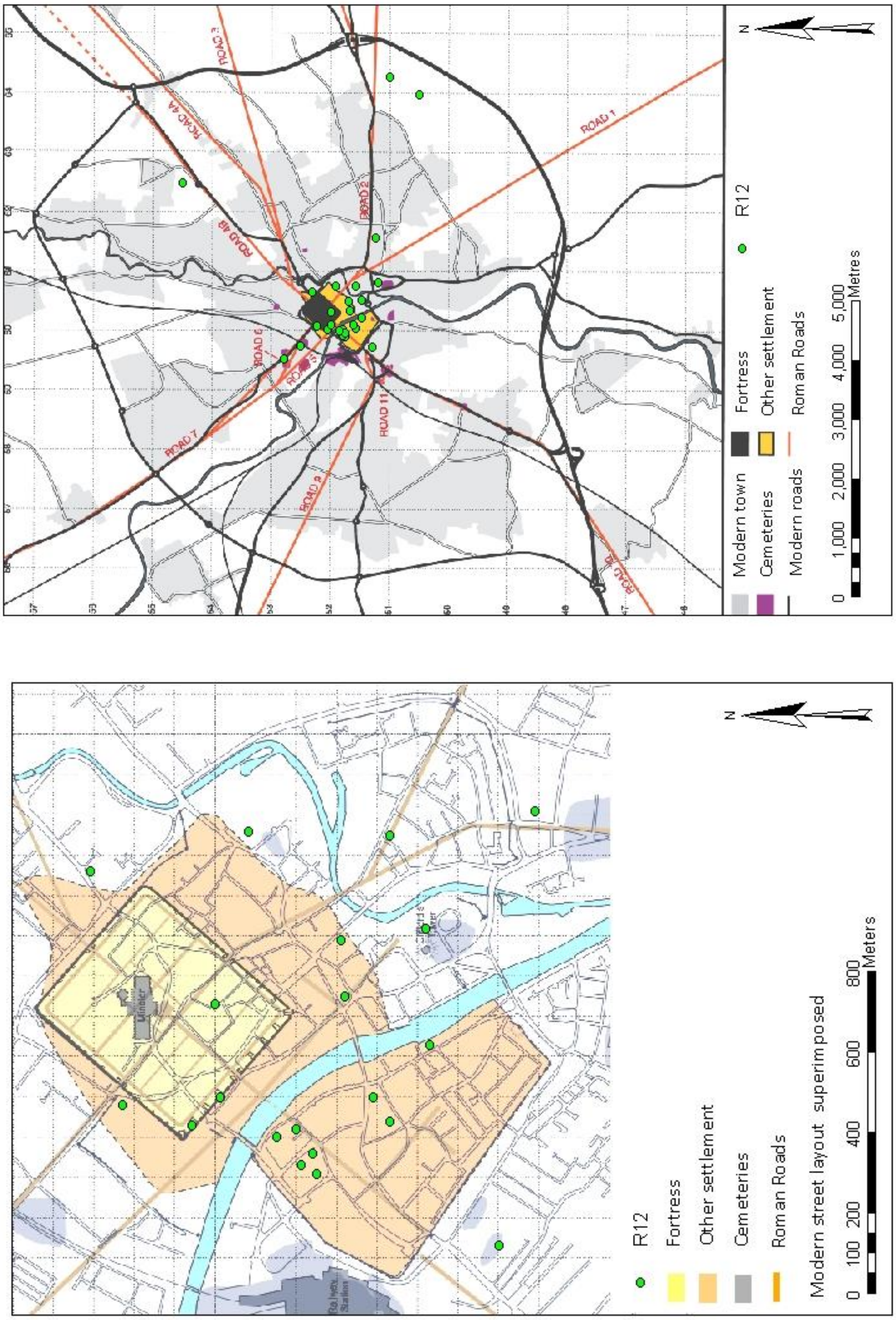


Figure 95. The location of Fabric R12. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

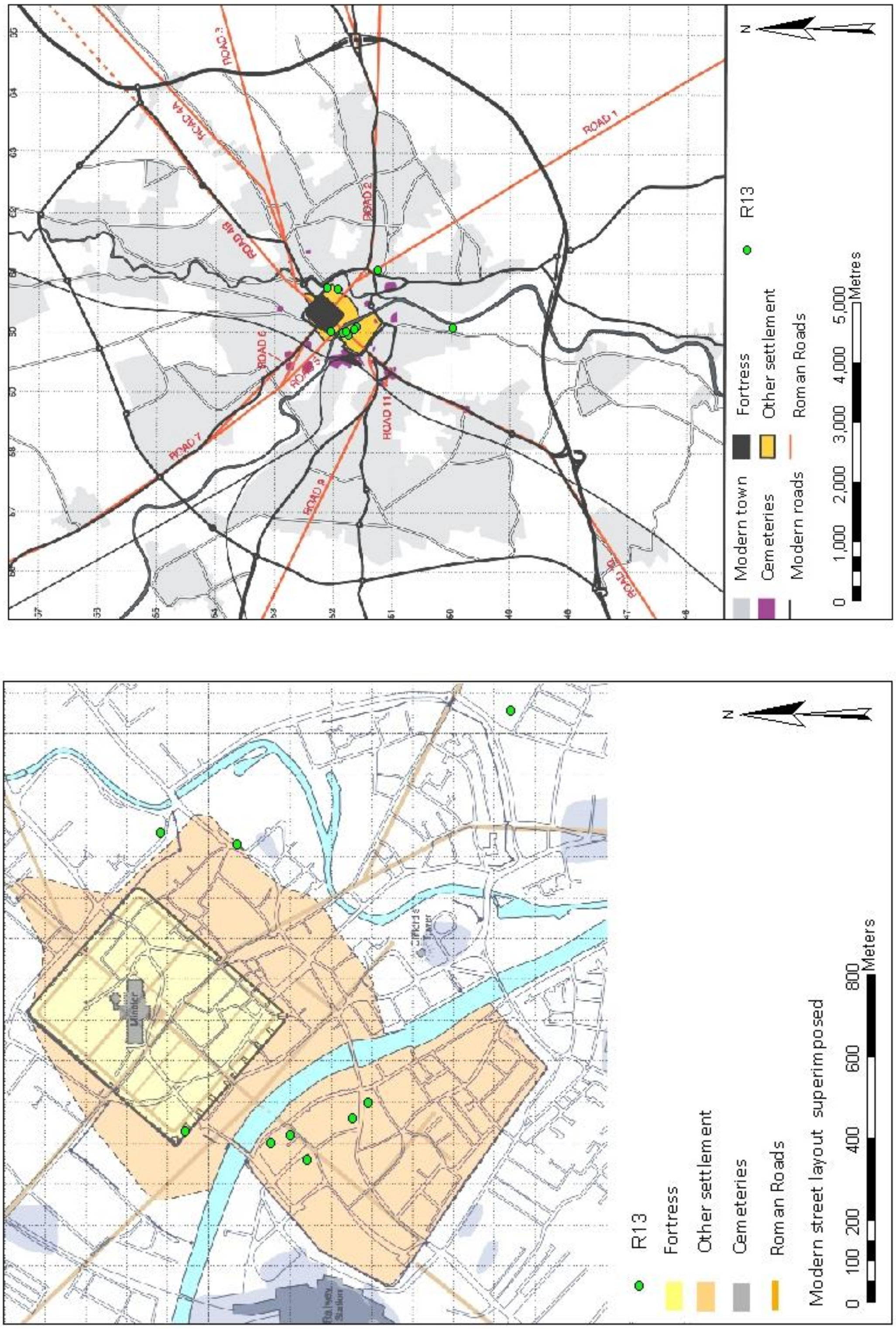
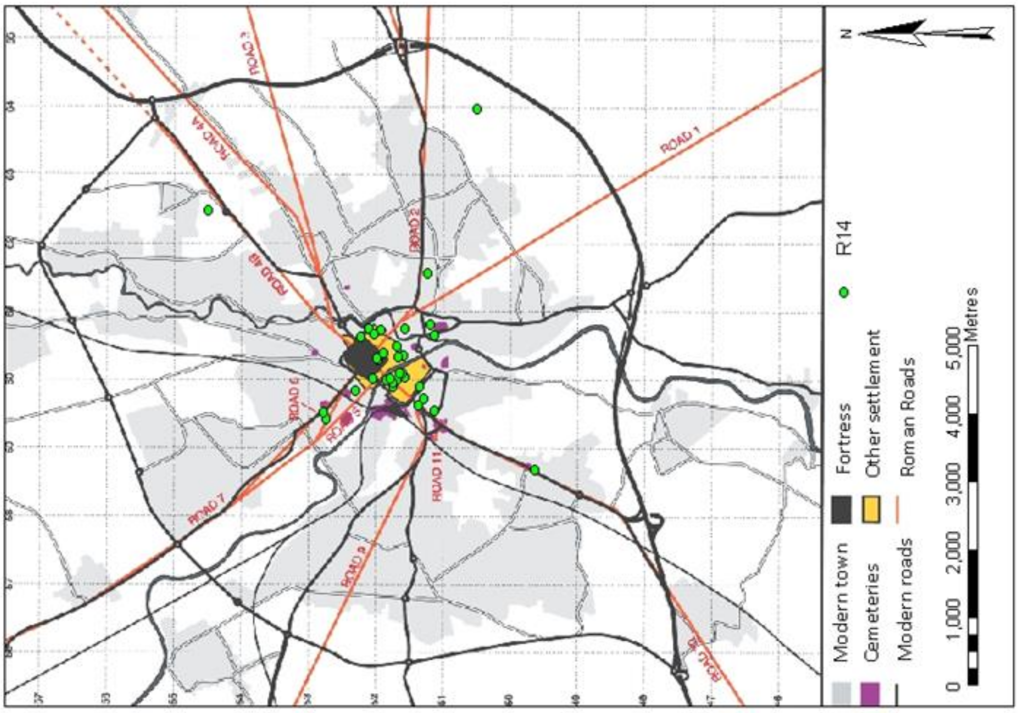


Figure 96. The location of Fabric R13, (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).



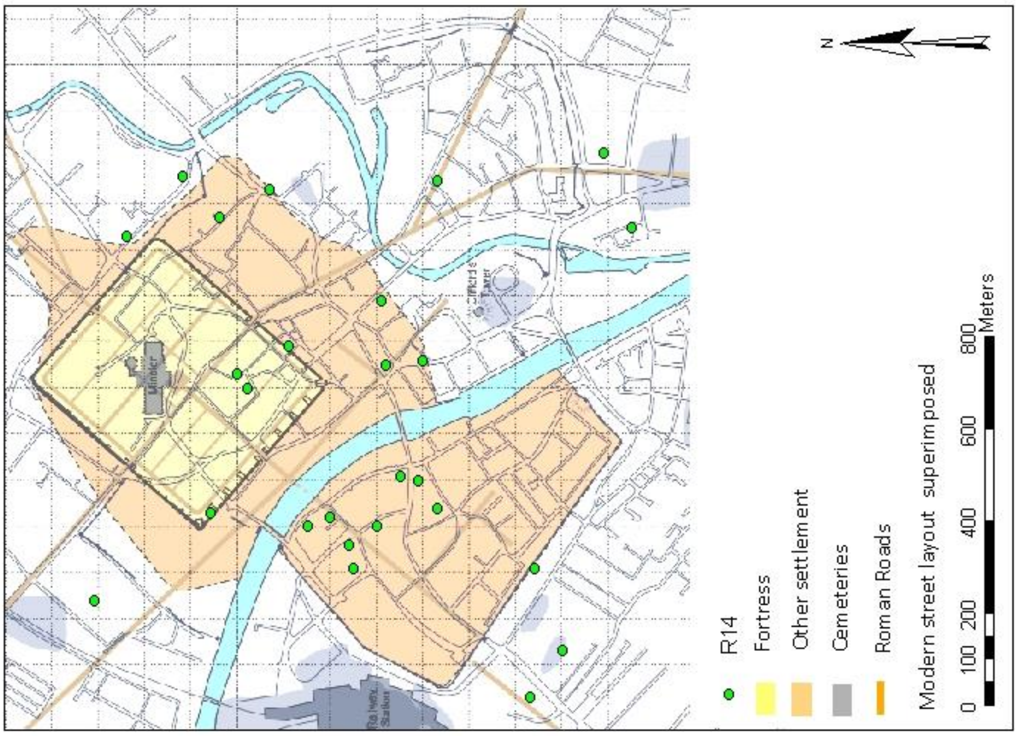


Figure 97. The location of Fabric R14. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

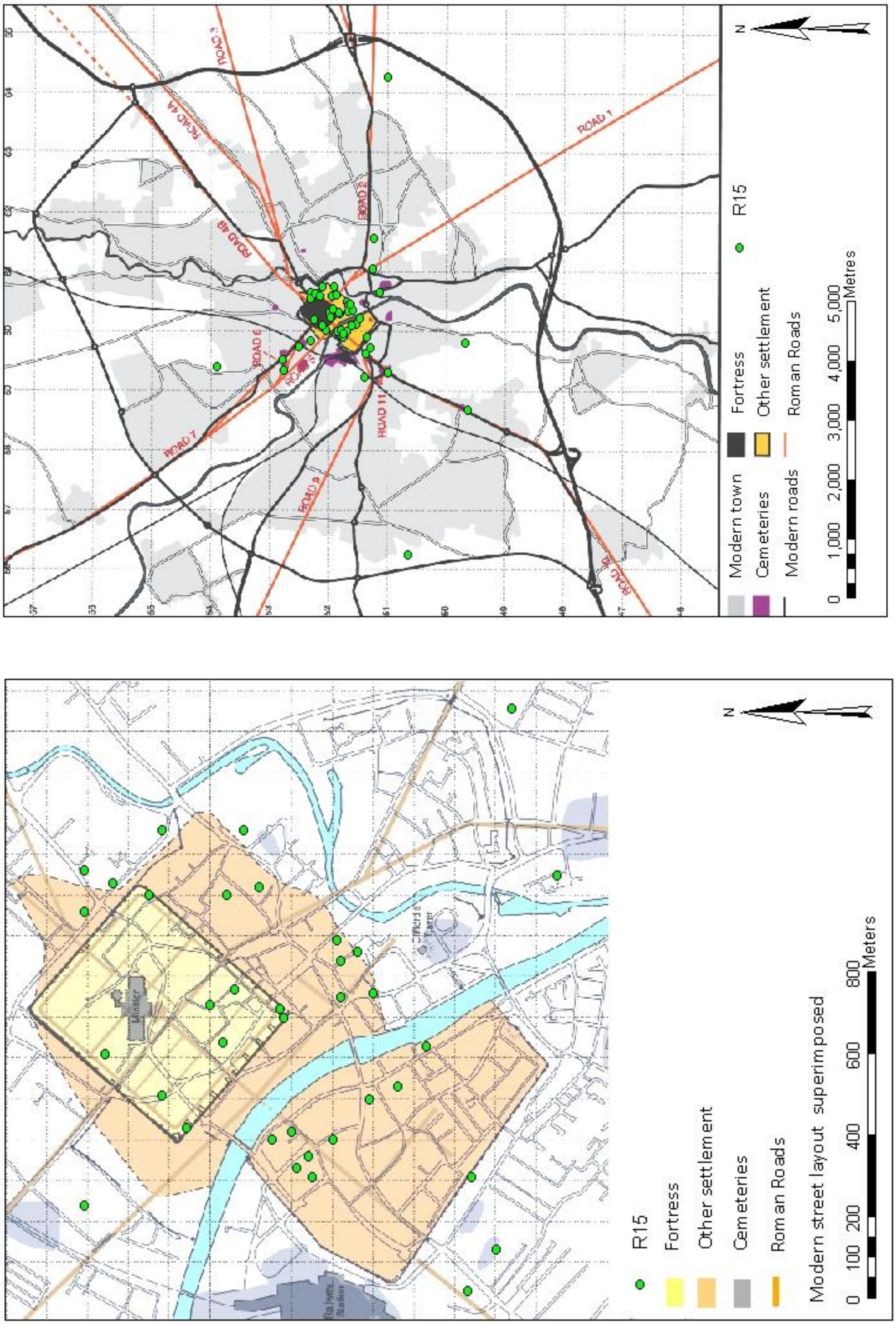


Figure 98. The location of Fabric R15. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

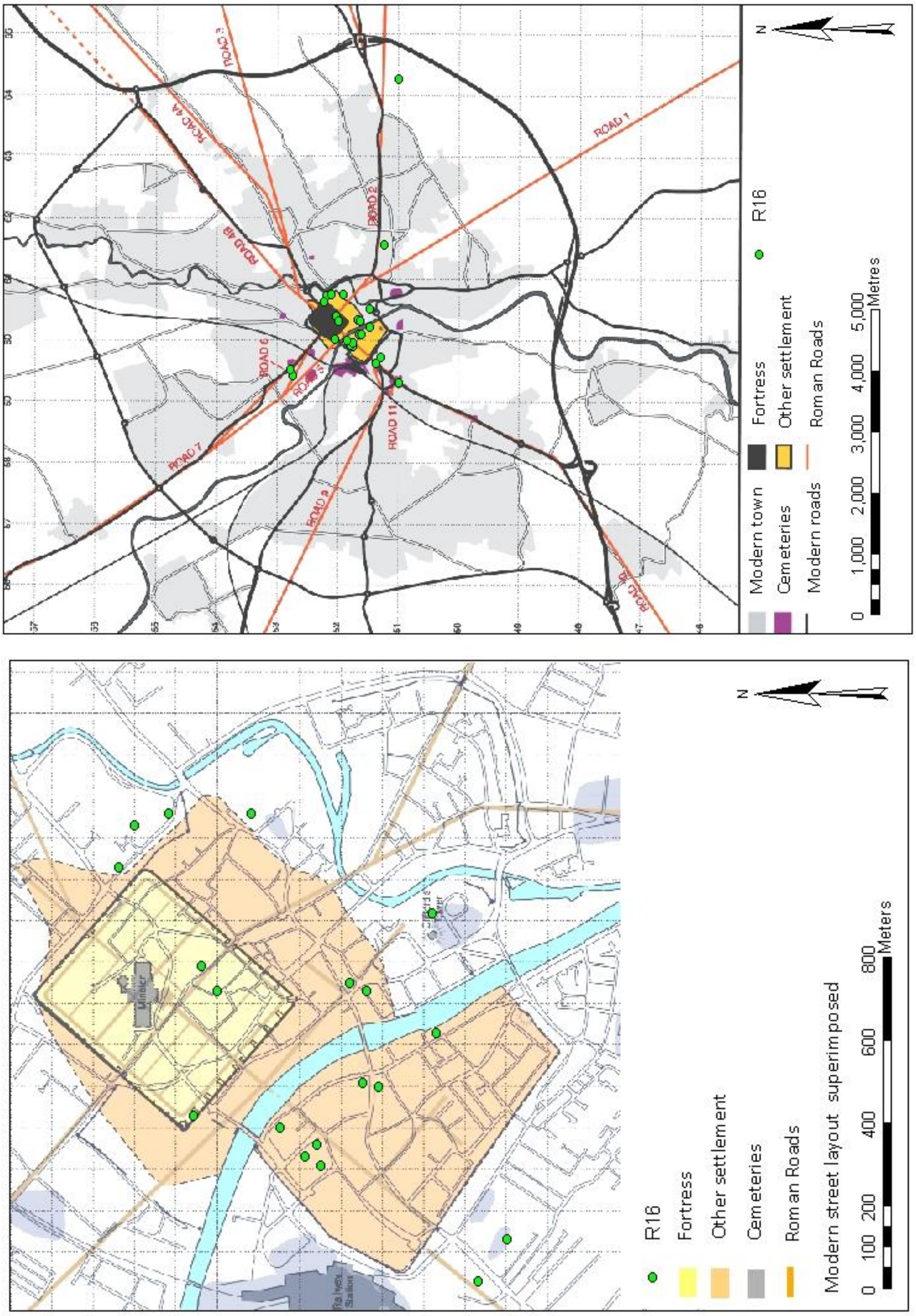


Figure 99. The location of Fabric R16. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

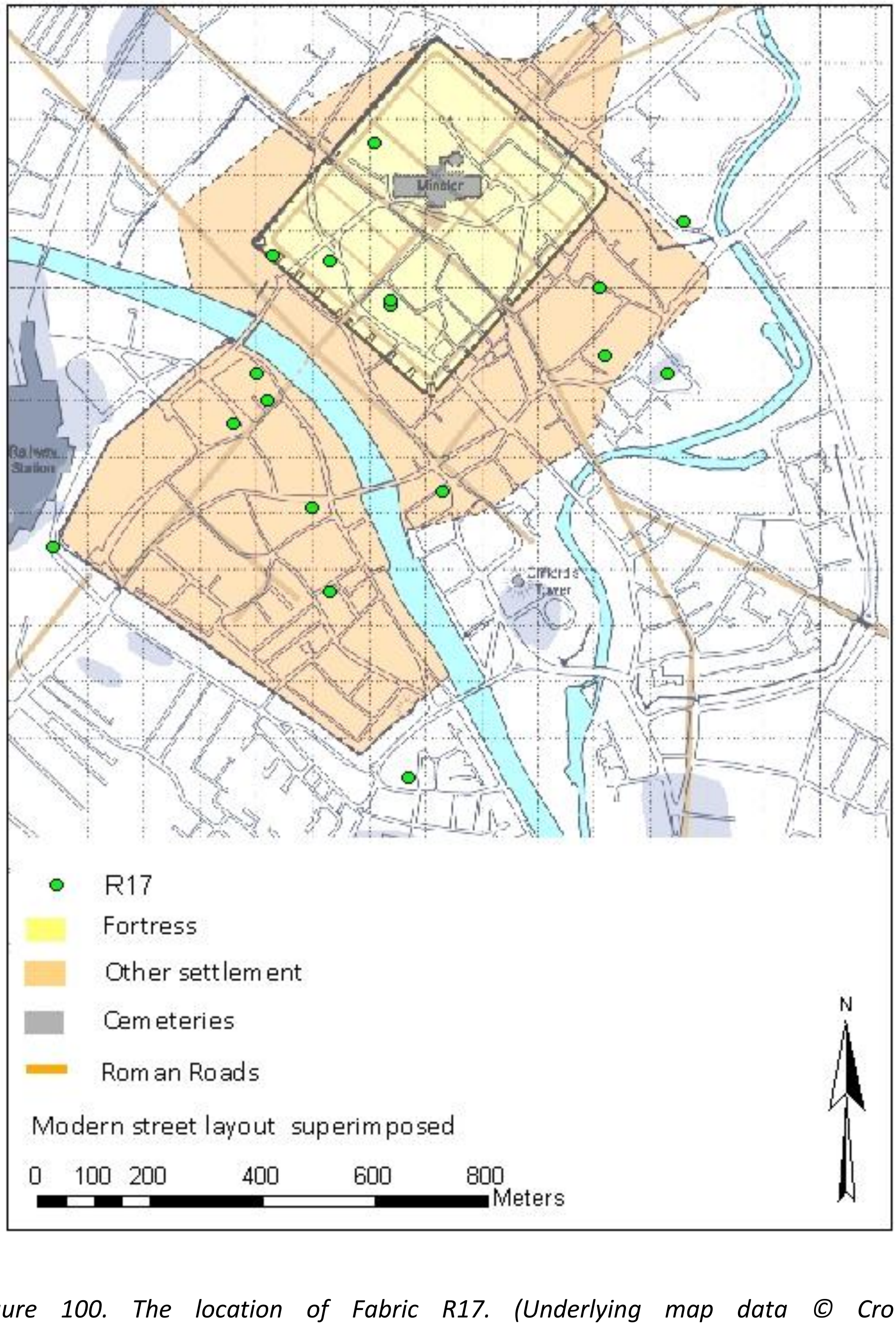


Figure 100. The location of Fabric R17. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

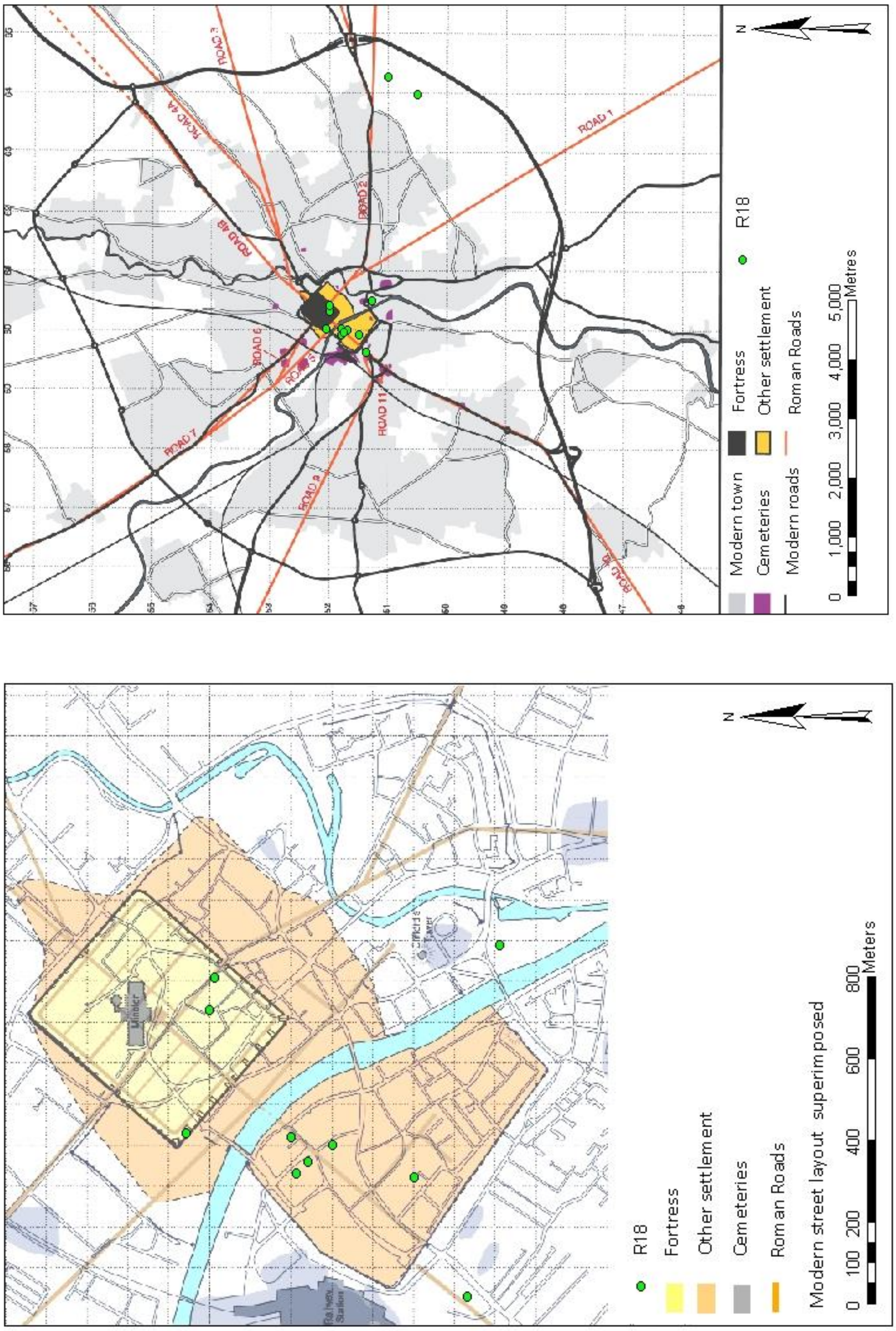


Figure 101. The location of Fabric R18. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

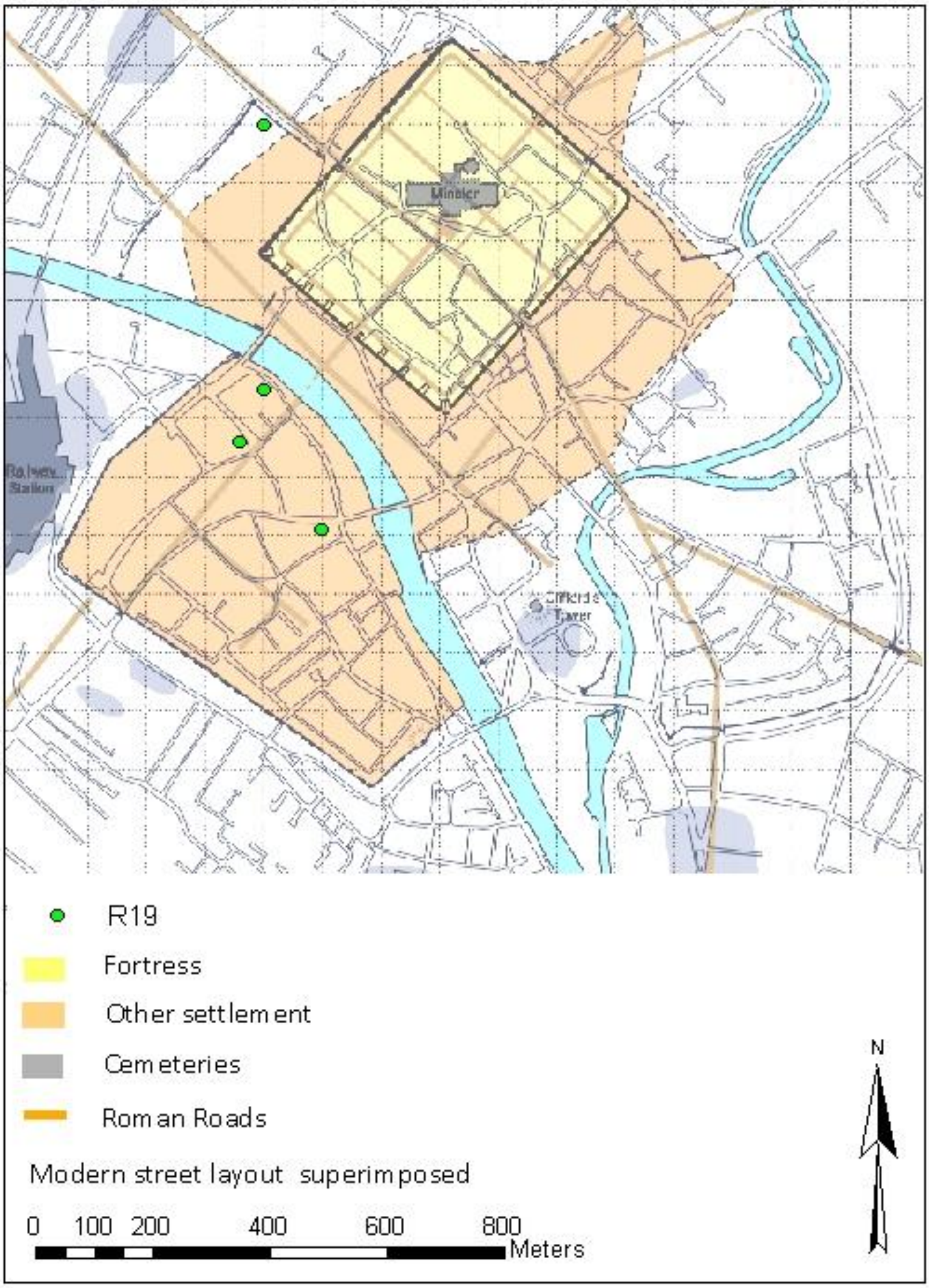
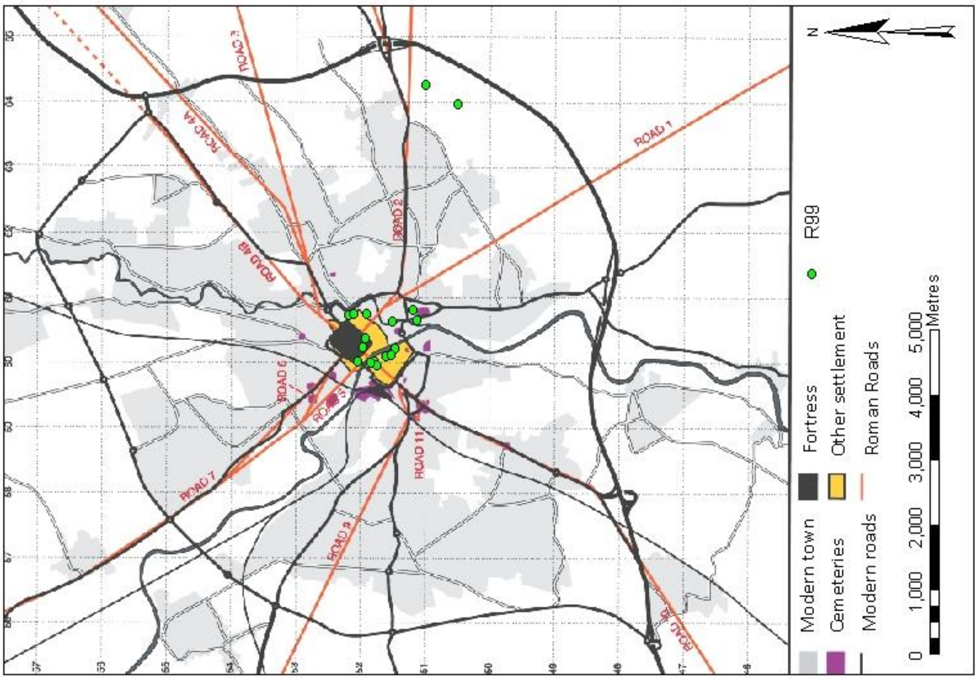


Figure 102. The location of Fabric R19. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).



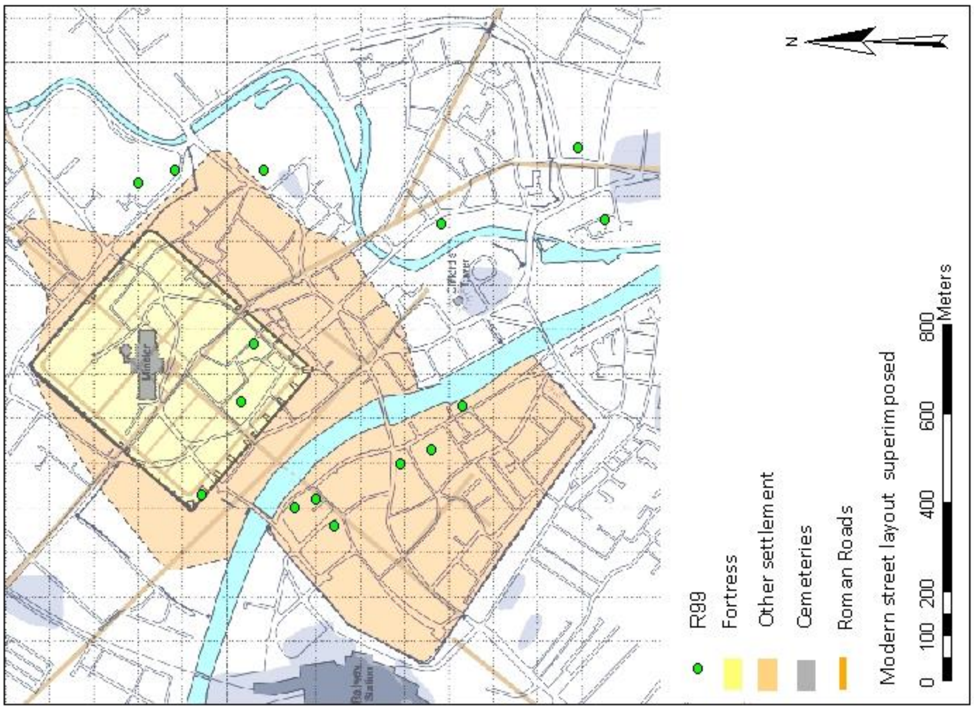


Figure 103. The location of Fabric R99. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

5.1.5 Fabrics in relation to date

The following analysis is based on the sites selected for details stratigraphic analysis (Appendices 8-13), with the tile from these sites representing 29.2 percent of the total volume of tile in the study, from sequences of deposits which cover the entire Roman period, and form a reliable sample of the dataset. It should be noted that 355g of this tile occurred as contamination within natural boulder-clay deposits, 944,573g was in contexts of Roman date, but 1,426,488g, or 60.2 percent of the tile from the selected excavations, occurred residually in contexts of post-Roman date. Correspondlingly high levels of residuality were seen in the pottery at the various Blossom Street sites and in the Roman deposits at Wellington Row of third century or later date (Monaghan 1997, 1114 and 1130-131). At the St Leonard's site the precise volume of residual pottery within Roman contexts is unclear at this stage, as the site has yet to be fully published, but the assessment report notes that "The problem of pottery assemblages from Roman defences is well known and particularly acute at York, where remodelling of the defences took place on the same line as earlier defences, resulting in much redeposition of earlier pottery" (R. Leary in Hunter-Mann 2011, 58).

The weight in grams of each fabric in relation to date is listed in Table 51, with the associated sherd count in Table 52. The sherd counts for fabrics R2, R4, R8, R12-R14 and R16-R18 were too low to enable any comparison of the fabric to date, and no sherds from Roman contexts were present in fabric R19. Sherds designated R0 were not examined as the fabrics were uncertain in these cases, while R99 was not examined as this represents non-standard fabrics. The remaining fabrics are illustrated on Figure 104. In the case of fabrics R1, R3, R5 and R9, there is a continuous increase in volume to c. AD 280, after which the volume of tile declines. Given that there would be a time lag between use on a building and deposition, and given that the bulk of these fabrics were deposited in the period AD 200-280, it can be suggested that these fabrics are largely of first and second century date. Fabrics R6, R7, R10 and R11 show a continual increase in volume over time, being markedly more common after AD 280, again assuming a time lag between use on a building and deposition, and given that the bulk of these fabrics were deposited in the period AD 280 or later, it can be suggested that these fabrics are largely of second to third century date. Fabric R15 is almost static in terms of volume up to AD 280, which may imply production throughout the Roman period. The slight increase in volume slightly after AD 280 is probably due to the problem of residuality.

Table 51. The weight in grams of each fabric in relation to date (for selected excavations)

Fabric	AD 71-120	AD 120-200	AD 200-280	AD 280-410	Total
R0	5729	15470	14562	13295	49056
R1	5175	9320	24022	18290	56807
R2	2085	570	1925	1094	5674
R3	12688	24955	31155	26720	95518
R4	125	150	200	1025	1500
R5	575	12815	27421	9225	50036
R6	1550	4460	13990	14885	34885
R7	3160	2725	16255	14355	36495
R8	150	495	1790	5110	7545
R9	29997	62740	80592	58889	232218
R10	5310	14095	45915	95137	160457
R11	9725	30205	35005	59865	134800
R12	725	1175	250	2760	4910
R13	25		100	550	675
R14	625	270	875	1095	2865
R15	12205	11110	10415	17142	50872
R16		400	250	535	1185
R17		920	3110	3900	7930
R18	150		5010	450	5610
R99	1350		1325	2860	5535
Total	91349	191875	314167	347182	944573

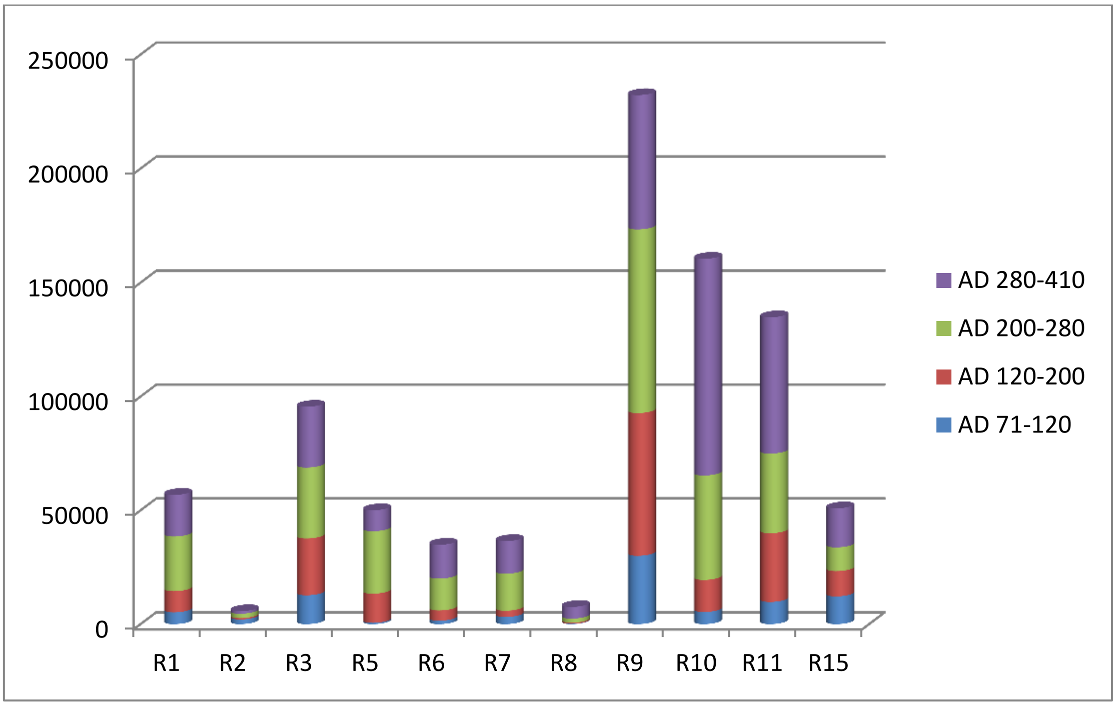


Figure 104. The of fabrics weight in grams in relation to chronological group (for selected excavations)

Table 52. The sherd count for Table 51

Fabric	AD 71-120	AD 120-200	AD 200-280	AD 280-410
R0	53	95	78	77
R1	33	69	124	98
R2	6	7	8	5
R3	47	156	177	159
R4	1	1	2	4
R5	5	79	134	48
R6	9	31	59	57
R7	13	17	72	58
R8	2	5	10	24
R9	127	343	380	298
R10	21	84	256	367
R11	30	99	153	241
R12	3	4	2	5
R13	1		1	1
R14	2	2	7	11
R15	36	57	79	85
R16		1	1	4
R17		6	8	9
R18	1		4	1
R99	2		3	4

Although the volume of tile present on the sites selected for detailed study seemingly increased over time (Table 51) this picture may be misleading, as evidence from the Aldwark area suggests that legionary tile production ceased after the mid-third century, implying that the tile from contexts dating to AD 280-410 was largely residual.

Only fabrics R9-R11 had sufficient lower cutaways to assess the link between cutaway types and fabric (Figure 105). It has been suggested on the basis of tile thickness and flange-heights that Group A^{Warry} cutaways were earlier than Group B^{Warry} cutaways with Group C^{Warry} cutaways being the most recent (see p82-3). Figure 105 would therefore suggests that R9 is the earliest of the three fabrics, and R10 the most recent. Fabrics R9 and R10 are from a single fabric group (Group 3) which may imply that R10 represents a replacement of R9.

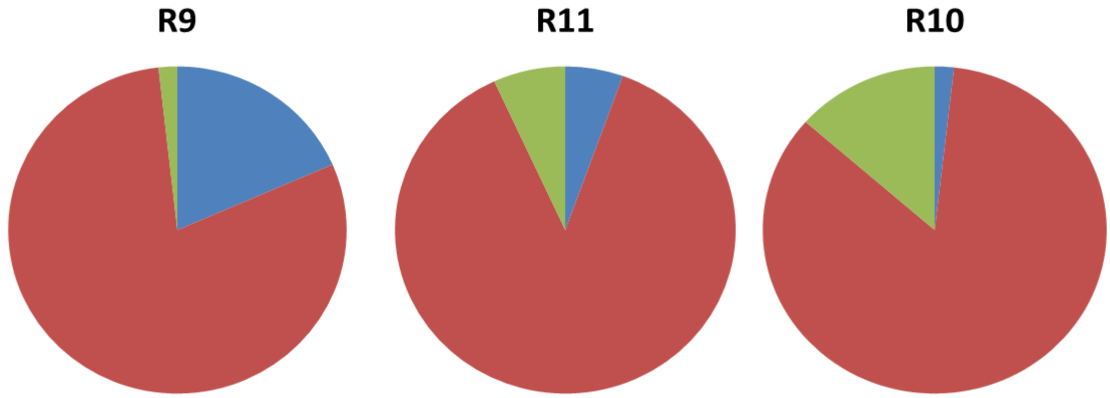


Figure 105. Fabric in relation to lower cutaway types for fabrics with over seventy examples (blue = cutaway Group A^{Warry}, red = cutaway Group B^{Warry}, and Green = cutaway Group C^{Warry}).

Two of the largest buildings in the present study were at 1-9 Micklegate, both of which were dated to the second quarter of the third century (Monaghan 1102). A total of 40,294 grams of fabric R9, 101,930g of fabric R11 and 649,750g of fabric R10 were present, and the dominance of fabrics R10 and R11 on a site with third century buildings again suggests that these two fabrics were more common in the later Roman period.

Given that the thickness of tegulae declined markedly over time, the average thickness of tegulae was calculated for all fabrics representing more than 1 percent of the total volume of tile (Figure 106) and this suggests that R2, R5 and R9, were the earliest fabrics, while R1, R3 and R8 were slightly later, and that fabrics R6, R10-R11 and R15 were the most recent.

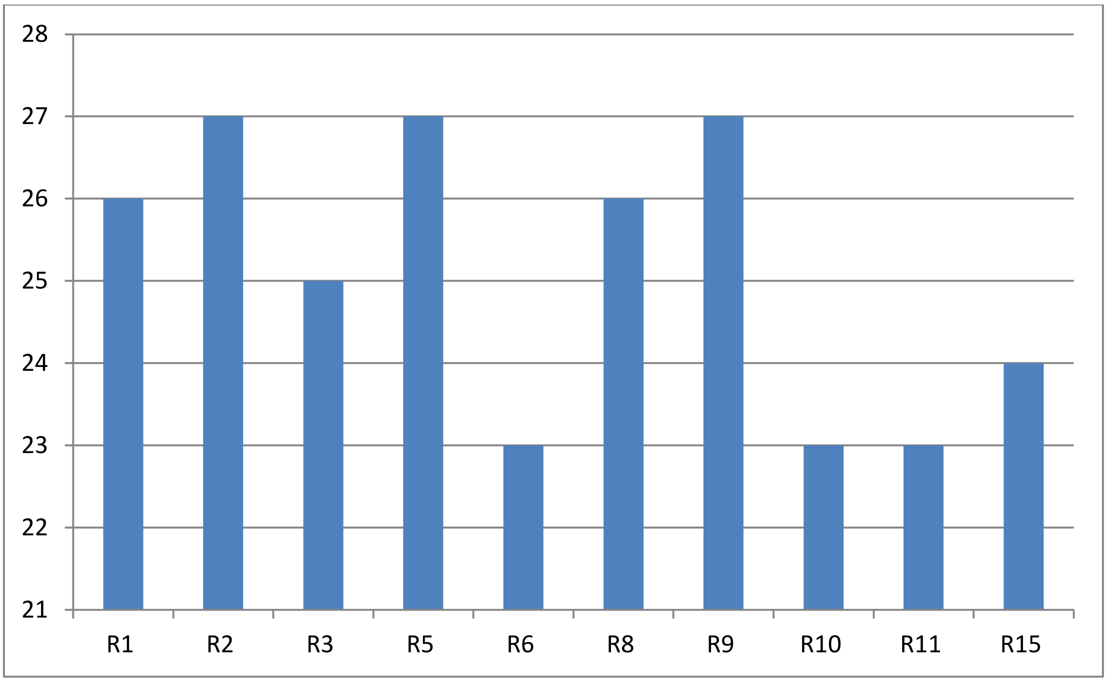


Figure 106. Average tegulae thickness in mm in relation to fabrics with a sherd count of over 100 (associated data on Tables 45-6).

The data above is summarised on Table 53, which also includes the evidence of the legionary stamps present. It must be stressed that the number of sherds was often too low to enable any comparison, with only fabrics R9-R11 having consistently sufficient sherds for analysis; in addition, high levels of residuality undoubtedly confuse the picture. In Table 53, the fabrics are assessed in relation to one another, the fabrics being based on Figure 104, while the cutaways are assessed in relation to one another as depicted on Figure 105, and the tegulae thicknesses are based on Figure 106. It is clear that most fabrics were present in most chronological phases (though in differing proportions), with fabrics R2, R5 and R9 seem to be largely of first to second century date, while fabrics R1, R3 and R8 were slightly later, then fabric R11, with fabrics R6 and R10 being largely of second to third century date. Fabrics R7 and R15 seemed to be evenly spread across all periods.

Table 53. Summary of the evidence for fabric date. Fabrics dated in relation to one another (where stamps of one legion clearly dominate the legion is in bold text)				
Fabric	Phased tile	Lower cutaways	Tegula thickness	Legionary stamps
R1	early		middle	IX
R2			early	IX
R3	early		middle	IX, VI
R5	early		early	
R6	late		late	VI
R7	late			IX
R8			middle	IX
R9	early	early	early	**IX,** VI
R10	late	late	late	VI
R11	late	middle	late	IX, **VI**
R15	evenly spread		mid-late	IX

5.2 Fabric groups

Although nineteen differing fabrics were seen when examining the sherds with a hand lens, with many of the visible differences being related to firing and reduction of the sherds, thin section analysis (Finlay, 2011) suggested that there were only five fabrics present in terms of the clay used, and these have been termed fabric groups. This is comparable to Silchester, where although four differing fabrics were seen when examining the tiles with a hand lens, there was no reason to believe that the fabrics derived from different clay sources (Cram and Fulford 1979, 203). The fabric groups are described on Table 54, while the total weight in grams of each fabric group is listed on Table 55, which also lists the weight as a percentage of the overall volume of tile.

5.2.1 Fabric groups in relation to form

The total weight in grams of each fabric group in relation to form is given on Table 56 with the associated sherd count on Table 57. It is clear that no individual fabric group was used exclusively for the manufacture of any particular form of tile, since each form is present in a variety of fabric groups, and this is even the case for comparatively rare forms, such as antefix or chimney sherds.

Table 54. Fabric group descriptions		
	Fabrics	Description
Group 1	R1, R13, R18	High number of vesicles, medium clay content
Group 2	R4, R16, R17	High number of vesicles, high clay content
Group 3	R3, R5, R9, R10	Low number of vesicles, high clay content
Group 4	R8, R12, R14, R15, R19	Low number of vesicles, low clay content
Group 5	R2, R6, R7, R11	Lowest number of vesicles, high clay content

Table 55. Fabric group weight and as a percentage of the total volume of tile		
	Weight in grams	Weight as a percentage of the total volume
Group 1	422447	5.5
Group 2	53515	0.7
Group 3	4707224	61.5
Group 4	556060	7.3
Group 5	1915758	25

Table 56. Total weight in grams of each fabric group in relation to form					
Form	Group 1	Group 2	Group 3	Group 4	Group 5
Antefix		75			175
Bessalis	5900	2950	52825	6850	48000
Chimney			300	550	575
Flue	10410	2385	157967	41945	142240
Imbrex	57220	7375	527757	70547	249752
Lydion			16125		5425
Opus spicatum		300			
Other	5460		25820	500	11100
Parietalis			28631	6350	5600
Pedalis			3350		13425
Pipe	330		7304	7435	12585
Rbrick	270454	28315	2941058	284286	954490
Sesquipedalis					4650
Tegula	70908	12115	943157	135542	464972
Tegula Mammata				1900	850
Tessera	65		820	30	769
Voussoir	1700		2110	125	1150
Total	422447	53515	4707224	556060	1915758

Table 57. Sherd count for Table 56					
Form	Group 1	Group 2	Group 3	Group 4	Group 5
Antefix		1			1
Bessalis	5	2	38	5	26
Chimney			3	10	2
Flue	56	11	616	175	467
Imbrex	424	39	3573	477	1436
Lydion			3		2
Opus spicatum		1			
Other	5		11	1	4
Parietalis			39	8	10
Pedalis			2		2
Pipe	4		143	134	183
Rbrick	1498	109	13588	1329	3959
Sesquipedalis					1
Tegula	263	32	3112	404	1264
Tegula Mammata				2	2
Tessera	5		40	2	37
Voussoir	1		1	1	1

5.2.2 Fabric groups in relation to zone

The total weight in grams of each fabric group overall and in relation to the three zones of the study area is given on Table 58, with the associated sherd count on Table 59. All the fabric groups were clearly widespread being present in all three zones of the study area, and it is clear, therefore, that no one fabric group was used exclusively in the fortress, *colonia* or environs.

Table 58. Total weight in grams of each fabric group for the study area overall and by zone				
Fabric group	Overall	Fortress	Colonia	Environs
Group 1	422447	66790	235415	120242
Group 2	53515	9995	32495	11025
Group 3	4707224	685440	3173923	847861
Group 4	556060	223097	284968	47995
Group 5	1915758	420122	1022474	473162
Total	7655004	1405444	4749275	1339173

Table 59. Sherd count associated with Table 58				
	Overall	Fortress	*Colonia*	Environs
Group 1	2261	471	1071	719
Group 2	195	34	119	42
Group 3	21169	3169	12800	5200
Group 4	2549	830	1351	368
Group 5	7398	1576	3530	2292
Total	32888	6080	18871	7937

5.2.3 Fabric groups in relation to date

The following analysis is based on the sites selected for details stratigraphic analysis (Appendices 8-13). The weight in grams of each fabric group in relation to chronological groups is listed in Table 60, with the associated sherd count on Table 61, and is illustrated on Figures 107-8. All fabric groups were present throughout the Roman period, suggesting that similar clay sources were in use throughout the entire period of production. Fabric Group 1 was most common in the period AD 200-280 but remained common into the late Roman period. Fabric Groups 2, 3 and 5 all steadily increased over time, though Group 2 was always rare. Fabric Group 4 remained largely static in terms of volume until AD 280 when the volume increased markedly. These variations are largely a reflection of the component individual fabrics (see p314).

Table 60. Weight in grams of fabric groupings in relation to phase					
Date	Group 1	Group 2	Group 3	Group 4	Group 5
AD 71-120	5350	125	48570	13705	16520
AD 120-200	9320	1470	114605	13050	37960
AD 200-280	29132	3560	185083	13330	67175
AD 280-410	19290	5460	189971	26107	90199
Totals	63092	10615	538229	66192	211854

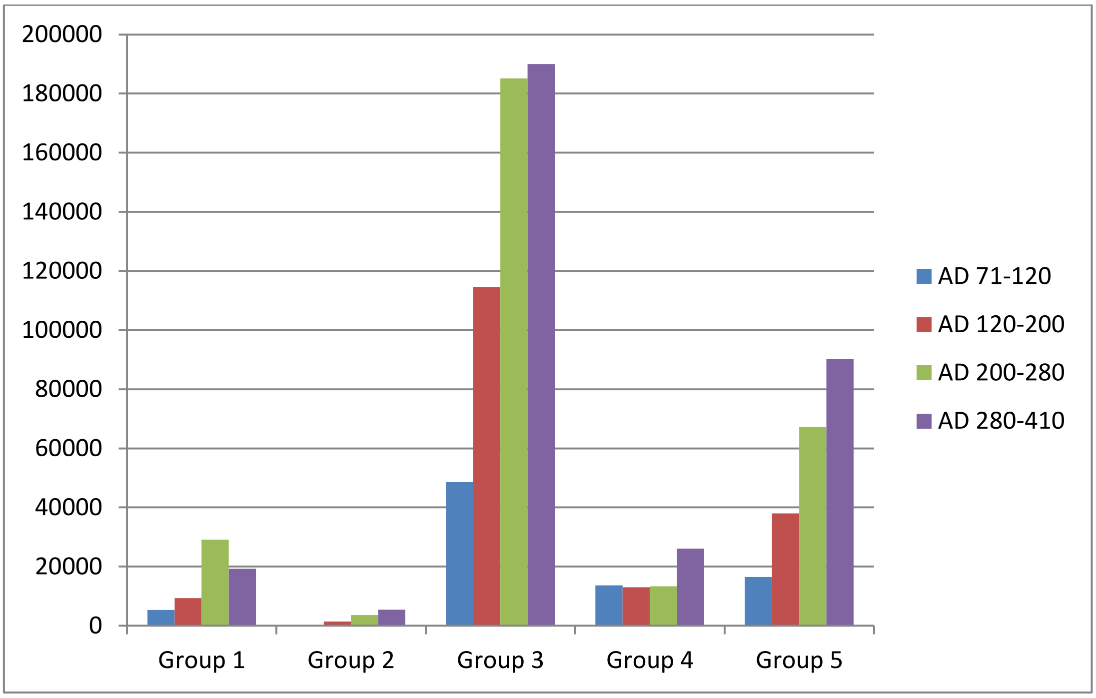


Figure 107. The weight in grams of fabric groups in relation to chronological groups from the sites selected for detailed stratigraphic analysis (associated data on Table 60)

Table 61. Sherd count for Table 60					
	Group 1	Group 2	Group 3	Group 4	Group 5
AD 71-120	35	1	200	43	58
AD 120-200	69	8	662	68	154
AD 200-280	129	11	947	98	292
AD 280-410	100	17	872	125	369
Overall	333	37	2681	334	873

The number of legionary stamps among the phased tile from selected sites was too low to determine a date range for any of the fabric groups, and this was also true for the fabric groups overall, irrespective of phase (Table 62). The sherd counts were still too low to draw any valid conclusions for Groups 1, 2 and 4, but they show that Group 3 and Group 5 were used for the manufacture of tiles by both of the legions stationed in York.

Table 62. Sherd count for legionary stamps in relation to fabric groups, irrespective of phase		
Form	Legio IX	Legio VI
Group 1	1	2
Group 2		1
Group 3	25	29
Group 4	3	
Group 5	3	10

A total of 144 lower cutaways were present on the phased tile but the sherd counts for fabric Groups 1 and 2 were too low to enable any comparisons between cutaway type and fabric group (Table 63). There is some suggestion that cutaway Group A^{Warry} was the earliest type with Cutaway C^{Warry} being the most recent (see p82-3). The number of Group A^{Warry} cutaways in fabric Group C may suggest that this group was more common in the early Roman period. This reflects the pattern seen for fabric R9, which forms a major component of this fabric group.

Table 63. Sherd count for lower cutaway types in relation to fabric group for the phased tile					
Cutaway type and date	Group 1	Group 2	Group 3	Group 4	Group 5
A			14	1	2
B	3	2	63	10	35
C	1		6	3	2
Other, date unknown			2		

Appendix 6 Surface markings

6.1 Signatures

Marks which are termed signatures do not comprise names or text, but rather take the form of simple designs drawn by the person making the tile while the clay was still wet. Signatures were usually drawn with the fingers (Warry 2006, 91), though nationally a few signatures are known which were drawn with a stick, a comb, or incised with a knife (Brodribb 1989, 102). There seem to be too few differing designs nationally to represent the work of all the individuals who must have been involved in the manufacture of tiles throughout the Roman period. The function of these marks is unclear, and it has been suggested that they could represent trade-marks, or were designed to denote grades of differing quality tile (Brodribb 1989, 104). It has also been suggested that the signatures were designed to indicate which tiles were to be stamped by the overseer (McWhirr and Viner 1978, 364).

Nationally the proportion of signed and unsigned tiles varies with form. A survey of complete tiles in Britain found that 60 percent of tegulae have signatures and 14.7 percent of imbrices are signed (Brodribb 1985, 101). There are far fewer signatures on brick, with 8 percent of bessales, 16 percent of pedalis, 27 percent of Lydion, 42 percent of sesquipedalis and 36 percent of bipedalis being signed, and there are virtually no signed box flues or hollow voussoirs (Brodribb 1989, 101-2). Clearly signatures were far more common on roofing tiles than on any other forms, and it is possible that tiles which were to be hidden within structures were not considered worthy of signing, in contrast to the roofing tiles, which were highly visible on buildings.

A survey of tiles from Britain found that 65 percent of the signatures on tegulae and 43 percent on bricks were semi-circles, which were remarkably symmetrical, even though they had been drawn with the fingers, there can be up to five concentric semi-circles present, though typically one or two semi-circles are seen (Brodribb 1989, 100). Warry (2011, 90) also noted that 80 percent of signatures on tegulae were of semi-circular types. Signatures are usually at the basal end of tegulae, as this would be the side closest to the tile maker during production. Similar types of signature marks are known from military, municipal and civilian tileries (I. Betts pers. comm.).

A total of 264 signatures were seen in the present study (Figures 108-110). There were 136 signatures which matched Betts' typology from York (Betts 1985, 192-4), a further fourteen that did not match the typology and were classed as 'Other', and 114 signatures that were too fragmentary to determine the original design which were classed as 'illegible'. The sherd count for the varying signatures overall is given in Table 64 together with the sherd count in relation to zone.

Table 64. Sherd count for signature type in relation to zone

	Overall	Fortress	*Colonia*	Environs
Type 1	46	2	32	12
Type 2	33	6	15	12
Type 2A	3		3	
Type 3	17	5	7	5
Type 3b	1		1	
Type 4	3	2	1	
Type 5	22	2	14	6
Type 6	4	3	1	
Type 7	1		1	
Type 8	2		1	1
Type 9	1			1
Type 18	2		2	
Type 30	1		1	
Illegible	114	21	61	32
Other	14		8	6
Total	264	41	148	75

Signature Types 1, 2, 2A, 3, 3B and 4 are semi-circular based designs which accounted for 68.7 percent of the legible stamps seen, conforming to the pattern seen nationally (see p325).

All but three of the signatures on identifiable forms of tile were on tegulae (Table 65), which is In keeping with the pattern seen nationally. There were too few examples of signatures on the remaining forms to determine if there were any links between signature type and form. There were also too few examples of any given signature on the tegulae in relation to fabric, to determine if there were any links (Table 66).

Similarly, there were too few signatures in relation to lower cutaways to determine any patterns (Table 67).

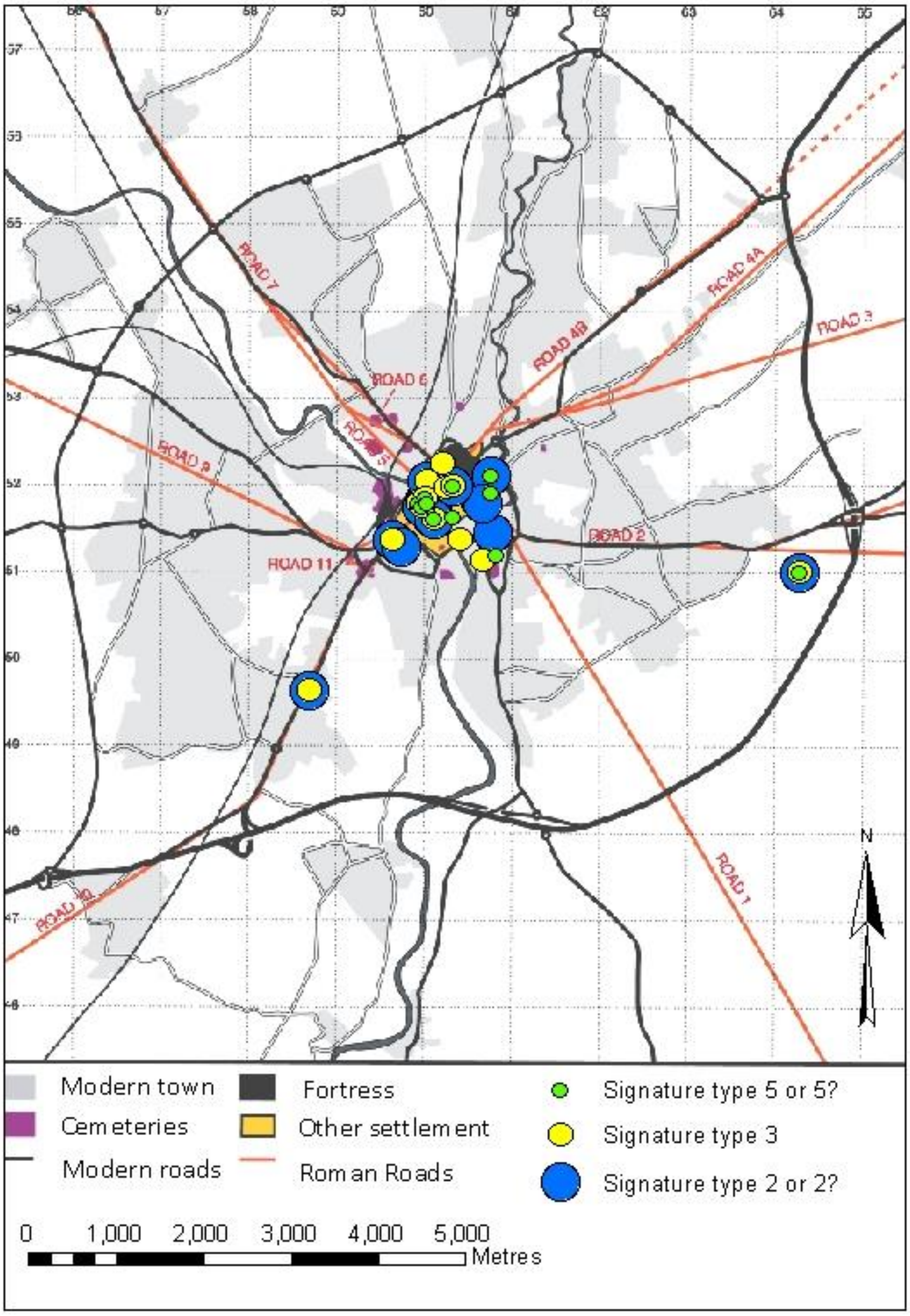


Figure 108. Location of signatures 2, 3 and 5 within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

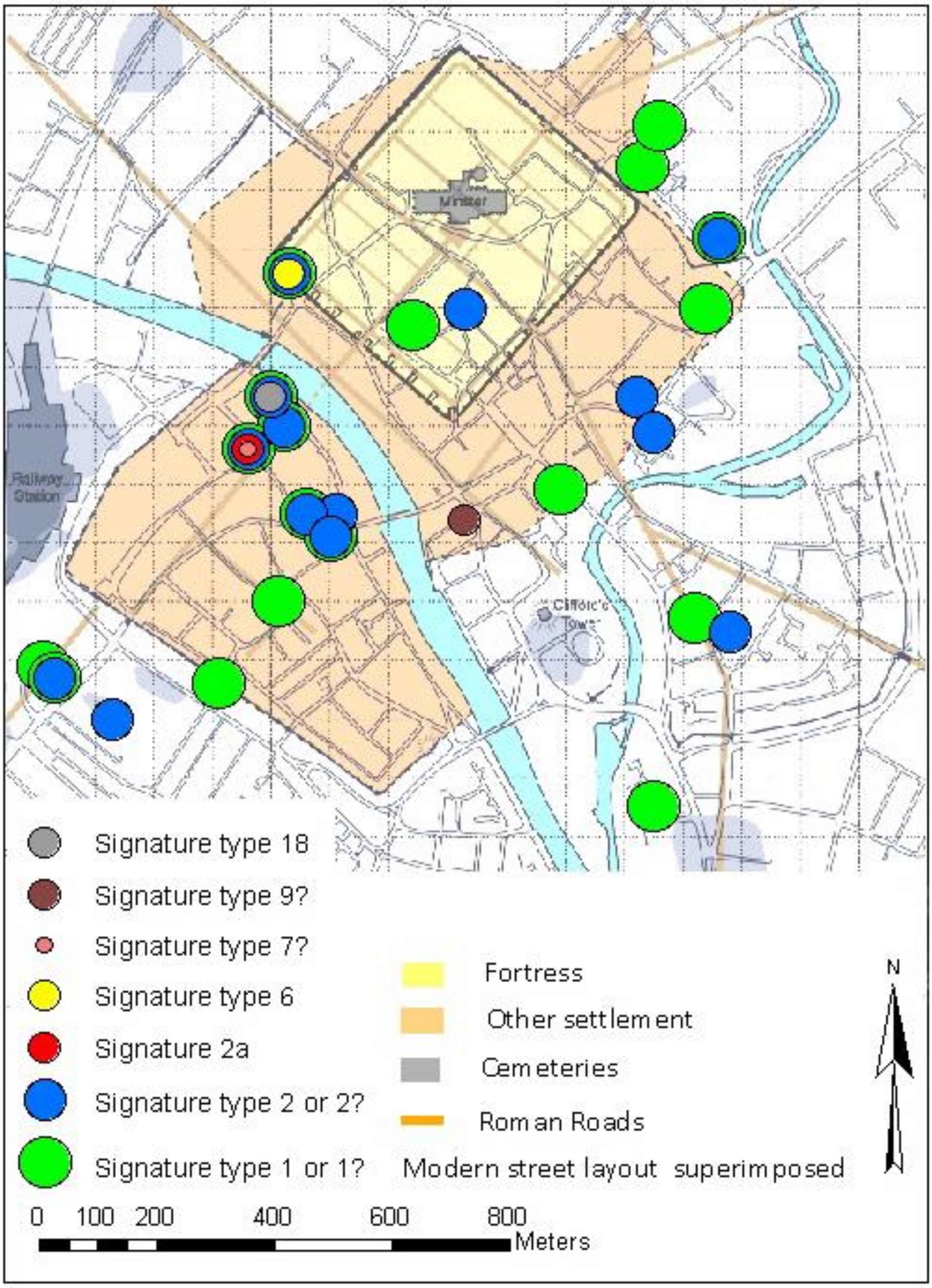


Figure 109. Location of signatures 1, 2, 2a, 6, 7, 9 and 19 within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

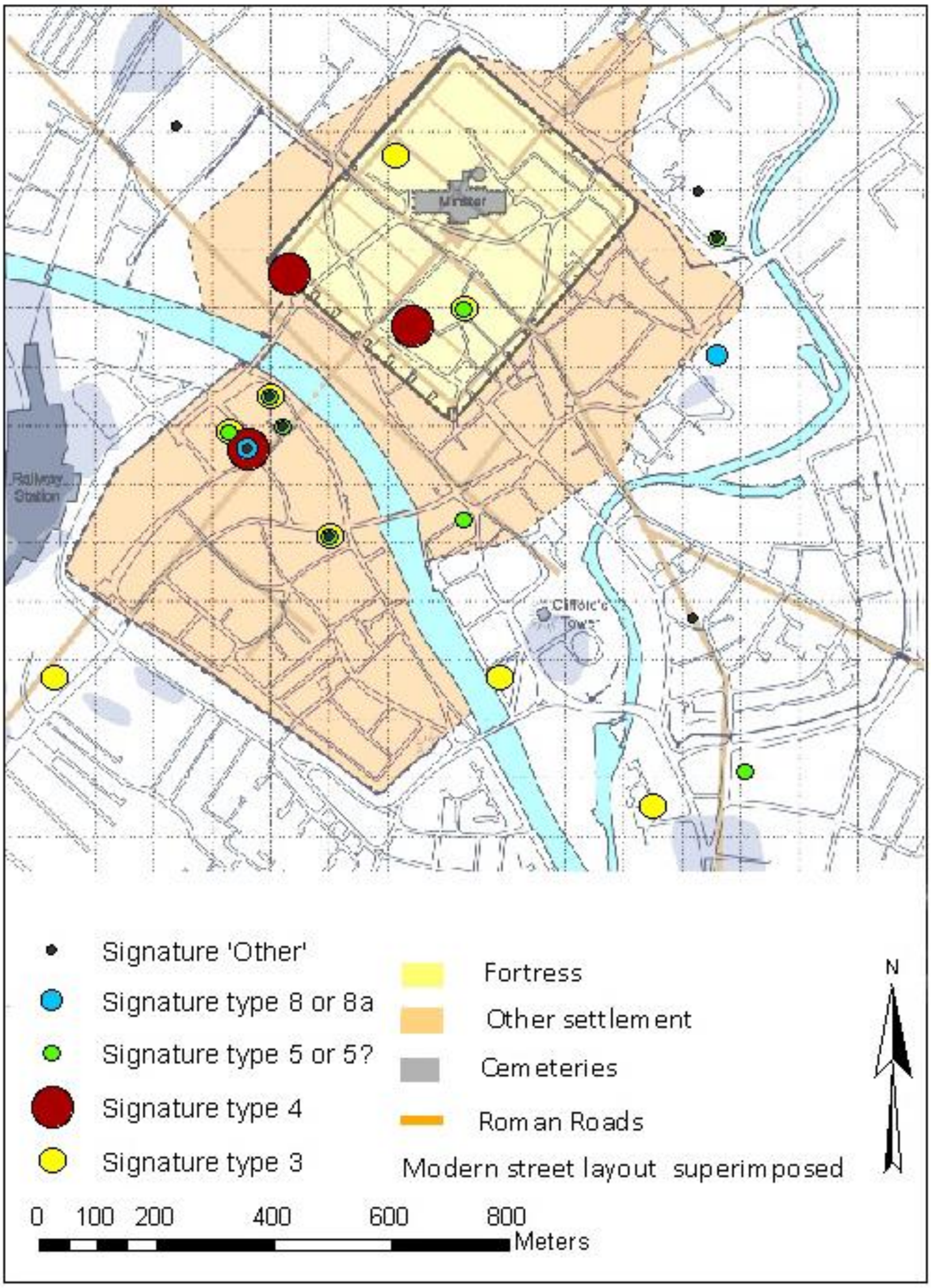


Figure 110. Location of signatures 3, 4, 5, 8 and 'other' within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

Table 65. Sherd count for signature type in relation to form					
	Flue	Imbrex	Parietalis	Rbrick	Tegula
Type 1		1		32	13
Type 2				21	12
Type 2A				1	2
Type 3				14	3
Type 3B				1	
Type 4				1	2
Type 5				18	4
Type 6				4	
Type 7				1	
Type 8				1	1
Type 9				1	
Type 18				2	
Type 30				1	
Illegible	1		1	92	20
Other				10	4
Total	1	1	1	200	61

Table 66. Sherd count for signed tegulae in relation to fabric												
	R0	R1	R2	R3	R5	R6	R7	R9	R10	R11	R14	R15
Type 1		1				2	1	1	2	3		3
Type 2	1		1			2		4	1	1		2
Type 2A		1								1		
Type 3		1							1	1		
Type 3b												
Type 4								1			1	
Type 5				1		1		1	1			
Type 8									1			
Type 9												
Type 30												
Other						3			1			

Table 67. The sherd count for signatures in relation to lower cutaway Types A2/B6		
	Cutaway A2	Cutaway B6
Signature 1		6
Signature 2		4
Signature 2A		1
Signature 4	1	
Signature 5	2	6
Signature Other		3

The overwhelming bulk of signatures were on tiles in fabrics R9, R10, R11 and R6 (Table 68), which are the four commonest fabrics overall. The sherd counts were too low to determine any clear links between signatures and fabrics.

Table 68. Sherd count for signature type in relation to fabric, % = sherd count as a percentage of the total number of signed sherds															
	R0	R1	R2	R3	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
1	1	3		2	1	3	2		10	9	9	1	1		4
2	1	1	1	3		4		1	10	6	3				3
2A		1							1		1				
3		1			1			1	10	1	3				
3b									1						
4									2					1	
5				1	1	2	1	1	8	4	4				
6		1							3						
7									1						
8									1	1					
9											1				
18										1		1			
30										1					
Other			1			6			2	6	1				
Total	2	7	2	6	3	14	2	3	49	29	22	2	1	1	7
%	1	5	1	4	2	9	1	2	33	19	15	1	1	1	5

Only two tiles had both a legionary stamp and a signature, one of which related to the Legio IX (signature Type 8) and one to the Legio VI (signature Type 1), and such low numbers of sherds prevents any analysis of the relationship between signature designs and stamps. Although the present survey did not shed any light on such links, Betts (1985, 198-199) recorded that eight differing designs were used on Legio IX stamped tiles (signatures 2-3, 5-6, 15, 17 and 22-23), and fourteen differing signatures were present on Legio VI stamped tiles (signatures 1, 3-5, 9-11, 19-20, 22, 31 and 36-38); in addition, signature 7 was seen on a Legio IX stamped tile from Slack.

The only signatures in the present study which have never been recorded in association with military stamps are Types 2a, 3b, 18, 30 and the fourteen new types designated as 'other' in the recording methodology. Of these 2a, 3b, 18, 30 and most of the designs termed 'other' were from sites which also yielded legionary stamped tiles (Table 69).

Table 69a. Signature types in relation to site, with the associated sherd count

Site	Zone	Signature types	Sherd count
12-18 Swinegate	F	2, 3, 5	4
1-5 Davygate and 9 Little Stonegate,	F	1	1
Purey Cust Nuffield Hospital	F	3	1
Rear of 3 Little Stonegate	F	3, 4	2
St. Leonard's Hospital	F	1, 2, 3, 4, 6	14
13-15 St. Martin's Lane	C	1, 2	2
1-9 Micklegate	C	1, 2, 3, 5, 18, other	19
5 Rougier Street	C	3, 5	2
City walls, Tower 9	C	1	1
24-30 Tanner Row	C	1, 2, 2a, 3, 3b, 4, 5, 7, 8,	33
Wellington Row	C	1, 2, 3, 5, 6, 18, other	27
County Hospital, Monkgate	E	1	1
County Hospital/Fossbank	E	5	1
42-50 Tadcaster Road	E	2, 3	2
Heslington East	E	2, 3, 5, other	10
Hungate 2000.6	E	2	1
Hungate 2000.7	E	2	1

Table 69b. Signature types in relation to site, with the associated sherd count			
Site	Zone	Signature types	Sherd count
Jewbury	E	1, 2, 5, other	5
Dixon Lane	E	1, 30	2
28-40 Blossom Street	E	1, 2, 3	5
St. Anthony's Hall, Aldwark	E	1	1
St. Georges Church	E	2	1
North Street sewer chamber	C	2	1
Trinity Lane Car Park	C	1	1
1-2 Tower Street	C	3	1
14-20 Blossom Street	E	1	1
2 Clifford Street	E	5, 9	2
2 St. Maurice's Road	E	1	1
22 Piccadilly	E	1	2
26-28 Marygate	E	Other	2
35-41 Blossom Street	E	2	1
46 - 54 Fishergate	E	1, 3	2
Adams Hydraulics	E	5, 8	2
Barbican leisure Centre	E	5	1

Most of the signatures in the fortress were from St Leonard's Hospital where they mainly occurred residually in dumps to raise the level of the ramparts, rather than originating from *in situ* remains. Most of the signatures from the *colonia* were from 1-9 Micklegate, 24-30 Tanner Row and Wellington Row, reflecting the size of these excavations, but also the presence of major Roman structures. Only three sites in the environs have both signatures and Roman structures; at 2 St. Maurice's Road, close to the north eastern side of the fortress, there was a building with a tessellated pavement (RCHM 1962, 65), at 42-50 Tadcaster Road, 3km to the south-west of the *colonia*, there were the remains of two Roman buildings, while at Heslington East, 3km south-east of the fortress, there was a small settlement with several buildings. Most of the signatures on sites in the environs were resultant from dumping (14-20 Blossom Street, 28-40 Blossom Street, 35-41 Blossom Street, 26-28 Marygate, County Hospital

Monkgate, County Hospital Fossbank, Jewbury, Hungate 2000.6 and Hungate 2000.7), alternatively they represent stray losses on sites with no known Roman structures (2 Clifford Street, 22 Piccadilly, 46-54 Fishergate, Barbican Leisure Centre, Dixon Lane and George Street Car Park). The sherds from St. Anthony's Hall, Aldwark and Adams Hydraulics presumably originated from the nearby legionary kilns.

Ninety of the signatures were from sites selected for detailed stratigraphic analysis (Table 70); these sites showed that production of signed tiles peaked in the period AD 120-200, though the overwhelming bulk of signatures occurred residually. This exactly matches the pattern seen on the lower cutaways, implying that from the third century onwards there was either a dramatic decline in tile production, or a decline in the signing of tiles.

Table 70. Sherd count for signatures in relation to date for selected sites

Location	AD 70-120	AD 120-200	AD 200-280	AD 280-410	Post-Roman
St Leonard's	1	0	0	0	18
Wellington Row	0	4	4	0	3
NW of fortress	0	5	0	0	0
E of fortress	0	0	2	2	1
SE of fortress	0	0	0	0	6
SW of *colonia*	0	4	4	0	3
Overall	5	12	9	8	56

The fourteen signatures termed 'Other', which did not match Betts' typology of signatures in York, were from either the *colonia* or the environs; the sites in the *colonia* yielding these signatures were 24-30 Tanner Row (five examples), Wellington Row (one example) and 1-9 Micklegate (two examples), while the sites in the environs were Jewbury (one example), 26-28 Marygate (two examples) and Heslington East (one example). The examples from Jewbury and 26-28 Marygate were resultant from dumping, presumably of material originating from the fortress. The remaining examples were all from sites associated with Roman buildings.

There were eight differing designs among the 'Other' signatures (Figures 111-16) but none of these were intact. An example from 24-30 Tanner Row, Context 1184, which may have been drawn with a stick rather than the fingers, took the form of a large V; a further example of this shape was seen at 1-9 Micklegate (Figure 111) while a third possible example was from Wellington Row, Context 1069. A signature from 24-30 Tanner Row, Context 4102, resembled an inverted letter L (Figure 112), while a signature from Context 2050 resembled an inverted letter Y (Figure 113), and a signature from Context 1199 was a long diagonal line (Figure 114). It is possible that a signature from 24-30 Tanner Row, Context 5022, comprising two arcs with two vertical lines to the right, is a Betts Type 39 in reverse (in Betts Type 39 the vertical lines are to the left of the arcs). A tile from Heslington East (Context 1073) had a single diagonal line. An example from 1-9 Micklegate, Contexts 6089, had an almost horizontal loop with one tail of the loop being horizontal and the second tail resembling a letter V, this occurred as residual material. The two examples from 26-28 Marygate were identical, with a diagonally aligned loop crossed by an almost vertical line (Figure 115). An example from Jewbury comprised two converging straight lines which may represent a variation of Betts Type 41 (Betts 1985, 194) which comprised two parallel lines. An example from Heslington East resembled a letter S beneath an arc, while a second example from the site had two parallel V shaped lines; this mark was close to the flange which is not the customary location for such marks and it is possible that this represents a graffito rather than a signature.

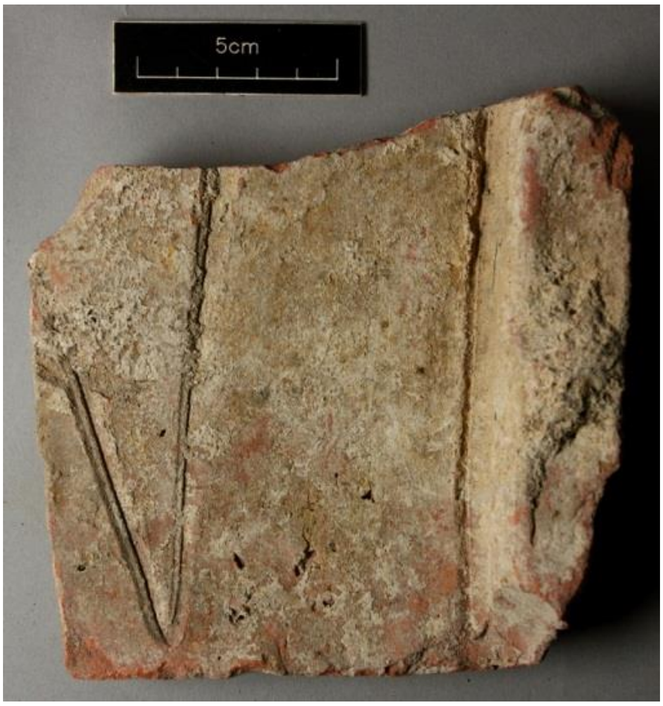


Figure 111. Signature mark from 1-9 Micklegate, Context 6071, © YAT

Figure 112. Signature mark from 24-30 Tanner Row, Context 4102

Figure 113. Signature mark from 24-30 Tanner Row, Context 2050, © YAT

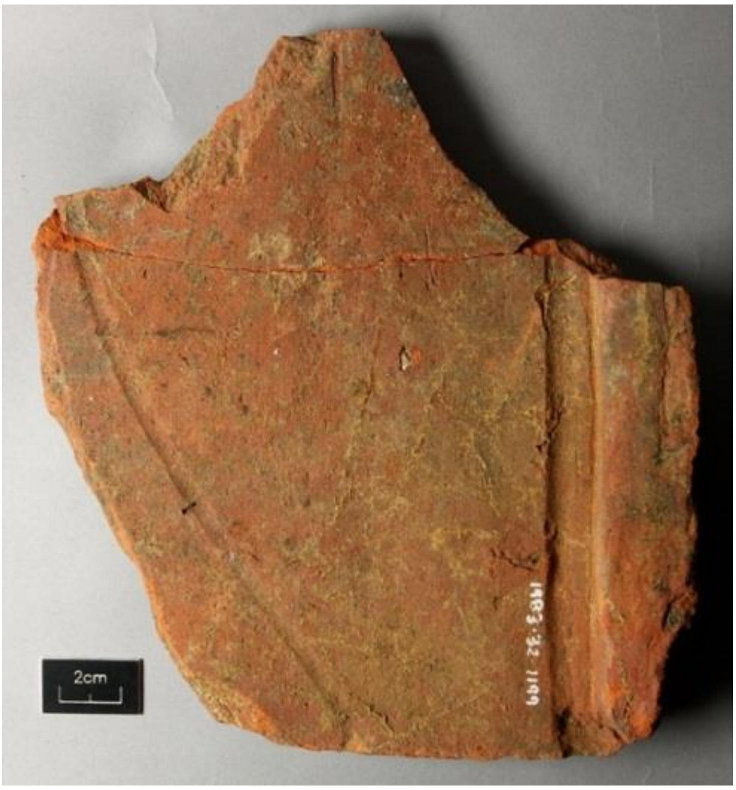


Figure 114. Signature mark from 24-30 Tanner Row, Context 1199, © YAT

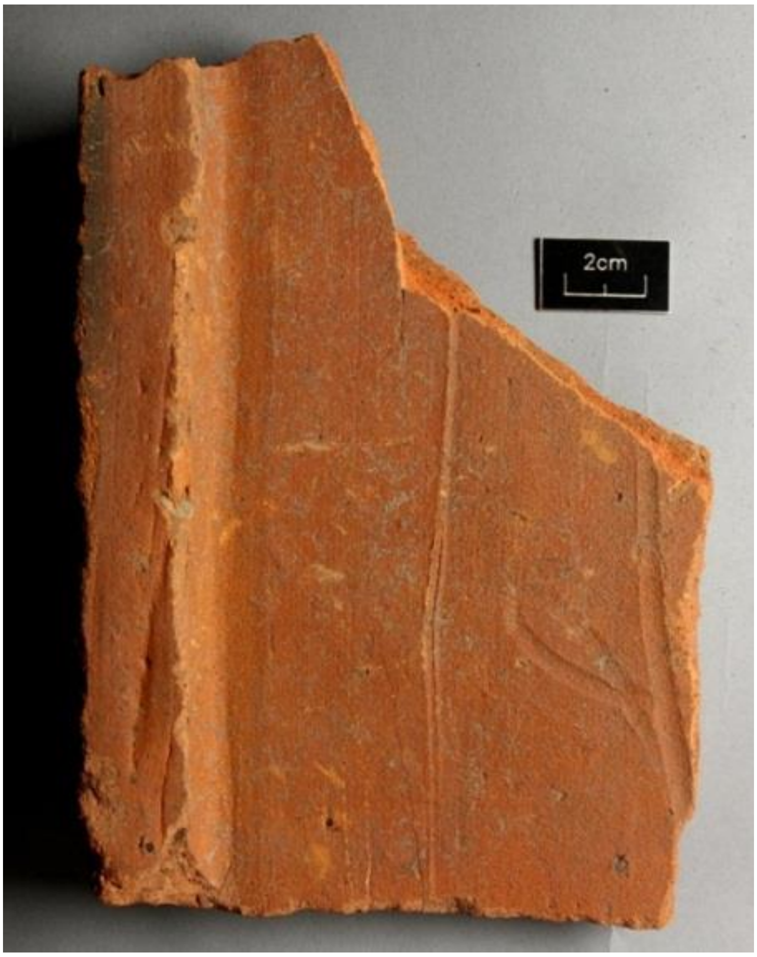


Figure 115. Signature mark from 26-28 Marygate, Context 2024, © YAT

6.2 Stamps

The practice of stamping tiles with a manufacturer's mark began in the late first century and continued until the mid-third century (Darvill and McWhirr 1984, 245-6). Nationally, where tiles have both a signature and a stamp, the stamp is always on top (Brodribb 1979b, 211-3), reflecting the fact that signatures were best drawn while the tile was wet, while stamping was done when the tile was leather-hard to avoid the stamp becoming clogged with wet clay.

The chance of recovering legible tile stamps from archaeologically excavated material is small, for a number of reasons. Firstly, not all tiles were stamped even in the period from the later first century to the early-mid-third century when stamping was routinely undertaken. Secondly, tile stamps are small in size and therefore represent a small proportion of the surface area of any given tile, in the case of tegulae it has been calculated that stamps typically represent only 1 percent of the surface area of the tile (Warry 2010, 143); the small size of the stamps reduces the chance of recovery where tile is highly fragmented, as in the present study. Thirdly, post-depositional events including frost damage, breakage, fragmentation, losses through robbing and damage through re-deposition, further reduce the chances of recovering intact stamps. In the light of these problems few individual excavations have produced collections of tile-stamps large enough to have any statistical validity, one notable exception being the site at Beauport Park (Collingwood and Wright 1993, 2), which was fortunate enough to be exceptionally well preserved, had suffered little post-depositional damage, had buildings constructed at a time when stamping was undertaken, and the tiles were produced by the navy, the *classis Britannica*, which routinely stamped its output.

Those stamps which are recovered can be problematic in terms of identification, due to differential shrinkage during firing, and the use of stamps clogged with clay producing imperfect impressions, both of which can make stamps difficult to read (Collingwood and Wright 1992, 127). Furthermore tile recovered from archaeological excavations is often abraded, making any stamps hard to read. It is impossible to know how many stamp dies were in use at any given time, or whether individual stamps were used at more than one site, furthermore stocks of tile may have remained in use for long periods, all of which can create a misleading picture in terms of the analysis of the distribution patterns of stamped tiles (Collingwood and Wright 1992, 125).

There were 101 stamps present in the current study, representing 0.47 percent of the total volume of tile. Thirty stamps related to the Legio IX (Figure 116 and 118), forty-four to the Legio VI (Figures 117-8) and twenty-seven were illegible (Figure 118). No civilian stamps were seen in the present study, though some have been recorded in York previously (Collingwood and Wright 1993, 56, 58, 72, 76).

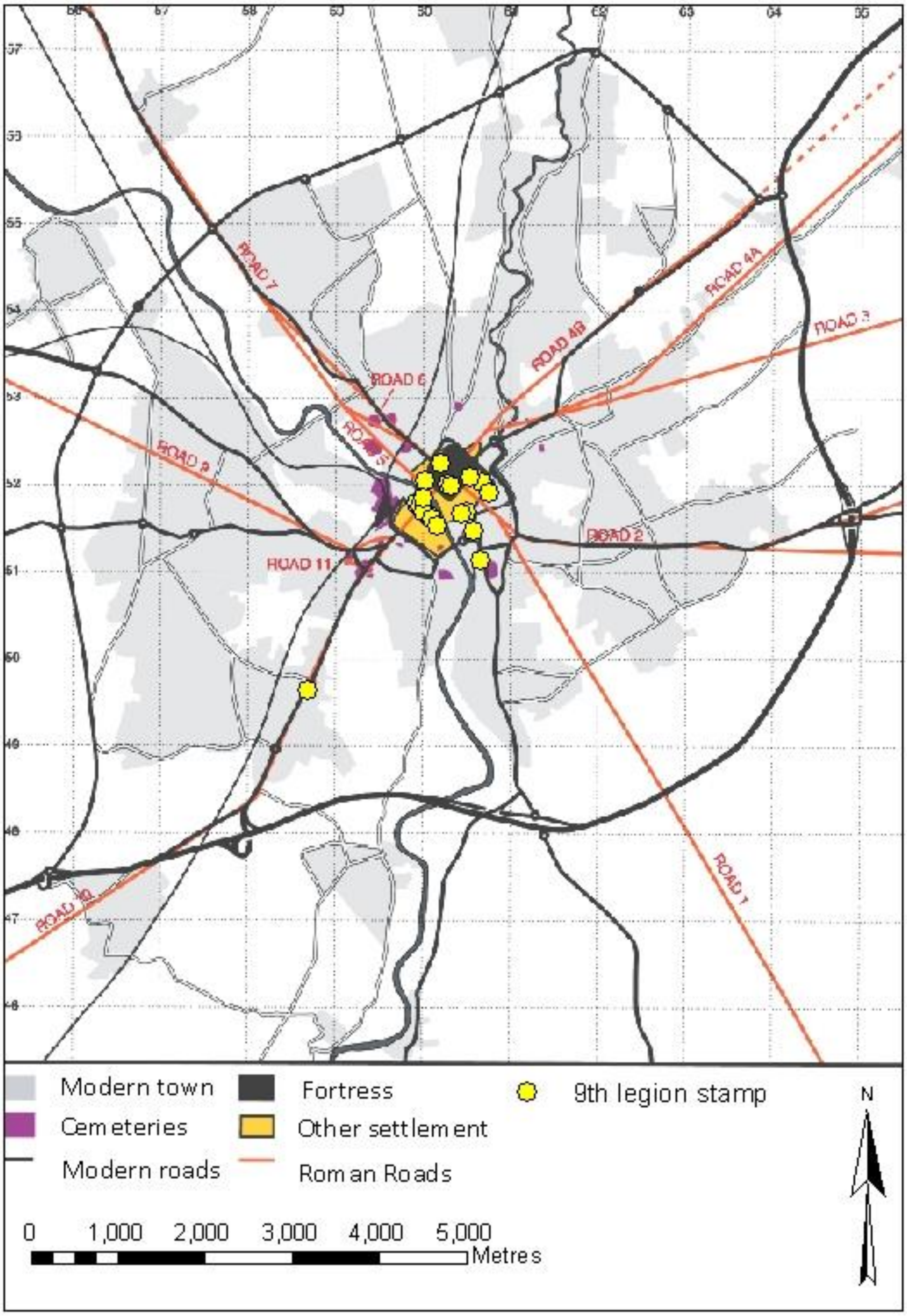


Figure 116. Location of Legio IX stamps within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

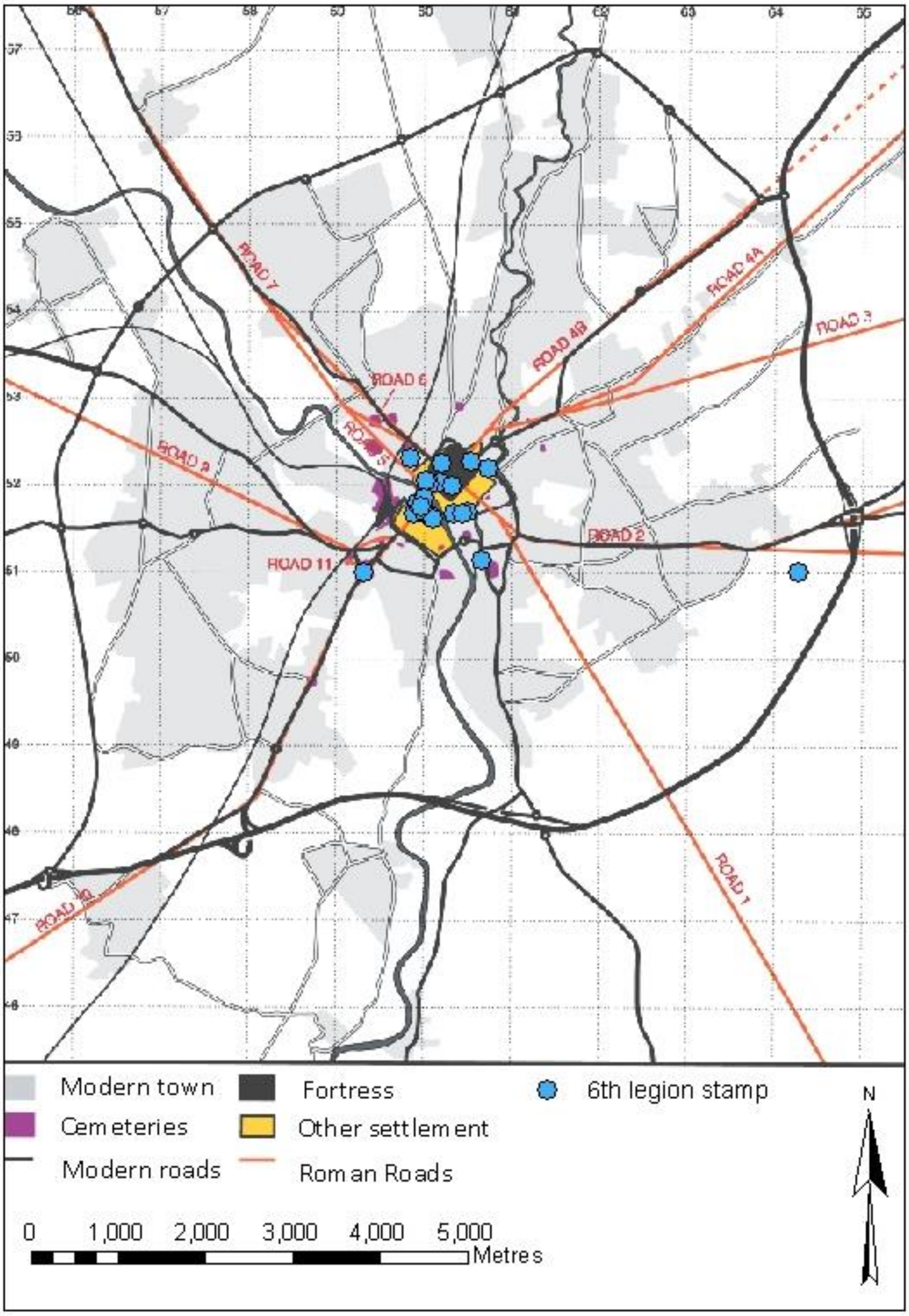


Figure 117. Location of Legio VI stamps within the study area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

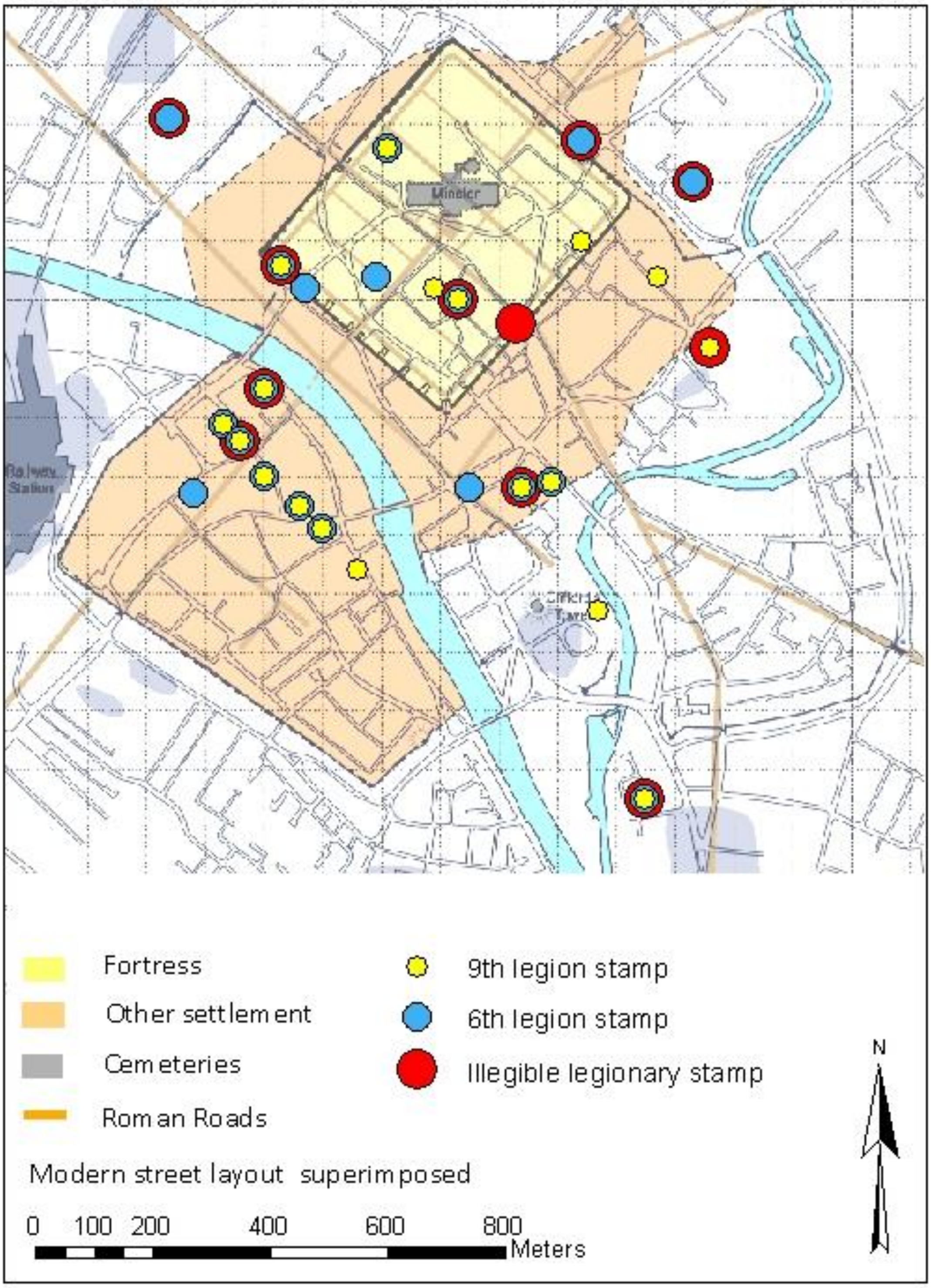


Figure 117. Location of legionary stamps within the central area. (Underlying map data © Crown Copyright/Database Right 2010. An Ordnance Survey/Edina supplied service; enhanced with archaeological data ©YAT).

The Legio IX tiles, which have a maximum date range of AD 71-120, were present in the fortress, *colonia*, six sites in the civilian settlements surrounding the fortress, and at one outlying site in Dringhouses to the south-west of the *colonia* (Figure 116). The nineteen legible stamps were from seven differing dies as identified by Collingwood and Wright (1992, 170-173); the dies in question were 2462.6 (two examples), 2462.7 (one example and one probable example), 2462.9 (two examples and two probable examples), 2462.9A (one example and two probable examples), 2462.9C (two examples), 2462.12 (five examples) and 2462.14 (1 example); all of these dies have previously been recorded in York. There was also one other ninth legion stamp on a tile from the Adams Hydraulics site, in the environs, that did not match Collingwood and Wright's typology but could represent the front and central portion of type 2462.13 which has been recorded in York before.

The Legio VI stamped tiles were present in the fortress, *colonia*, seven sites to the south-east of the fortress, and at two outlying sites at Heslington East to the south-east of York, and at 3 Driffield Terrace to the south-west of the *colonia*. (Figure 117) The thirty-one legible Legio VI stamps were of twenty-four differing designs, those present as single examples were 2460.5, 2460.7, 2460.8, 2460.16, 2460.17, 2460.21, 2460.23, 2460.26, 2460.40, 2460.43, 2460.51, 2460.75, 2460.79, 2460.86, 2460.87, 2460.90, 2460.92 and 2460.93 (though the examples in 2460.7, 2460.21, 2460.40, 2460.79, 2460.87 and 2460.90 were probable identifications), while there were two examples each of stamps 2460.6, 2460.9, 2460.39, 2460.63, 2460.81 and 2460.84 (though one example of 2460.63 and both of the 2460.81 were probable identifications); all of these stamps have been recorded in York before (Collingwood and Wright 1992, 149-166), there was also one tile with a Legio VI stamp that has not been recorded before (Figure 119).

Figure 119. Rbrick with Legio VI stamp, from 16-22 Coppergate, Context 33212, © YAT

The Legio VI stamped tiles date from their arrival in York in AD 120, until at least AD 244, and while most of the stamped tiles seen in the present study cannot be more closely dated, there were two stamps which offered the potential for closer dating; stamp die 2460.43 dates to AD 222-235, while stamp die 2460.75 could date to either AD 184, or AD 210 (Collingwood and Wright 1992, 148; Warry 2010, 148). The type 2460.43 stamp was unstratified, from a site at Museum Street/Lendal, while the 2460.75 stamp from 1-9 Micklegate, in the *colonia*, occurred as residual material; so neither of the more closely dated stamp dies were helpful in dating the contexts from which they were recovered, or in clarifying the date of the 2460.75 stamp die.

Twenty-three stamps were present on sites selected for detailed chronological analysis (Appendices 8-13), seven of these stamps related to the Legio IX, but all three of these occurred residually in contexts of later date, while sixteen of the stamps related to the Legio VI, of which twelve occurred residually. The low number of stamped tiles in phased contexts prevented any analysis of stamps in relation to phase.

In terms of location, 15.8 percent of the legionary stamps seen were from within the fortress, as compared to 43.6 percent in the *colonia*, and 40.6 percent in the environs (Table 71). Most of the twenty-nine sites to have yielded stamped tiles in the present study had between one and four examples, but four sites produced larger numbers of stamped tiles; 16-22 Coppergate to the south of the fortress produced twenty stamps (four Legio IX, seven Legio VI and nine illegible), 24-30 Tanner Row in the *colonia* produced eighteen stamps (four Legio IX, ten Legio VI and four illegible), Leedhams Garage in the *colonia* yielded ten stamps (two Legio IX, three Legio VI and five illegible stamps), and 1-9 Micklegate in the *colonia* yielded eight stamps (three Legio IX and five Legio VI). These high numbers may simply be a reflection of the size of these excavations, each of which was among the largest undertaken in York. As a proportion of the total far more illegible stamped tiles were present outside the fortress; this is probably because most were the result of dumping (see Table 71), presumably of old broken tiles, which were already worn at the time of deposition.

Table 71. Sherd count for stamped tiles in relation to zone

	Fortress	*Colonia*	Environs
Legio IX	6	13	11
Legio VI	6	22	16
Illegible	4	9	14
Total	16	44	41

To provide as accurate a picture as possible of the distribution of stamped tile within the study area, the decision was taken to combine the results of the present study with the stamped tiles catalogued in 1992 by Collingwood and Wright, which are summarised on Table 72 in relation to the zones of the present study area (tiles without a clear find spot are listed as being from York). Combining the total number of sherds from the present study with those listed in Collingwood and Wright (1992), yielded a very different distribution pattern to that seen in the present study alone (Figure 120), due to the inclusion of large numbers of stamped tiles found in excavations beneath York Minster, making the fortress dominant both in terms of the overall number of stamped tiles and in terms of the number of stamp-dies present (Figure 121), this being particularly true of the Legio VI.

Table 72a. Sherd count for stamped tiles listed in Collingwood and Wright (1992) in relation to zone

Signature	Fortress	*Colonia*	Environs	York
Legio IX 2462.5		1+	2	1
Legio IX 2462.6	1			2
Legio IX 2462.7	1			7
Legio IX 2462.8	2			
Legio IX 2462.9	7	4	3	11
Legio IX 2462.9A	1	1		1
Legio IX 2462.9B	1			1
Legio IX 2462.9C				3
Legio IX 2462.10				1
Legio IX 2462.11		1		3
Legio IX 2462.12	14	3	4	4
Legio VI 2460.1	13		1	2
Legio VI 2460.1A	8	1		
Legio VI 2460.2		1		
Legio VI 2460.3	1			2
Legio VI 2460.4	1			
Legio VI 2460.5	6		1	1
Legio VI 2460.6				1
Legio VI 2460.7	1			
Legio VI 2460.8	2		1	2
Legio VI 2460.9				1
Legio VI 2460.10				1
Legio VI 2460.11	2			1
Legio VI 2460.12	1		3	
Legio VI 2460.13		1		
Legio VI 2460.14	1			
Legio VI 2460.15	3			
Legio VI 2460.16	2	1		
Legio VI 2460.17	2			
Legio VI 2460.18	1	1		
Legio VI 2460.19				1
Legio VI 2460.20	1			
Legio VI 2460.21			1	
Legio VI 2460.22	1			
Legio VI 2460.23			1	1
Legio VI 2460.24	1			
Legio VI 2460.25		3		
Legio VI 2460.26	2			

Table 72b. Sherd count for stamped tiles listed in Collingwood and Wright (1992) in relation to zone				
Signature	Fortress	*Colonia*	Environs	York
Legio VI 2460.27	1			
Legio VI 2460.28		1		
Legio VI 2460.29				1
Legio VI 2460.30	7			
Legio VI 2460.31		1		
Legio VI 2460.32	2			
Legio VI 2460.33	3			
Legio VI 2460.33A	1			
Legio VI 2460.34	3			1
Legio VI 2460.35		1		2
Legio VI 2460.36	6			
Legio VI 2460.37	17			1
Legio VI 2460.38	3			
Legio VI 2460.39	11			
Legio VI 2460.40	6			
Legio VI 2460.41		1	8	1
Legio VI 2460.42	1			1
Legio VI 2460.43	1			
Legio VI 2460.44		1	1	
Legio VI 2460.45				1
Legio VI 2460.46	3			5
Legio VI 2460.47	1			1
Legio VI 2460.52	3			6
Legio VI 2460.52A	4	2		1
Legio VI 2460.53	1		3	
Legio VI 2460.54	1			
Legio VI 2460.55	3	1		1
Legio VI 2460.56				1
Legio VI 2460.57				1
Legio VI 2460.58	1			
Legio VI 2460.59				1
Legio VI 2460.60			1	2
Legio VI 2460.61	1		1	2
Legio VI 2460.61A	1			
Legio VI 2460.62	4	1	1	

Table 72c. Sherd count for stamped tiles listed in Collingwood and Wright (1992) in relation to zone

Signature	Fortress	*Colonia*	Environs	York
Legio VI 2460.63				1
Legio VI 2460.64	1		1	6
Legio VI 2460.65	2			1
Legio VI 2460.66		1		
Legio VI 2460.67	1			
Legio VI 2460.68		1		
Legio VI 2460.69	1			
Legio VI 2460.70	1			
Legio VI 2460.75		1		1
Legio VI 2460.76	1	2	1	1
Legio VI 2460.77				1
Legio VI 2460.78	1			1
Legio VI 2460.79				2
Legio VI 2460.80	1	1	1	
Legio VI 2460.81	1		1	
Legio VI 2460.82	1			1
Legio VI 2460.83		1		0
Legio VI 2460.84			1	1
Legio VI 2460.84A	1			1
Legio VI 2460.85			1	1
Legio VI 2460.86				2
Legio VI 2460.87				1
Legio VI 2460.88				1
Legio VI 2460.89	1			
Legio VI 2460.90	5	2		3
Legio VI 2460.91		1		
Legio VI 2460.92	2	1		2
Legio VI 2460.93	1			
Civilian	1	3		1

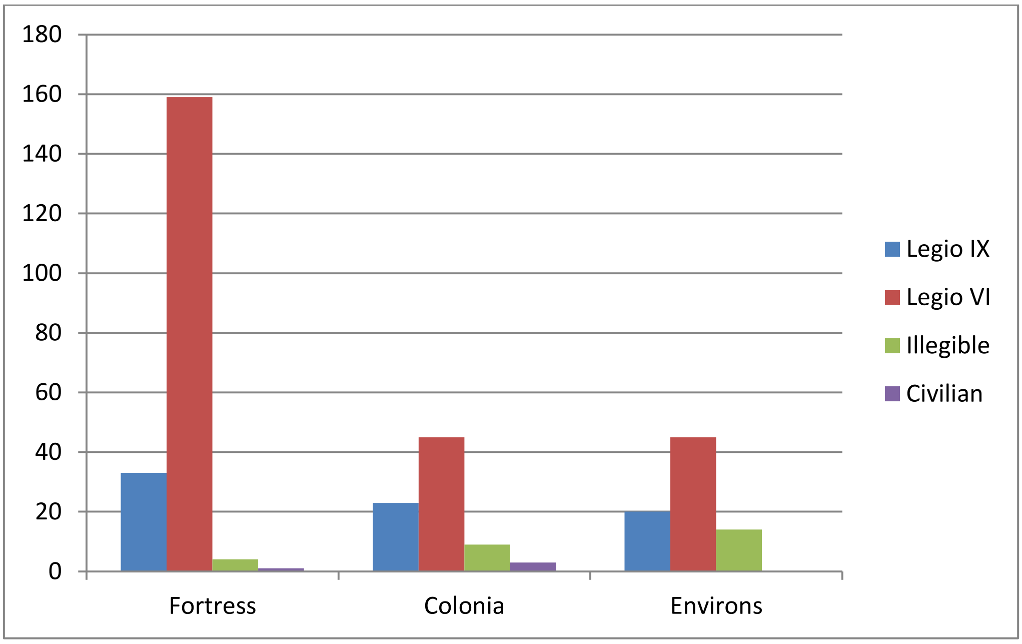


Figure 120. Sherd count for legionary stamped tile in relation to zone, for tiles from the present study and tiles catalogued by Collingwood and Wright (1992). The associated sherd count is on Table 5).

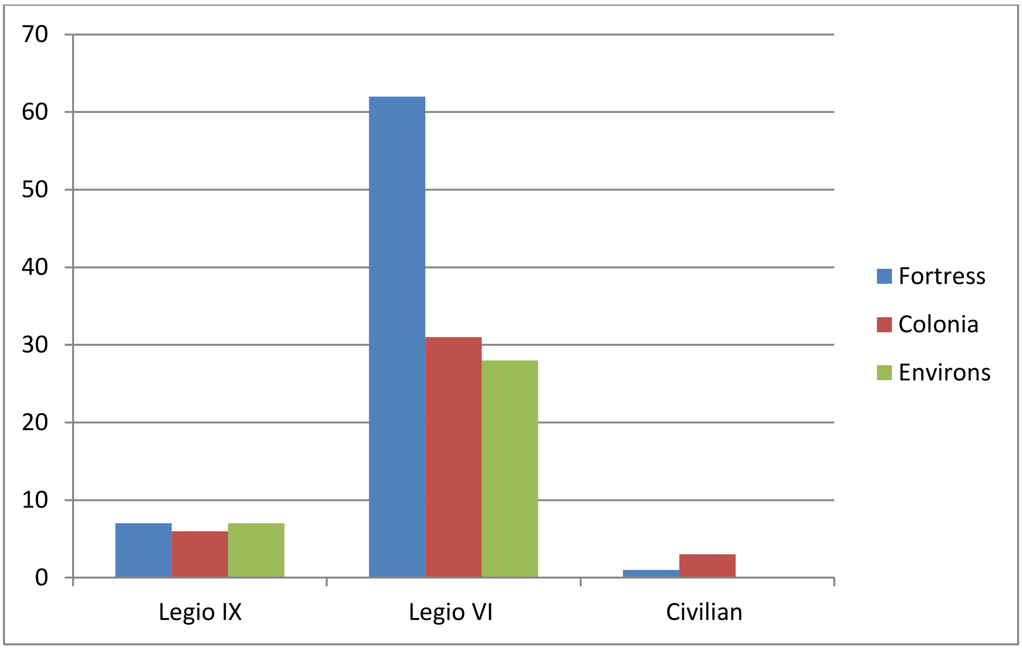


Figure 121. Sherd count for stamp dies in relation to zone for the present study and for tiles catalogued by Collingwood and Wright (1992). The associated sherd count is on Table 73).

Table 73. Number of legionary dies in relation to zone from the present study and from Collingwood and Wright (1992, 149-174)			
	Fortress	*Colonia*	Environs
Legio IX dies in the present study	3	4	5
Legio IX dies in C&W	7	4	3
Total number of Legio IX dies present	7	6	7
Legio VI dies in the present study	6	13	11
Legio VI dies in C&W	56	18	17
Total number of Legio VI dies present	62	31	28
Civilian dies in C&W	1	3	

Taking the stamped tiles in the present study, together with those catalogued by Collingwood and Wright (1992), there were examples present at forty-nine differing sites in the study area (Table 74). Many of the stamped tiles listed on Table 74 were from sites which were known to have been used for the dumping of material from either the fortress, the *colonia*, or the legionary kilns (County Hospital Fossbank, Adams Hydraulics, 21-33 Aldwark and 14 Skeldergate), or were from sites which had very little, if any, structural activity suggesting that the stamped tiles present were the result of casual disposal (46-54 Fishergate, Land Adjacent to the Female Prison of York Castle, Museum Street, Florence Row, Holgate Road and 22 Piccadilly). Two stamped tiles were from 26-28 Marygate, a site with extensive dumps of building materials; it is unclear if these were from nearby buildings or were the result of municipal dumping (Finlayson 1997, 567-8). The occasional stamped tiles found adjacent to the city walls probably also represent the dumping of material to create ramparts, or the disturbance of Roman construction levels by later medieval activity (City walls Lord Mayors Walk, Tower NE6, Tower SW5, Kings Square and St Leonard's Hospital). These sites are excluded from the following discussion.

The presence of legionary tiles on various sites in the fortress is to be expected, but it is clear from Table 74 that York Minster has by far the largest number of stamps of either legion. York Minster is sited above the Legio IX *principia*, basilica and three phases of timber barrack blocks (Monaghan 1997, 1058). The distribution of Legio IX tiles shows that they were present in the area of the timber barracks and the *principia*, suggesting that both the barracks and *principia* had tiled roofs (Phillips and Heywood

1995, 197). Detailed analysis of the dies in relation to the site stratigraphy would be required to determine precisely which of the phases of timber barracks were associated with tile.

There were 137 Legio VI stamped tiles from York Minster, suggestive of considerable building activity in the area. Streets were laid out and stone barracks were built after AD 120 (Monaghan 1997, 1058), this was followed by a period which saw little building activity other than roof repairs, which continued until the early fourth century when there was wholesale rebuilding of the area (Phillips and Heywood 1995, 7). The fourth century rebuilding post-dates the period when tiles were stamped, and while this might suggest that the Legio VI stamped tiles are more likely to relate to the stone barracks, Phillips and Heywood (1995, 40) noted that the *principia* roof in the late Roman period incorporated re-used tiles; it is unclear without further analysis of the tiles in relation to the site stratigraphy, precisely which phases of activity the Legio VI tiles related to.

Table 74a. Sherd count for stamped legionary tile from the present study and stamped tiles listed in Collingwood and Wright (1992) in relation to zone. F = Fortress, C = *Colonia*, E = Environs.

Site	Zone	Legio IX (C&W)	Legio IX Present study	Legio VI (C&W)	Legio VI Present study	Illegible Present study
York Minster	F	21		137		
Tower NE6	F	2		1		
Mailcoach Inn (now the Roman Bath pub)	F	4		2		
12-18 Swinegate	F		2		1	1
Purey Cust Hospital	F		1		1	
Bedern South-west	F		1			
2 Coffee Yard	F		1			
St Leonard’s Hospital	F		1		2	1
Blake Street	F			9	1	
St Williams College	F			1		

Table 74b. Sherd count for stamped legionary tile from the present study and stamped tiles listed in Collingwood and Wright (1992) in relation to zone. F = Fortress, C = *Colonia*, E = Environs.

Site	Zone	Legio IX (C&W)	Legio IX Present study	Legio VI (C&W)	Legio VI Present study	Illegible Present study
Petergate	F			2		
Stonegate	F			2		
Tower SW5	F			1		
City Walls Lord Mayors Walk	F				1	1
King Square	F					1
Fetter Lane	C	1+				
24-30 Tanner Row	C	3	4	2	10	4
Bishophill Junior area	C	3		8		
George Hudson Street	C		1		1	
5 Rougier Street	C		1		1	
13-15 St Martin's Lane	C		1		1	
14 Skeldergate	C		1			
1-9 Micklegate	C		3		5	
Rougier Street	C			2		
St Mary Bishophill Junior	C	3		13		
Leedhams Garage and Wellington Row	C		2		3	5
St Mary Bishophill Senior	C			3		
47-55 Tanner Row	C				1	
York Railway	E	2				
Tile lined tombs	E	4		16		
Mount Vale	E	1				
Museum Street	E			1	1	
St Mary's Abbey	E			8		

Table 74c. Sherd count for stamped legionary tile from the present study and stamped tiles listed in Collingwood and Wright (1992) in relation to zone. F = Fortress, C = *Colonia*, E = Environs.

Site	Zone	Legio IX (C&W)	Legio IX Present study	Legio VI (C&W)	Legio VI Present study	Illegible Present study
26-28 Marygate	E				1	1
28-9 High Ousegate	E				1	
County Hospital Fossbank	E				1	1
Heslington East	E				1	
3 Driffield Terrace	E				1	
Holgate Road	E	2				
21-33 Aldwark	E		1			
22 Piccadilly	E		1		2	
46-54 Fishergate	E		1		1	1
Adams Hydraulics	E		2			2
16-22 Coppergate	E		4		7	9
42-50 Tadcaster Road,	E		1			
Next to Female Prison	E		1			
The Mount School	E			2		
Florence Row	E			1		
Trentholme Drive	E			1		

Four Legio IX tiles from the Mailcoach Inn (now the Roman Bath public house), which were recorded by Collingwood and Wright (1992, 170-71), relate to the legionary bath house. Three of the stamped tiles were hollow voussoirs, implying that there must have been a baths with a vaulted roof in the area prior to AD 120, when the Legio IX left York. All four of the stamped tiles from this site were from a single die (die 2462.9, though one was of the die when slightly worn, die 2462.9a); the presence of only one die perhaps implies a single phase of construction for the Legio IX vaulted roof. One tile from the Mailcoach Inn had an incuse stamp bearing the letters $\widehat{\mathrm{AV}}$ which is of civilian manufacture (Collingwood and Wright 1993, 58); this is the only evidence of a civilian produced tile in the fortress. Warry (2006, 140) notes that incuse stamps on tegulae date from the second quarter of the second century, to the end of the second century. RCHM (1962, 42-43) dates the Mailcoach Inn baths to the early fourth century, stating that they contained re-used Legio IX and VI tiles; given the date of incuse stamps this would imply that the $\widehat{\mathrm{AV}}$ stamp also represents re-used material. It should also be noted that the re-used Legio IX tiles would have been 200 years old when re-used in these baths.

With regard to the stamped tiles in the area to the south-west of the Ouse, there were twenty-three stamped tiles relating to both legions at the 24-30 Tanner Row site, and a number of nearby sites at 47-55 Tanner Row, Leedhams Garage, 5 Rougier Street and George Hudson Street, yielded a further seventeen examples relating to both legions. The eleven Legio IX tiles from these sites are probably the result of dumping, given that the earliest buildings in the area post-dated AD 120 (Monaghan 1997, 1106-08; McComish 2001, 34), while the Legio VI tiles relate to buildings on these sites. Excavations at 1-9 Micklegate yielded tiles relating to both legions; the pottery evidence suggests that there was little activity on the site prior to the mid-second century, followed by two successive large scale buildings, of later second and third century date (Monaghan 1997, 1099-1101). Given that the Legio IX left York c. AD 120, the presence of three Legio IX tiles on this site may suggest that the area was largely used for dumping prior to the late second century. The five Legio VI tiles relate to the buildings on the site, which may suggest military involvement in their construction. The stamped tiles from 13-15 St Martin’s Lane (one relating to each legion) almost certainly relate to a building with *opus signinum* floors, limestone walls and post-pads, which has been observed in two watching briefs at 12 St Martin’s Lane (Finlayson 1997, 911-12), unfortunately the date of this building is unknown. St Mary Bishophill Junior and various adjacent Bishophill sites have yielded stamped tiles of both legions; the Legio IX tiles may relate to clearance deposits in the area, with the Legio VI tiles relating to either a street of late second-early third century date, or a building dating to AD 200 or later (Monaghan 1997, 1126).

It is known that the third century saw considerable development of the *colonia*, and a number of sites with Legio VI stamped tiles can be linked to this process. On some sites there were several successive buildings and without detailed analysis of the stratigraphic sequences, it is unclear precisely which of the buildings in question had tiled roofs. At St Mary Bishophill Junior the Legio VI tile could relate to either of two successive third century buildings (Monaghan 1997, 1126), while at 24-30 Tanner Row the tiles could be from the roofs of timber buildings dating to the late second century, or from a stone building dating to the early third century (Monaghan 1997, 1106). Stamped tiles from 1-9 Micklegate could relate either to a structure dating to the late second century, or to either of two successive massive stone buildings of early third century date (Monaghan 1997, 1102). The stamped tiles at Leedhams Garage/Wellington Row presumably related to a major building dating to AD 150 (Monaghan 1997, 1109), while Legio VI stamped tiles from St Mary Bishophill Senior were probably from a third century building at the site (Carver et al. 1978, 1). Single examples of Legio VI tiles were found on four sites, 5 Rougier Street, which had a pillared building dating to AD 160 or later (Monaghan 1997, 1107), 13-15 St Martin's Lane where an undated Roman building has been observed (Finlayson 1997, 911-12), 47-55 Tanner Row, where a Roman mortar floor was present (Finlayson 1997, 992), and George Hudson Street, which had a hypocausted building of second or third century date (McComish 2001, 34). A stone-walled, hypocausted, building of third century date was present at St Mary Bishophill Senior (Carver et al. 1978, 1), and an earlier drain was present at the site (RCHM 1962, 51); the tile evidence confirms the date of the building as only Legio VI tiles were present at the site.

In the area between the fortress and the rivers the site at 16-22 Coppergate yielded a particularly large number of stamped tiles (twenty sherds relating to both legions) while a site at 28-9 High Ousegate in the vicinity of Coppergate also had a Legio VI tile. Buildings were present at Coppergate to which the Legio VI tiles could have related (Monaghan 1997, 1077).

Most of the stamped tiles from the environs were from tile-lined tombs, or were from Roman cemeteries (York Railway Station, Trentholme Drive cemetery, the Mount

School, Mount Vale and 3 Driffield Terrace). A number of tile-lined tombs from York, which are now in the care of the Yorkshire Museum, had stamped tiles; Collingwood and Wright (1992, 151-2, 159-61, 163-4, 170, 173) recorded that Tomb 1 had two Legio IX dies and two Legio VI dies present, Tombs II and III each had three Legio VI dies present, Tomb IV had one Legio IX die and one Legio VI die present, and Tomb V had two Legio VI dies present, while Tomb VI had a single Legio VI die present. The presence of both Legio IX and Legio VI tiles in some of the tombs would imply either that stocks of tiles remained available for use for a considerable time, or that the tombs date to precisely the period when the Legio VI replaced the Legio IX in York.

RCHM (1962, 71, 81, 85-6 and 107) also recorded a number of tile-lined tombs from York, but where stamps were specified, the tomb in question had stamps relating to a single legion. It is difficult to determine which, if any, of the RCHM tombs relate to those described in Collinwood and Wright, as they are not clearly cross-referenced. RCHM also noted that at least one of the tile tombs at the Yorkshire Museum seems to have undergone some rearrangement when displayed (RCHM 1962, 81), possibly conflating tiles from two different tombs; which could perhaps account for the mixing of legionary dies in at least one of the tile-lined tombs.

Eight Legio VI stamped tegulae were from the south aisle of St Mary's Abbey, to the immediate north-west of the fortress, and these probably relate to a stone building interpreted as being of early third century date on the site (Ottaway 2011, 123). The presence of so many stamps on this small site perhaps implies military involvement in the construction of the building; this could be seen as bolstering the argument in favour of a military annexe (RCHM 1962, 45-7; Ottaway 2011, 123). The presence of a Legio IX stamp at 42-50 Tadcaster Road, Dringhouses, may suggest that settlement in the area began prior to AD 120, but the pottery evidence suggests a late second century date for the settlement of this area (Ottaway 2011, 363). The Legio IX stamped tile is more likely therefore to represent a stray loss, or the re-use of material salvaged from the fortress and sold on for re-use elsewhere. A single Legio VI stamp was recovered from excavations at Heslington East; the site has a Roman settlement including a hypocausted building; while the presence of a legionary tile at the site could imply military control of the area, it is more likely to represent the re-use of earlier tile given that the tile must pre-date the mid-third century, and that the settlement is largely of fourth century date.

It is unclear how long an individual wooden stamp die lasted, but if the results of the present study are combined with the stamps listed in Collingwood and Wright (1992), and assuming that one die was in use at any given time, then there were eleven Legio IX stamps which could have been used over a maximum 50 year period, giving a lifespan of one die every 4.4 years, while the 104 Legio VI stamps were in use over approximately 125 years, giving an average of one die every 1.2 years.

Relatively few forms of tile in the present study were stamped (Table 75); most of the stamps were on Rbrick sherds that were too fragmentary to identify the original form, followed by examples on tegulae, then imbrices with a single example on a Lydion brick. As a proportion of the total weight of each form, only 0.5 percent of imbrices in the present study were stamped, 0.4 percent of the Rbrick, 0.4 percent of the tegulae and 20 percent of the Lydion bricks (this seemingly high figure for the Lydion bricks represents one out of only five examples within the study, the rarity of the form skewing the percentage of stamped tiles seen). The number of stamped tiles in the present study is exceptionally low, and this is undoubtedly due to the highly fragmented nature of the tile examined. The fact that the stamps were usually associated with roofing tile conforms to the national picture, whereby stamps are relatively rare on non-roofing forms (Warry 2010, 140). It is unclear if roof tiles were the most frequently stamped because they were the most visible on a building, other forms being largely hidden within walls. Warry (2010, 140) also raised the possibility that while roofing tiles were made by the military, it was possible that non-military contractors, who did not stamp their tiles, made the more specialised products such as box flues or pipes.

There were only two examples of tegulae with both a legionary stamp and lower cutaway, of which two had Legio IX stamps (see p226), while the third had an illegible stamp. Two sherds of Rbrick had both a stamp and a signature (see p331-2). There were too few examples present to determine any links between stamps and cutaway types, or stamps and signatures.

Table 75. Number of stamps in relation to form				
	Imbrex	Lydion	Rbrick	Tegula
Legio IX	4		24	2
Legio VI	18		24	2
Illegible	10	1	15	1

None of the stamped tiles had a complete surviving length or breadth, but the thickness measurements for roofing tiles (Table 76) hint at an overall reduction in size for imbrices and tegulae, but it should be stressed that the sherd count is very low. There is also some suggestion of a greater range of thicknesses on Legio VI imbrices, perhaps reflecting the longer period of production for this legion. Since both of the more closely dateable Legio VI stamps, in dies 2460.43 and 2460.75, were on sherds of Rbrick, that is sherds where the form could not be identified, they cannot contribute to the question as to whether roofing tile size reduced over time.

Table 76. Minimum, maximum and average thickness of stamped roofing tiles, together with the related sherd count				
	Minimum thickness in mm	Maximum thickness in mm	Average thickness in mm	Sherd count
Legio IX imbrex	20	24	22	3
Legio VI imbrex	12	27	19	18
Legio IX tegula	29	41	35	2
Legio VI tegula	29	34	32	2

A comparison of stamp dies to fabric (Table 77) shows that the overwhelming bulk of stamps were associated with fabric R9. Comparing the percentage of stamps in each fabric to the volume of each fabric as a percentage of all the tile in the present study, shows that there are far more stamps on fabric R9 tiles and far fewer stamps on fabrics R3, R6, R10 and R15 than might be expected (though it should be stressed that the sherd count is low). While the high levels of stamps on fabric R9 might suggest an association between fabric R9 and the practice of military stamping, it could also be an accident of survival, as R9 tiles are highly fired and tend to be very hard, leading to better survival. The almost equal number of Legio IX and Legio VI stamps in fabric R9 shows that this fabric was used by both legions. In contrast fabrics R6 and R10 were only associated with Legio VI stamps, suggesting that these fabrics were mainly used after the departure of the Legio IX, and fabric R11 though present on one Legio IX tile was predominantly used by the Legio VI. Assuming that R10 is a later fabric than R9 (see p318-9), the contrast between the percentages of stamped tiles in fabrics R9 and R10 is of interest, as it might suggest that R10 was mainly in use while the practice of stamping was declining from the mid-third century onwards.

As most of the dies present occurred on single tiles it was not possible to determine if there were links between fabrics and a specific die (Table 77), though in the case of fabrics R9-R10 it is clear that the clay sources were in use long enough to be associated with several dies.

Table 77. Stamp dies with two or more examples in relation to fabric							
Fabric	R2	R3	R7	R8	R9	R10	R11
2462.6					2		
2462.7					2		
2462.9				2	2		
2462.9A			1		2		
2462.9C		1			1		
2462.12	1				4		
2460.6					1	1	
2460.9					4		
2460.39						2	
2460.63					1		1
2460.81					1	1	
2460.84					1		1

6.3 Tally marks and batch numbers

Two differing sets of numbering are seen on Roman tiles. Firstly there are marks incised into the edges of tiles which are known as tally marks, these were often located on the fore-edge of tegulae, usually below the signature and seem to have been designed to be visible when the tiles were stacked. Tally marks are rare nationally, usually being associated with military sites (Warry 2006, 91). Nationally, most represent the numbers I-XII, with IV being the commonest followed by V, but three larger numbers XXV, XXX and LXXVIII have each been recorded once (Collingwood and Wright 1993, 92). Four tally marks have previously been noted in York (Betts 1985, 202).

A single example of a tally mark was noted in the present study, in the form of the numerals XX, this was from Heslington East 3km south-east of the fortress, and was on the side of a fragment of Rbrick in fabric R6. The lack of tally marks in the study is probably due to the highly fragmentary nature of the material examined, but also conforms to their rarity in Britain as a whole. The tally mark was not from the fortress, as might have been expected given their usual association with military sites.

There are also numbers incised on the upper surface of tiles which are classified as batch numbers in order to distinguish them from tally marks; these may represent a tile placed at the top of a stack of tiles. Most batch numbers from Britain range from IV to XXX, though occasional larger numbers are known with the largest being DLXXXXV or 595 on a tile from Holt (Collingwood and Wright 1993, 92, 106). An example from Woodchester has two numbers present XXXXIIII and XXXXVI (44 and 46); it is unclear why this tile has both numbers present, unless one of the numbers represents a correction (Collingwood and Wright 1993, 103). Examples previously recorded in York include a tile found near the north-east gate of the fortress with the letters VIIIS meaning eight and a half, which might imply it is something other than a batch number, and a tile with the letters [...]XXXV meaning thirty five or more which was found at the junction of Bishophill Junior and Prospect Terrace (Collingwood and Wright 1993, 100, 102).

Fourteen possible batch numbers were present in the study, though many were incomplete and it is equally possible that they represent graffiti. The commonest number seen was X, which occurred three times, once on a chimney sherd from 12-18 Swinegate (Figure 22), once on an imbrex from 24-30 Tanner Row (Figure 34) and once on a flue from 12-18 Swinegate, though in each case other numbers could have preceded the X. An Rbrick sherd from the Bedern was incised XI.II (Figure 59), at 35-41 Blossom Street there was a tile incised with a V with II below, and a number V was also present on two tiles from Heslington East. A tile from Heslington East was incised IX or

XI depending on which way up it was originally. Partial numbers were seen on several sherds including a bessalis from George Hudson Street, which had a single incised line, as did an Rbrick from 12-18 Swinegate. An Rbrick and an L shaped brick from 1-9 Micklegate both had II on the upper surface (Figure 45), as did an Rbrick from Wellington Row, and a tegula from 26-28 Marygate.

There were too few batch numbers present to determine if there were any links to legionary stamps, lower cutaways, fabric or form, though it should be noted that examples were seen on a bessalis, two imbrices, a flue tile and a tegula, which implies that such numbers were applied to a variety of forms of tile.

6.4 Graffiti

Graffiti are known from many sites across Britain; text based graffiti include information relating to tile manufacture, personal names, presumably of the tile maker, lists of names, and examples where tile makers seem to be practising writing the alphabet (Collingwood and Wright 1993, 92-159). There are also some which are pictorial, such as the drawing of a pharos on a tile in the collections of the British Museum (Brodribb 1982, 299).

Graffiti previously recorded in York include three with personal names; one with the letters OTTO[...]COM[...] was found in the garden of the Borthwick Institute, which is the legionary kiln area, a second inscribed [...]ΛM[...] was found at York Minster, and a third inscribed MSA[...]|[...]M[...] was found outside interval tower NE6 (Collingwood and Wright 1993, 127, 144, 150). There is also a graffito on a tile found in 1737 at the 'brick hills', thought to be Clifton Fields to the north of the fortress, which read POLIO COLEGIO FELICTER 'Polio to the guild, good luck' (Collingwood and Wright 1993, 128). Betts (1985, 123) has suggested that if the workman who wrote the graffito was the tile maker this would imply the existence of a tilers guild, but this interpretation is not suggested in either RCHM (1962, 114) or Collingwood and Wright (1993, 128). A graffito on a tile from immediately north-east of the *principia* had the letters $\widehat{XP}$ and P indicating the presence of Christianity (Collingwood and Wright 1993, 142).

Only five graffiti were seen in the present study, the first on a Lydion brick from 16-22 Coppergate, in the environs, seemed, to be an inscription, but this was illegible (Figure 37), while the second on a sherd of Rbrick from Wellington Row in the *colonia* had a series of lines and arcs (Figure 61). The third example on a bessalis from George Hudson Street was a triangular shape, but the remainder of the graffito was broken off (Figure 122) making its original form unclear. The letters VVX were seen on an imbrex from 24-30 Tanner Row (Figure 35) and a tile from 12-18 Swinegate had a partial graffito which seemed to read VVV (Figure 41).

Figure 122. Graffito from George Hudson Street, Context 6071, © YAT

6.5 Other surface marks

A large number of other surface marks were present on the tiles in the present study, most of which were accidental. Nineteen tiles had finger or thumb prints, eleven had grip marks, and one had a possible hand impression left during manufacture, while one tile had a textile impression. Two sherds had finger drawn smoothing lines on the upper surface. One imbrex had a leaf impression on the underside, this leaf had presumably stuck to the former before the clay was laid over the former (Figure 32).

Various marks show that the tiles in question had been dried on the ground, rather than under cover. Five tiles had straw marks on the base, six had grass marks on the base, one tile had the impression of seeds, and one tile the impression of a shell. Forty-five of the tiles had hob-nail boot imprints on the upper surface. Eighty-eight tiles had rain marks on the upper surface, while six had hail-stone marks. Various animals walked over the tiles while they were drying, the commonest prints were those of dogs (seventy-six examples), followed by cats (six examples), goats (two examples), sheep (one example), and chickens (two examples), together with a number of less well preserved examples where identification was difficult, including one unidentified claw mark, eight unidentified hoof prints and nine unidentified paw prints. Two tiles had worm marks on the base caused by tiles being dried on exceptionally wet ground (worms come to the ground-surface during heavy rain).

Appendix 7 Phasing information for Appendices 8-11

The sites selected for detailed study yielded a total of 2,371,416g of tile, representing 29.2 percent of the total volume of tile examined. Given the known links between pottery and tile production, the date ranges used for the chronological groups in the present study are based upon those devised by Monaghan (1997, 837-50) for the pottery from Roman York. For clarity the terms phase and period have been avoided in the present study, and the tile has been divided into six chronological groups (pre-Roman, AD 71-120, AD 120-200, AD 200-280, AD 280-410 and post-Roman). The archive and publication reports for the St Leonard's Hospital site, Wellington Row, Dixon Lane and Blossom Street excavations, each contained differing numbering systems for the phases and periods observed. For ease of reference Table 78 equates the date-ranges used in the present study to the phase and period numbers from the original excavation reports for these sites.

It should be noted that in some cases phases allocated in the original excavation reports did not correspond exactly to the chronological groups used in the present study. For example, Phase 33 of the site at St Leonard's Hospital was dated as c. AD 110 to the end of the Roman period (Hunter-Mann 2011, 13, 22), thereby spanning four of the chronological groups in the present study. In such cases the original phases were subdivided, with contexts being allocated to the chronological groups in the present study on the basis of a combination of the pottery dating and the stratigraphy. It should also be noted that at Dixon Lane there were three groups which lacked pottery dating but were interpreted as being Roman on the basis of the stratigraphy, these have been placed in the group AD 280-410, as it is the latest date at which they could have occurred, and they are listed in parenthesis in Table 78; these groups produced only a single sherd of tile from Context 2107.

For the remaining sites analysed in Appendices 11-13 the contexts are not allocated to specifically numbered phases or groups in the archive reports, but rather are described in terms of the pottery dating, it was not therefore necessary to include these sites in Table 78.

Table 78a. Date of contexts used in the present study equated with paragraph numbering used in the various excavation reports				
Term in the present study	St Leonard's Hospital	Wellington Row T= Trench	Dixon Lane	Monaghan's ceramic phase
Pre-Roman	Phases 11 and 21	T7 Group 1	Groups 1-2	
AD 71-120	Phases 31 and 32 except for Contexts 3531/3558/3572, Phase 33 (except Groups 104/105 and Group 303 Set 308), Phase 35	T4 Groups 1-15 T7 Group 2	Group 3	Phase 1
AD 120-200	Phase 32 Contexts 3531/3558/3572, Phase 33 Groups 104/105/303 (except Group 303 set 308)	T4 Group 17 T7 Groups 3-11		Phase 2
AD 200-280	Phase 33 Group 506	T4 Group 16 T7 Groups 12-42 (excluding 29b)	Group 4	Phase 3
AD 280-410	Phase 36 and Phase 37	T4 Group 18.2-3 T7 Groups 29b and 43-60	Group 12 (Groups 13-14 and 17)	Phase 4
Post-Roman	Phase 33 Set 308, Phases 38 onwards	T4 Group 18.5		

Table 78b. Date of contexts used in the present study equated with phase numbering used in the various excavation reports				
Term in the present study	14-20 Blossom Street	28-40 Blossom Street	35-41 Blossom Street	Monaghan's ceramic phase
Pre-Roman		Phase 1		
AD71-120				Phase 1
AD 120-200	5.1.1	Phases 2 and 3	Periods 1-2	Phase 2
AD 200-280	5.1.2-5.1.3, 5.4.1-5.4.2, 5.5.1-5.5.2	Phases 4 and 5	Period 3a	Phase 3
AD 280–410	5.1.4-5.1.5. 5.2.1-5.2.3,	Phase 6	Period 3b, Period 4	Phase 4
Post-Roman	5.1.6-5.1.9, 5.2.4-5.2.7, 5.3.1-5.3.3, 5.4.3-5.4.6, 5.5.3-5.5.4	Phases 7-11	Periods 5-7	

Every context containing Roman tile is specified in Appendices 8-13, to clearly show which contexts were examined. The only exceptions are post-Roman contexts containing Roman tile, which are not described in detail as they lie beyond the scope of the present study.

Appendix 8 The site of St Leonard's Hospital, within the legionary fortress

The excavations at the site of St Leonard's Hospital, York (YAT project code 834), comprised six trenches located immediately inside the westernmost corner of the fortress wall, Figure 123, which were opened in four summer seasons from 2001-4. The following research is based upon the updated assessment report for the site (Hunter-Mann 2011), coupled with the IADB database as accessed on 15th June 2011, and any subsequent changes to the phasing resultant from further post-excavation analysis are inevitably not included here. The site yielded 359,840g of Roman tile, from contexts relating to the entire period of Roman occupation, though the bulk of the tile occurred residually in contexts of post-Roman date.

8.1 Summary of the stratigraphy at the site of St Leonard's Hospital

8.1.1 Pre-Roman

The glacial boulder clay was typically overlain by naturally deposited sand, and this was truncated by two narrow ditches and two associated stake-holes, possibly from fences, which were interpreted as being of probable Iron Age date (Hunter-Mann 2011, 14). As would be expected no tile was present in any of these contexts.

8.1.2 AD 71-120

The earlier Iron Age ditches were infilled, prior to the construction of the first fortress (Hunter-Mann 2011, 15). The rampart of the first fortress was only uncovered in Trench 1, but due to later truncation only the lowest 0.6m of this rampart survived (Hunter-Mann 2011, 14). Five contexts within the first rampart contained tile (1376, 1388, 1445, 1449 and 1454). There were clearly problems of contamination with two of these contexts (1388 and 1454), both of which contained thirteenth to sixteenth century tile, and in the case of 1388, thirteenth century pottery, it is unclear therefore if the Roman tile in these contexts (four sherds weighing a total of 25g) relates to the first rampart, or is intrusive.

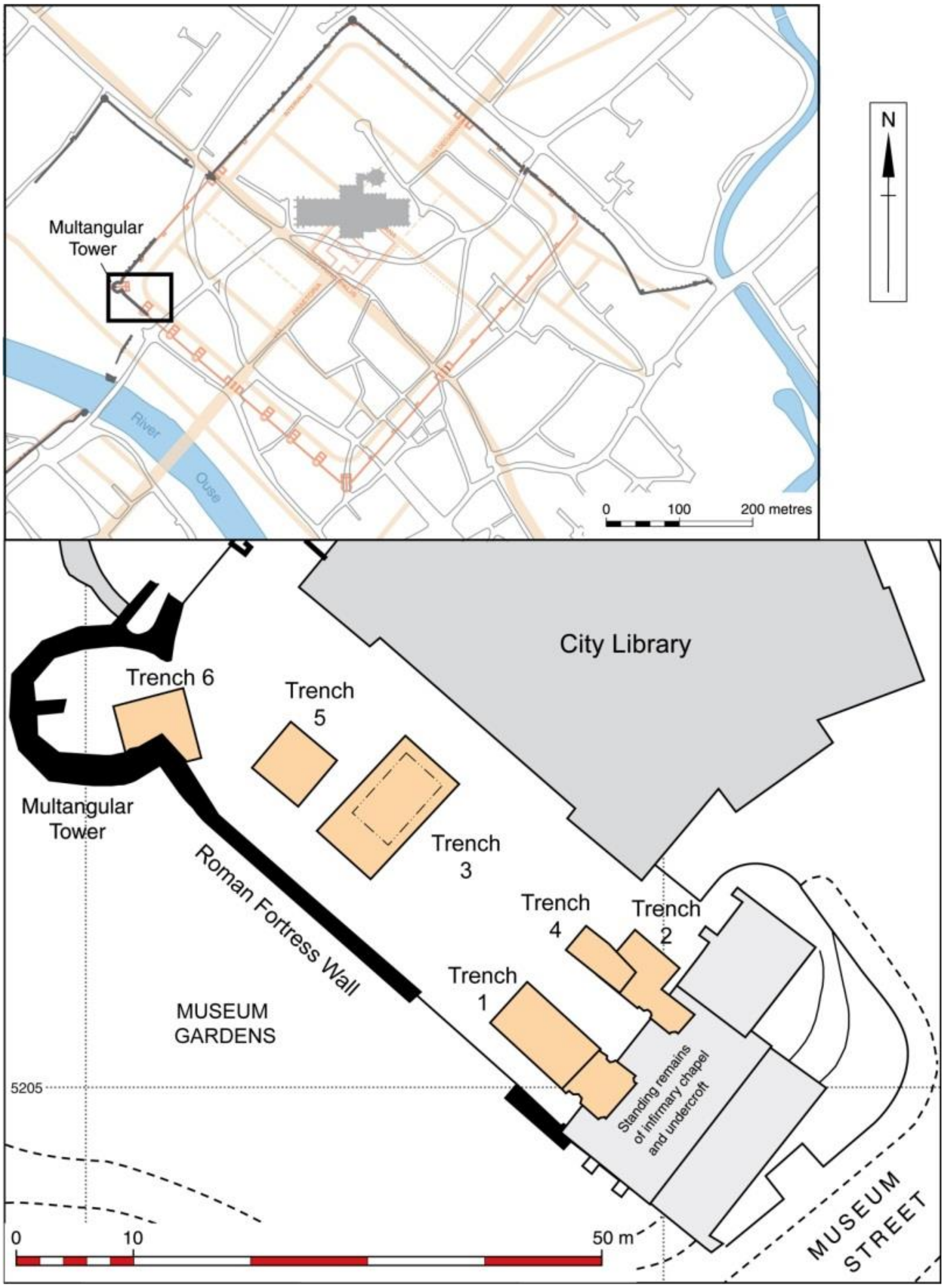


Figure 123. The location of the St Leonard's Hospital site. (Illustration from Hunter-Mann 2011, 10 ©YAT, using underlying © Crown Copyright data Ordnance Survey Licence Number 100018343)

Activity to the rear of the rampart was seen in both Trenches 3 and 5. In Trench 3 there was a pit backfilled with ashy material derived from industrial activity, and part of the intervallum road (Context 3618) was present, the surface of which incorporated a small quantity of tile (Hunter-Mann 2011, 15). An associated dump, Context 3615, contained Roman and thirteenth to sixteenth century tile, suggesting a problem of contamination. Sealing the pit were a sequence of hearths, dumped deposits, two cobble surfaces, and a clay and stone revetment or sill wall, which were interpreted as activity in the intervallum area (Hunter-Mann 2011, 15-16); tile was present in Contexts 3534, 3555-7, 3559, 3563-5, 3567-9, 3576-83, 3586, 3590-92 and 3600. In Trench 5 there were a number of dumped deposits cut by a cess pit (Hunter-Mann 2011, 18), with tile being present in Context 5157. These features were sealed by gravel and pebble surfaces (Hunter-Mann 2011, 18), of which Context 5156 contained tile.

The stone defences of the second fortress seem to have been constructed in a single phase. Radiocarbon dating of the timber piles beneath the Multangular Tower dated this phase of construction to the early second century, probably no later than AD 110, which is two hundred years earlier than the generally accepted date (Hunter-Mann 2011, 20-22). Levelling deposits associated with the construction of Tower SW6 and the Multangular Tower were present, of which Contexts 1296, 1321, 1339, 1367, 1370, 1375, 1399, 6003-4, 6023, 6025, 6039 and 6046 contained tile. Mortar floors within the Multangular Tower and Tower SW6, Contexts 5142 and 1366, contained some tile sherds, as did internal occupation deposits within the tower (Contexts 1275, 1277, 1297, 1364, 5143 and 5146).

A total of 34,495g of tile was recovered from contexts dating to AD 71-120, accounting for 9.6 percent of the tile from the site. The tile largely comprised small sherds of Rbrick, with a few sherds of imbrices and tegulae. A sherd of tegula from Context 3534 had both a Type 2 signature (Betts 1985, 15) and a Type B6 lower cutaway (Warry 2006, 4). Three sherds of tile were overfired (one Rbrick and two imbrices).

8.1.3 AD 120-200

The second fortress rampart extended 13.8m from the wall and was roughly in line with the rear walls of the interval towers (Hunter-Mann 2011, 22). A long sequence of activity was seen on the rampart continuing from the late first century to the end of the Roman period. The deposits within the second rampart were more varied in character than those of the first rampart, often containing abundant domestic rubbish (Hunter-Mann 2011, 22).

There were a small number of contexts for which the original phase allocation was changed for the purposes of this study, Contexts 1424 and 1430 in Trench 1, and Contexts 3531, 3558 and 3572 in Trench 3, were classed as dating to AD 120-200 due to the presence of Hadrianic pottery (Hunter-Mann 2011, 16, 53-4, 274-5).

A group of contexts in Trench 1 (Group 105, Phase 33, in the original phasing) were interpreted as relating to the second rampart, on the basis of the pottery dating for the majority of the contexts within the Group. This included a number of deposits yielding tile, Contexts 1145, 1152, 1165, 1190, 1197, 1200, 1242, 1258, 1264, 1272, 1285, 1288, 1298 and 1320. All but eleven contexts within this group contained pottery post-dating AD 120 (the eleven contexts being Contexts 1327-8, 1343-4, 1353, 1431-5, 1440 and 1442) and these were either stratigraphically earlier than the contexts dating to AD 120-200, or had no direct stratigraphic links to them, and stratigraphically it is possible that these eleven contexts could relate to the period AD 71-120, but they have been phased here as this is the most recent date at which they could occur.

A small number of deposits in Trench 3 dating to AD 120-200 contained tile (Contexts 3526, 3547 and 3550-4). These were beneath make-up deposits for the second rampart, some of which contained tile (Contexts 3498-9, 3501, 3505, 3511 and 3519). Contexts 3521 and 3546 which were interpreted as stacks of turf associated with the rampart contained tile, while a small area of rampart slippage, Context 3515, contained second century pottery and tile.

Only 9,535g of tile was recovered from contexts dating to AD 120-200, representing 2.6 percent of the tile from the site. The only notable feature was a tegula with an irregular lower cutaway that did not conform to Warry's (2006, 4) typology.

8.1.4 AD 200-280

Thin deposits at the foot of the rampart were suggestive of the accumulation of debris or waste in the area (Hunter-Mann 2011, 23); Contexts 3484-5 within this sequence contained tile.

A total of 2,645g of tile was recovered from contexts dating to AD 200-280, representing 0.7 percent of the tile from the site. The tile mainly comprised small sherds of Rbrick, though a few sherds of tegulae and imbrices were present. One of the Rbrick sherds had a reduced core.

8.1.5 AD 280-410

Some of the deposits on the rampart were of fourth century date; a number of these deposits contained tile (Contexts 5107, 5111, 5115, 5120, 5151 and 5154). At some stage the foundations of the Multangular Tower were re-inforced, this work involved the removal of subsoil in the southern central chamber of the tower, and its replacement with limestone rubble, presumably to stabilise the foundations (Hunter-Mann 2011, 23), and Context 6033 within this repair contained tile. A lack of pottery or closely datable artefacts makes the precise dating of this repair work unclear, it has been placed here as it is the latest possible date at which the activity could have occurred.

Only 5,425g of tile was recovered from contexts dating to AD 280-410, representing 1.5 percent of the tile from the site. The bulk of the tile comprised small sherds of Rbrick, though there were also some flue tiles, imbrices and tegulae present. The only features of note were that one of the flue tiles was combed, there was a tegula with a Type B6 lower cutaway (Warry 2006, 4) and one Rbrick was overfired.

8.1.6 Medieval and later

The rear of the Multangular Tower was dismantled down to foundation level, and the internal rampart was redesigned to continue around the western corner of the defences, the pottery suggests an Anglian date for this activity (Hunter-Mann 2011, 23). The remains of a possible Anglo-Scandinavian timber building were present, but there was no evidence to associate this with the pre-Conquest hospital of St Peter, which subsequently became St Leonard's Hospital (Hunter-Mann 2011, 8).

The fortress rampart was reduced in the early twelfth century, and the undercroft of St Leonard's Hospital was built in the mid-twelfth century (Hunter-Mann 2011, 8). Part of the fortress wall was dismantled in the fourteenth century to be replaced by a new portion of city wall, connecting the fortress wall with Lendal Tower (Hunter-Mann 2011, 8). The hospital was largely demolished at the time of the dissolution in the sixteenth century (Hunter-Mann 2011, 9). Some nineteenth century landscaping was undertaken on the site, and a Second World War public air-raid shelter was also built there (Hunter-Mann 2011, 9).

The post-Roman deposits contained 307,740g of residual Roman tile, representing 85.5 percent of the total volume recovered. Given that the bulk of the Roman tile was from post-Roman contexts, inevitably most of the features of interest seen on the tile were from this material. There were two tegulae mammatae and one sherd of solid voussoir, which are rare for York as a whole. There were fourteen tegulae with upper cutaways, and thirty-three with lower cutaways, of which eight were Type A2, five were Type B6, five were Type C5, and one was an irregular cutaway (Warry 2006, 4). Four legionary stamps were present of which one was illegible, one related to the Legio IX and two to the Legio VI; in addition, eighteen signatures were present of which eight were illegible while the remainder were in Types 1-4 and 6 (Betts 1985, 192). Two of the flue tiles were combed and two had incised keying. Two Rbrick sherds were pierced by holes, and twenty sherds were overfired or vitrified. Surface marks on the tiles included claw marks, a paw print, four finger prints, six hob-nail boot prints, a textile impression, rain marks on the upper surface of one tile and straw marks on the underside of another.

8.2 The tile from the site of St Leonard's Hospital

The St Leonard's Hospital site is notable for the high level of residuality among the tile, with 85.5 percent of tile occurring in contexts of post-Roman date. High levels of residuality were also seen in the pottery from the site, with at least 74.9 percent of the Roman sherds occurring in contexts of post-Roman date (Hunter-Mann 2011, 46 and

Appendix 2); the pottery has yet to be fully catalogued, so the precise quantity of residual sherds was uncertain at the time of writing. While the level of residuality for the pottery is a slightly lower figure than for the tile, it must be remembered that percentage of residuality for the tile is based on weight, while that for the pottery is based on sherd count, which may account for the difference. The volume of tile by phase is given on Table 79 and Figure 124, with the associated shed count on Table 80.

Table 79. Weight of tile in grams, by date and form, at the St Leonard's Hospital site

	AD 71-120	AD 120-200	AD 200-280	AD 280-410	Post-Roman
Overall	34495	9535	2645	5425	307740
Flue		300		50	1725
Imbrex	1760	500	200	450	28595
Other					500
Rbrick	31235	8105	2120	4750	227440
Tegula	1500	630	325	175	45420
Tegula mammata					1950
Voussoir					2110

Table 80. Sherd count for Table 79

	AD 71-120	AD 120-200	AD 200-280	AD 280-410	Post-Roman
Overall	185	116	22	37	2459
Flue		2		1	14
Imbrex	9	9	2	6	228
Other					1
Rbrick	174	101	16	28	1970
Tegula	2	4	4	2	243
Tegula mammata					2
Voussoir					1

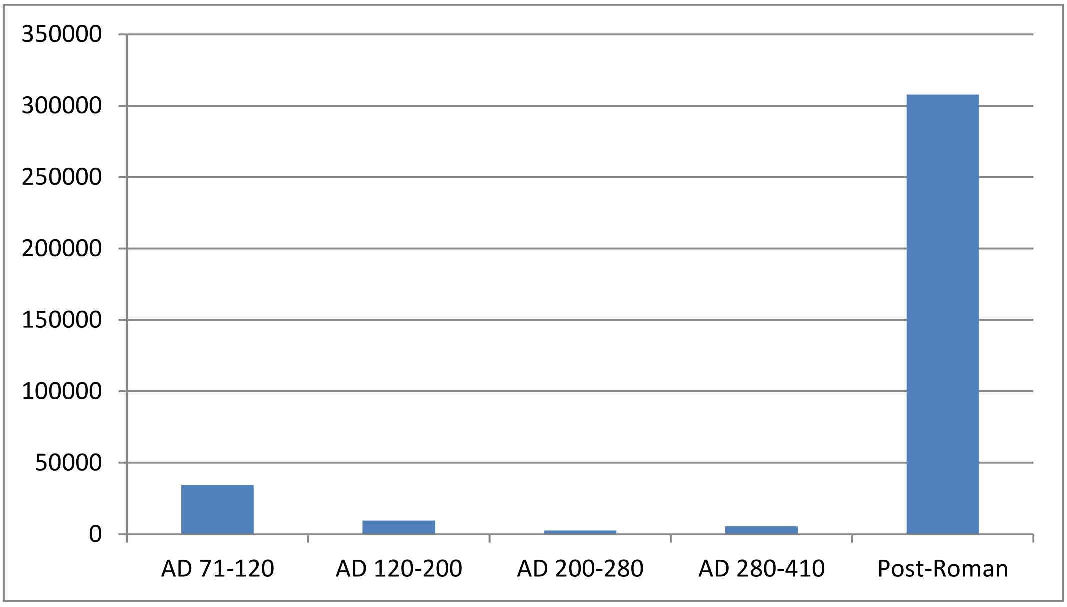


Figure 124. Total weight of tile in grams for each chronological grouping at the St Leonard's Hospital site

Most of the tile from the Roman contexts at the site was from the period of Legio IX occupation, with a marked decline in the volume of tile thereafter (Figure 124). Very little of the tile originated from *in situ* structural remains, severely limiting any study of chronological variation in the tile seen. The only structural deposits to yield tile were floor surfaces associated with the use of the Multangular Tower and Tower SW6, where small tile sherds, weighing just 125g in total (or 0.0002 percent of the tile from the site) were accidentally incorporated into the floors.

No complete length or breadth dimensions were present, preventing any analysis of chronological change in relation to these dimensions. The thickness dimensions of the flue tiles, imbrices and tegulae from Roman contexts are given in Table 81, but the sherd count was too low to enable any analysis of changes to thickness over time. There were no legionary stamps present, and only one signature, in the contexts of Roman date, making analysis of chronological change impossible. There were also too few examples of lower cutaways present in the Roman contexts to determine any chronological variations (Table 82).

The weight in grams for each fabric in relation to date is given in Table 83 with the associated sherd count on Table 84. Most of the fabrics seen in York as a whole are present on the St Leonard's site, with only fabrics R13, R16 and R19 being absent, but as each of these fabrics is rare in the study area as a whole, their absence is unsurprising. The sherd count for the individual fabrics was too low to enable a comparison of fabric to date, and the same was true for fabric groups (Tables 85-6).

Table 81. Tile dimensions in mm and sherd count in relation to form and date, for tile from the St Leonard's Hospital site

Date and form	Minimum thickness	Maximum thickness	Average thickness	Sherd count
AD 120-200 flue tile	21	21	21	2
AD 71-120 imbrices	14	29	21	7
AD 120-200 imbrices	12	20	15.9	7
AD 200-280 imbrices	21	22	21.5	2
AD 280-410 imbrices	17	21	19	4
AD 71-120 tegulae	20	356	27.5	2
AD 120-200 tegulae	22	23	22.5	2
AD 200-280 tegulae	20	23	21.3	3

Table 82. Sherd count for cutaway forms in relation to date at the St Leonard's Hospital site

	Type A2	Type B6	Type C5	Other
AD 71-120		1		
AD 120-200				1
AD 280-410		1		
Post-Roman	8	5	1	1

Table 83a. Weight of fabric in grams in relation to date, at the St Leonard's Hospital site

Fabric	AD 71-120	AD 120-100	AD 200-280	AD 280-410
R0	4540	2450	195	1460
R1	2590	675	150	425
R2	2085	270	125	
R3	950	275		300
R4	125			
R5	100			
R6	575		550	
R7	2660	275		100
R8	75	395	900	210

Table 83b. Weight of fabric in grams in relation to date, at the St Leonard's Hospital site				
Fabric	AD 71-120	AD 120-100	AD 200-280	AD 280-410
R9	14705	3380	725	1830
R10	735	950		575
R11	2255	570		150
R12	525			
R14	625	270		
R15	1350	75		
R17				325
R18	150			
R99	450			

Table 84. Sherd count used for Table 83				
Fabric	AD 71-120	AD 120-100	AD 200-280	AD 280-410
R0	41	37	4	7
R1	23	13	1	5
R2	6	2	2	
R3	6	5		5
R4	1			
R5	1			
R6	4		2	
R7	10	3		1
R8	1	4	5	1
R9	67	31	8	13
R10	3	6		2
R11	11	7		2
R12	2			
R14	2	2		
R15	5	1		
R17				1
R18	1			
R99	1			

Table 85. Weight in grams of each fabric group at St Leonard's Hospital in relation to date					
	Fabric Group 1	Fabric Group 2	Fabric Group 3	Fabric Group 4	Fabric Group 5
AD 71-120	2740	125	16940	2575	7575
AD 120-200	675		4555	740	1115
AD 200-280	150		725	900	675
AD 280-410	425	325	2755	210	250

Table 86. Sherd count used for Table 85						
	Fabric Group 1	Fabric Group 2	Fabric Group 3	Fabric Group 4	Fabric Group 5	Total
AD 71-120	24	1	78	10	31	144
AD 120-200	13		42	7	16	78
AD 200-280	1		8	5	4	18
AD 280-410	5	1	20	1	3	30
Total	43	2	148	23	54	

Appendix 9 The Wellington Row excavations, within the *colonia*

Wellington Row, York, (Figure 125) was the largest Roman site ever excavated by YAT (Monaghan 1997, 1108), and the excavation yielded a total of 1,682,769g of tile. The excavation was undertaken in two stages, the first stage comprising the excavation of three trial pits is referred to as Leedhams Garage (YAT site code 1987.24), with the second stage being a large scale excavation known variously as Stakis, Leedhams Garage or Wellington Row (Site code 1988-9.24). Nine trenches were excavated in all; Trial Trench 3 was expanded to become Trench 7, while Trenches 8 and 9 overlapped in terms of area (Monaghan 1997, 1108).

The pottery from the site was extensively studied as part of an overall analysis of Roman pottery from York (Monaghan 1997), and this publication also contains a summary of the deposit sequence at the site (Monaghan 1997, 1108-23). As Monaghan's (1997) volume does not include Trenches 1-3 or 8-9 detailed pottery data is not available for these trenches, they are therefore excluded from Appendix 9 reducing the volume of tile analysed to 1,554,639g. Unpublished archive reports for the site are available in the YAT archives, and there are a number of tables summarising various aspects of context data prepared by Dr M. Whyman.

9.1 Summary of activity at Wellington Row

The context information has been taken from the relevant site archive report, coupled with site summaries in Ottaway (1993, 73-7 and 112-16) and Monaghan (1997, 1108-23). For ease of reference the trench and group numbers from the site archive reports are given in the form T* or G*.

9.1.1 Pre-Roman

Naturally occurring clay was reached in Trenches 5-7; single sherds of tile were present in Contexts 5710 and 71808, this was presumably contamination and represents 0.01 percent of the tile from the site.

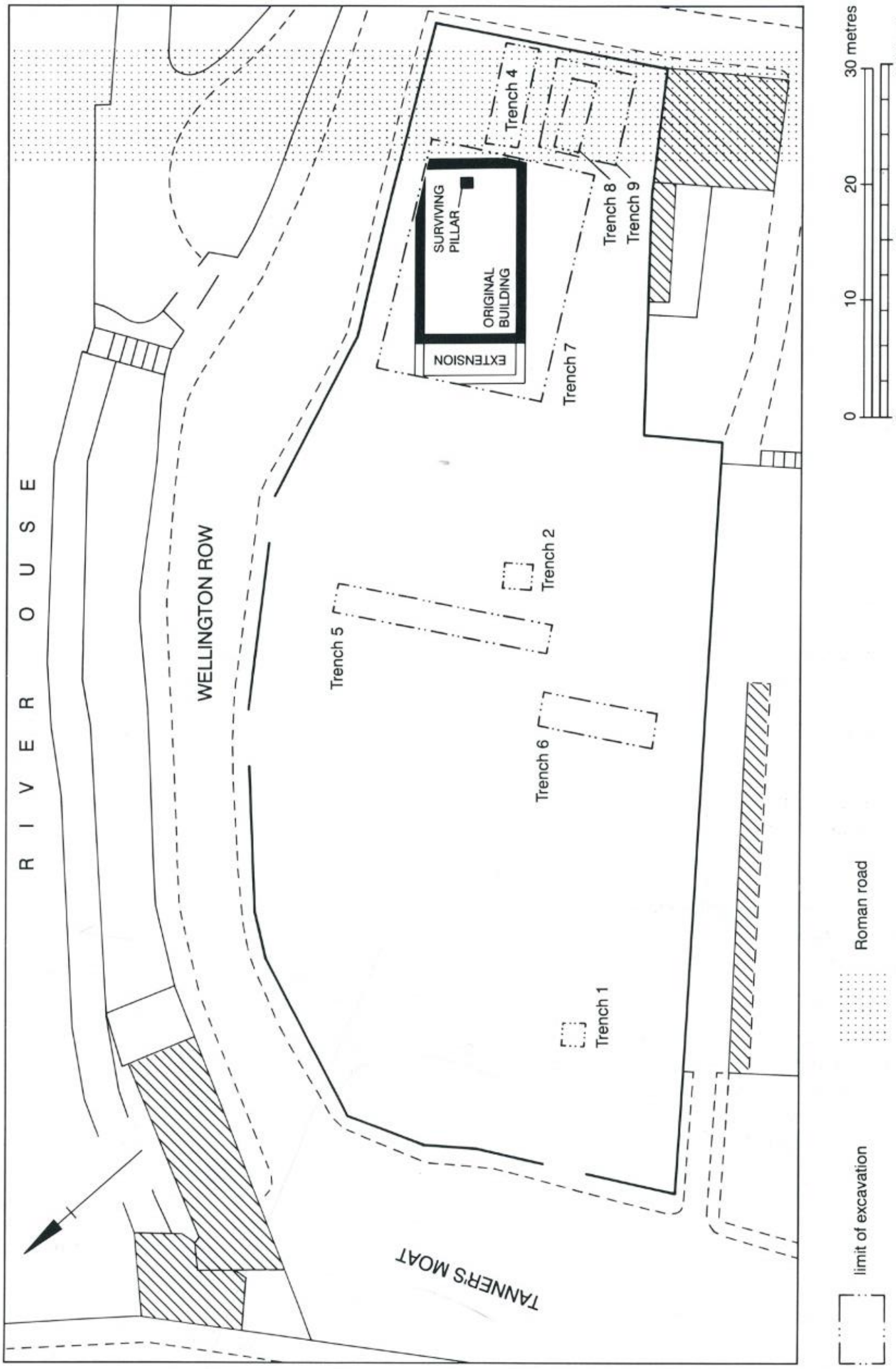


Figure 125. The location of the Wellington Row excavation trenches. (Illustration from Monaghan 1997, Figure 428, ©YAT)

9.1.2 AD 71-120

The main Roman road leading from the fortress to Tadcaster was present in Trench 4, comprising a number of make-up deposits and road surfaces (T4 G1-15) which were dated by the pottery to the later first century (Monaghan 1997, 1108). A second road parallel to the river Ouse was present in Trench 7, and a series of deposits accumulated adjacent to this road (T7 G8). A large ditch was cut across Trench 7, possibly to improve drainage (T7 G2). The spatial arrangement of these features suggests that they were related (Monaghan 1997, Figure 429). Contexts 4117, 4120, 4124, 4146, 4148-50, 4154-7, 4165, 71855, 72007, 72017, 72023, 72060, 72069-70, 72078 and 72097 within these groups contained tile.

Only 50,224g of tile was present in contexts dating to AD 71-120, representing 3.23 percent of the total volume of tile from the site. The only features of note were a Type 1 and Type 3 signature (Betts 1985, 192), five tegulae with Type B6 cutaways (Warry 2006, 4) and three overfired sherds.

9.1.3 AD 120-200

The road to Tadcaster was widened into a two lane surface with a central stone-lined channel that contained a lead water-pipe (T4 G16-17), which represented the development of a public water-supply (Ottaway 1993, 72). Contexts 4067, 4089, 4102 and 4109 within these groups contained tile.

Trench 5 saw a build-up of deposits (T5 G2), and a small number of cuts interpreted as being possibly structural (T5 G3), which were sealed by pebble surfaces (T5 G4-5). Trench 5 then became open ground used for dumping and the cutting of rubbish pits (T5 G6-10). Contexts 5571, 5681-82, 5584, 5606, 5613, 5646, 5653, 5687-9, 5695 and 5697-8 within these groups contained tile.

A ditch was present in Trench 6 which may have been for drainage (T6 G2). There was also a cut which was interpreted as a possible construction cut (T6 G3), together with spreads of construction related material (T6 G4-5). Contexts 6421 and 6427 within the construction cut, and associated spreads Contexts 6404, 6414 and 6419 contained tile. These groups were dated by the pottery to AD 120 or later (Monaghan 1997, 1109).

The large ditch adjacent to the Roman road in Trench 7 silted up. A number of stakes in Trench 7 may indicate structural activity at this stage, but equally these could have been driven down from deposits of a later date (T7 G3). Flooding led to the disuse of the roadside ditch (T7 G4), after which a new ditch was dug (T7 G5), which in turn silted up. A square pit of uncertain function was dug, and this was later infilled with dumps of rubbish (T7 G6). A second rectangular cut of uncertain function was cut (T7 G9). A series of build-up and levelling deposits across much of the site raised the ground level prior to major construction work (T7 G10-11). Contexts 2515, 71807, 71882, 71885, 71937, 71947, 71957, 72079, 72123, 72139, 72158, 72160, 72177-8, 72209, 72215, 72217, 72224-5, 72231, 72233, 72245, 72250, 72253, 72258, 72299 and 72470 within these groups contained tile.

The earlier ditches in Trench 7 were infilled, and a large rectangular stone building was constructed (T7, G12 and G17) sometime after AD 150 (Monaghan 1997, 1109). The building was 15.5m x 10.5m in size, and had a row of stone pillars down the centre to support the roof (Ottaway 1993, 73). The gable end of the building fronted onto the main Tadcaster Road, while the longer side partly overlay the earlier street parallel to the river Ouse, though this street continued in use to the north of the building. Due to later robbing no trace of the original doorways into the building had survived. There were a number of dumped deposits around the exterior and interior of the building, which were interpreted as spreads of construction related material (T7 G13 and 16). These were sealed by a number of levelling deposits (T7 G14 and G18), which were in turn beneath cobbled surfaces located both within and externally to the building. A drain relating to the building was also present (T7 G15). A single post-pad was present (T7 G19), and there was an internal oven within the building (T7 G27). Large numbers of contexts from these groups produced tile (Contexts 71608, 71636, 71687, 71696, 71721, 71725, 71760, 71767, 71770, 71779, 71854, 71860, 71871, 71901, 71918, 71936, 72055, 72083, 72195 72214, 72223, 72234, 72306, 72388, 72456, 72463, 72466, 72468 and 72518).

The road metalling of the street parallel to the river Ouse was continually repaired and resurfaced (T7 G20-26) with tile being present in Contexts 7848, 7916, 7918, 71861, 71874, 71887, 71889, 71938, 71953 and 71985.

A mortar floor and a slot suggested that the Trench 7 building was internally partitioned (T7 G37). Although G37 was originally classed as being in a third century phase (Monaghan 1997, 1109), this group has been placed in the second century for the purposes of this study on the basis of the pottery dating. This does not contradict the original site report which states that this group was stratigraphically above G18, but could have been either contemporaneous with or later than G27. Contexts 72437-8, 72444 and 72447 within this group contained tile.

A series of deposits (T4 G4) were dumped sometime after AD 175 to raise the level of the main road to Tadcaster (Monaghan 1997, 1108), with tile being present in dumps 4047-50, 4053, 4057, 4060, 4062-4, 4070 and 4091.

A total of 132,050g of tile was recovered from contexts dating to AD 120-200, amounting to 8.49 percent of the tile from the site. The tile included one residually occurring tile stamp relating to the Legio IX, which was possibly a type 2462.9 (Collingwood and Wright 1992, 171); in addition, there were two imbrices with Legio VI stamps, of which one was illegible and one was a type 2460.86 (Collingwood an Wright 1992, 165), and one further illegible legionary stamp was present. One Type 3 signature (Betts 1985, 192) and two illegible signatures were present. There were six combed flue tiles, and three tegulae had upper cutaways, while a further twelve had Type A, B and B62 lower cutaways (Warry 2006, 4). Five of the sherds were overfired.

9.1.4 AD 200-280

Within Trench 5 there was a series of dumps notable for the presence of crushed brick and mortar and an absence of domestic rubbish (T5 G11). These were truncated by the badly disturbed remains of a building comprising cuts and postholes (T5 G12-16). Monaghan (1997, 1114) noted that an antefix and tubuli were present in association with this structure, but no such sherds were seen when recording the tile for the present study, though a few pipe sherds were present in later demolition dumping within the trench. Further dumps were present (T5 G17-18) together with a series of shallow cuts, stake-holes and postholes which represented the remains of light structural features (T5 G19-33). Footings for a stone building were then constructed (T5 G34-5) while a series of mortar and pebble surfaces (T5 G36-9) may have represented external surfaces. Large numbers of contexts from these groups produced tile (Contexts 5300-01, 5344, 5378, 5397, 5405, 5411, 5416, 5420, 5461, 5466, 5470, 5476, 5503, 5506, 5512-13, 5518, 5520-22, 5524, 5526, 5536, 5538, 5546, 5556-7, 5563, 5575, 5582-83, 5607, 5611, 5615-6, 5629-30, 5649, 5651, 5655, 5673 and 5675-76).

Deposits resultant from robbing were present in Trench 6 (T6 G6), the area was then used for dumping (T6 G7-11). The dumps were beneath a series of surfaces and structural elements, including post-pads, a beam-slot and internal surfaces (T6 G12-G15). Contexts 6283, 6368, 6373-4, 6376, 6378, 6380, 6381 6390, 6392, 6398, 6400-01, 6403, 6409, and 6413 within these groups contained tile.

There was a series of dumps of hearth-derived material within the major Trench 7 building, and to the west of it (T7 G28-29a and G30-35). The earlier oven was deliberately demolished (T7 G36). Levelling took place within the major Trench 7 building to raise the ground-surface (T7 G38-39) and a limestone flagged floor (T7 G40) was then laid within the building. A series of postholes and slots suggestive of partitions were inserted into the building (T7 G41). These features were later infilled (T7 G42). New timber flooring was then inserted into the building (T7 G43). Tile was present in contexts 71698, 71891, 71893, 71924, 71956, 72341, 72367, 72383, 72395, 72399, 72420, 72422-24, 72427, 72435-36, 72439 72445, 72451 and 72458 within these groups.

The Trench 7 building was damaged by fire at some stage after AD 220 (T7 G29b and G44-46), and only residual pottery was present within deposits relating to the fire (Monaghan 1997, 1114). The building continued to be used following the fire, with the insertion of new timber flooring (T7 G47). A number of structural features were present which were difficult to interpret (T7 G48-49), together with a possible hearth (T7 G50), which re-used the earlier G12 oven. Groups 47-50 contained only residual second century pottery (Monaghan 1997, 1109, 1114). Further internal floors and levelling deposits were present (T7 G51-60) which were dated by pottery to AD 200 or later (Monaghan 1997, 1109). Tile was present in contexts 71344, 71572, 71575, 71593, 71640, 71866, 71873, 71878, 71881, 71888, 71890, 71902, 72263, 72304-05, 72314-15, 72318, 72335-36, 72241, 72285, 72297, 72289, 72302, 72343, 72350, 72353-54, 72362, 72370 and 72398, but given the high levels of residuality among the pottery it is possible that much of this tile was also residual.

The Trench 7 building underwent major structural alterations, with the demolition of the north wall (G61-64), but the demolition deposits only contained residual pottery. Following this demolition, an extension was constructed at the northern end of the building (G65-66). A new structure was constructed on the south-western side of the main Trench 7 building (G67-8). There was a series of new internal floors and levelling deposits associated with the extended building (T7 G69-76, G80-81 and G114-15), which were dated by pottery as AD 200 or later. Contexts 7949, 71141, 71296, 71351, 71401, 71439, 71454, 71462-63, 71471, 71488, 71531, 71534, 71548, 71555, 71565, 71573, 71626, 71630, 71632-3, 71657, 71683, 71769, 71795-6, 71908, 72071, 72108, 72142, 72152, 72165, 72172, 72222, 72232, 72247 and 72288 contained tile.

Contexts dating to AD 200-280 yielded 162,228g of tile, accounting for 10.44 percent of the total from the site. Various features of interest were present, including two combed flue tiles, three illegible signatures and one Type 3 signature (Betts 1985, 192). Three of the tegulae had upper cutaways, while ten had Type B6 lower cutaways and one had a Type C4 lower cutaway (Warry 2006, 4). Two sherds had dog’s paw prints on the upper surface, while one sherd had a hob-nail boot imprint. Three of the sherds were overfired.

9.1.5 AD 280-410

In Trench 5 there was a series of surfaces and floors within the main stone building (T5 G40-4), these were followed by spreads of demolition deposits representing the disuse of the building (T5 G45-50), which dated to AD 360 or later (Monaghan 1997, 1109). Late structural activity was seen by a series of cobble footings (T5 G51). Contexts 5329, 5349, 5352-3, 5386, 5389, 5398-99, 5425, 5434, 5467, 5472, 5475, 5478 and 5486 within these groups contained tile.

A number of third to fourth century mortar surfaces were present in Trench 6 but it was unclear if these represented internal or external surfaces (G16-17), and Contexts 6320, 6327, 6329 and 6349 within these groups contained tile.

In Trench 7 various pits, postholes and dumps (T7 G77-9 and G82-9) were present within the main building which suggested that its’ function had changed, though the precise nature of activity at this stage was unclear. A series of structures comprising stake-holes and slots were dug within the building, but these were difficult to interpret due to later truncation. A pot was deliberately buried near the central stone pillar of the building, and various dumps and levelling deposits were present (G90-96 and G116-122). These structures later became disused (G97 and G123). A second structure of stake-holes and slots was then built within the south-east corner of the building (G98-100) and an animal was buried in a pit (G101). This second structure also became derelict (G102). A rubbish pit was then dug (G102-3), and a series of internal surfaces, stake-holes, structural features and occupation derived deposits were located within the main building (G104-10 and G124-31). Tile was present within contexts 7648, 7935-6, 71014, 71023, 71036, 71113, 71256, 71870, 71899, 71900, 71917, 71929, 71935, 71952, 71958-59, 71978, 71984, 72003-04, 72006, 72010, 72013, 72022, 72025-26, 72047, 72049-50, 72054, 72062-63, 72067, 72089-90, 72110, 72112, 72117, 72121-2, 72126, 72134, 72137, 72144, 72146-7, 72162, 72198, 72203, 72207, 72221, 72226 and 72235. Groups 77-79 and 82-110 and 116-131 were dated as post AD 346 on the basis of coin evidence, but they contained only residual pottery (Monaghan 1997, 1109-10, 1116), it is possible therefore that all the tile from these groups also represents residual material.

Groups 176-178 were stratigraphically isolated from the main Trench 7 building, being located in the north-western portion of the trench, while G179-182 relate to a building that was largely outside the area of excavation. Tile was present in contexts 71196, 71724, 71903, 72074 and 72076 from these groups. Although the pottery in Groups 176-178 dated to the second and third centuries, it was of similar character to that in groups G77-79, G82-110 and G116-131, and was also interpreted by Monaghan (1997, 1115) as being residual pottery in contexts of fourth century date.

The structures in the main Trench 7 building fell into disuse and were sealed (T7 G111-112). The area was then used for dumping and levelling (T7 G132-8). All these groups were dated by pottery to AD 388 or later (Monaghan 1997, 1109). Tile was present in contexts 7808, 7932-3, 7939, 7951, 7956, 7965, 7979, 7984, 71140, 71174, 71253, 71541, 71554, 71562, 71568, 71580, 71586, 71588, 71596, 71605, 71618, 71629, 71649, 71655, 71674-5, 71716, 71719, 71729, 71732-3, 71740, 71746, 71754, 71766, 71852, 71862, 71864, 71931 and 72073 within these groups.

Deposits dating to AD 280-410 contained 16.73 percent of the tile examined, a total of 260,020g. Eleven of the flue tiles had combed keying and one had incised keying. Five illegible signatures were present, together with one example of a Type 1 signature and one example of a Type 2 signature (Betts 1982, 192). One tegula had a hole which had been pecked out after firing, while five of the Rbrick sherds were pierced by holes. Twelve of the tegulae had upper cutaways, while fourteen tegulae had Type B6 lower cutaways, one had a Type C4 lower cutaway, and two had Type C5 lower cutaways (Warry 2006, 4). Five sherds had rain marks on the upper surface, one sherd had hail-stone impressions, two Rbrick sherds had finger keying, one dog's paw print was present, one imbrex had an illegible legionary stamp, and one sherd had worm impressions on the base. Six of the sherds were overfired.

9.1.6 Post-Roman

All the remaining contexts at Wellington Row were of post-Roman date, and for brevity they are not described in detail here. The principal post-Roman features at Wellington Row included a medieval cess pit and two brick lined wells of Victorian and modern date.

The bulk of the tile examined, 949,912g, or 61.1 percent of the total, was from contexts of post-Roman date. Surface marks present included two grip marks, two thumb prints, one paw print, eight dog's paw prints, two hoof prints, three hob-nail boot impressions, two tiles with seed marks impressed on the surface, one tile with worm marks on the base, and nine with rain marks on the upper surface. Graffiti were present on two tiles. Two illegible legionary stamps were present, together with one relating to the Legio IX, and one to the Legio VI. Ten illegible signatures were present together with eleven examples of a Type 1 signature, two Type 2 signatures, three Type 5 signatures, one Type 6 signature and one Type 18 signature (Betts 1985, 192-3). Forty-six of the flue tiles were combed, two were incised and two had finger drawn keying lines. Four Rbrick sherds also had finger drawn keying lines on the upper surface and twenty-three Rbricks were each pierced by a hole, with one example having seven holes stabbed into the reverse. Thirty-two upper cutaways were present on the tegulae, together with forty-one Type B6 lower cutaways and four Type C5 lower cutaways (Warry 2006, 4). Twenty three sherds were overfired.

9.2 The tile from the Wellington Row site

A total of 1,554,639g of Roman tile was examined from the Wellington Row site, the overwhelming bulk of which occurred residually in post-Roman deposits. The volume of tile in relation to date is given on Table 87 and Figure 126, while the associated sherd count is on Table 88.

While Figure 126 would seem to imply that there was a steady increase in the use of tile throughout the Roman period, this is misleading, firstly few contexts dating to the late first to early second century were excavated on the site, and secondly the picture is further confused by residuality; much of the pottery in third and fourth century deposits at Wellington Row was residual (Monaghan 1997, 1114-6), which suggests that much of the tile from contexts of this date was also residual.

No *in situ* tile from structures was present, though sherds of tile occurred within construction cut backfills and as hard-core within road and floor surfaces. This lack of *in situ* structural remains hampers any attempts to study chronological changes in tile usage or dimensions.

Table 87. The weight of tile in grams, by date and form, for the Wellington Row site						
	Natural	AD 71-120	AD 120-200	AD 200-280	AD 280-410	Post-Roman
Overall	205	50224	132050	162228	260020	949912
Bessalis					6450	20275
Chimney						675
Flue			3350	1610	8460	16110
Imbrex		1975	20360	31030	34482	97423
Other						
Parietalis					875	750
Pedalis			8300			2500
Pipe				275	10	1260
Rbrick	205	41324	71055	96252	171263	680592
Tegula		6925	28985	31911	38480	130317
Tessera						10
Voussoir				1150		

Table 88. Sherd count for Table 87						
	Natural	AD 71-120	AD 120-200	AD 200-280	AD 280-410	Post-Roman
Overall	2	173	613	899	988	4091
Bessalis					3	14
Chimney						11
Flue			13	7	40	100
Imbrex		14	130	251	189	712
Other						
Parietalis					2	3
Pedalis			1			1
Pipe				1	1	15
Rbrick	2	140	386	532	633	2772
Tegula		19	83	107	119	462
Tessera						1
Voussoir				1		

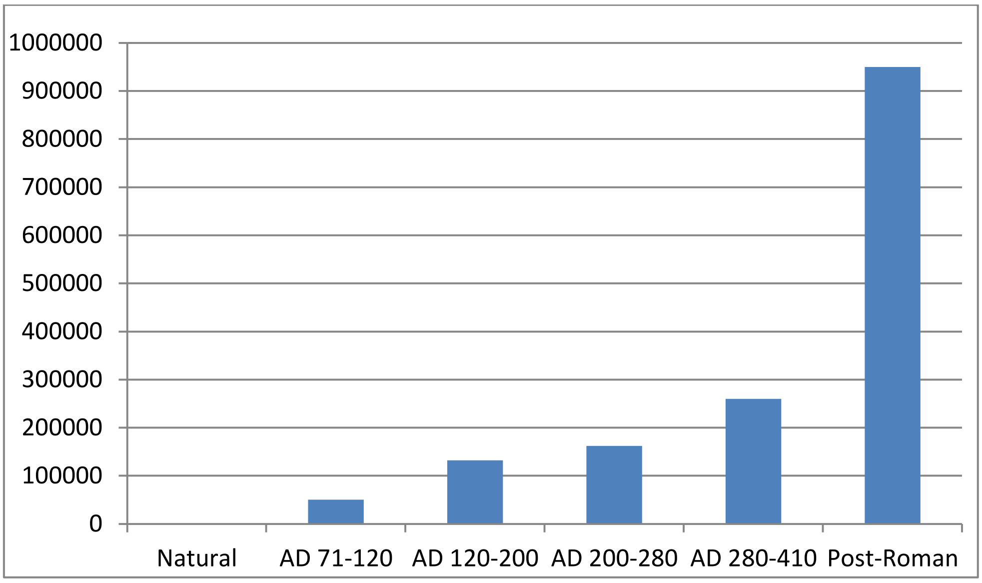


Figure 126. Total weight of tile in grams for each chronological grouping at the Wellington Row site.

Only five sherds had complete surviving length and breadth dimensions, including a pedalis 305mm² and 62mm thick, in a context dating to AD 120-200 and a voussoir 150x130x32-45mm in a context dating to AD 200-280. Residually occurring examples in post-Roman contexts included a pipe 68mm in diameter and 13mm thick, a tessera 10x20x16mm in size, and a bessalis 210x215x31mm in size. There were an additional sixteen examples of bessales with one breadth surviving, which ranged from 178-224mm in size, but only three examples were from Roman contexts (one dating to the third century and two to the fourth century), with the remainder occurring residually in contexts of medieval or later date. A single flue tile in a context of third century date had a surviving breadth which was 107mm. The presence of so few examples from Roman contexts with either complete lengths or breadths makes any analysis of these dimensions in relation to fabric or date impossible.

Only flue tiles, imbrices and tegulae had sufficient surviving thicknesses to enable a comparison of thickness to date (see Table 89 and Figure 127). The flue tiles, imbrices and tegulae all show a decrease in thickness over time, and this is particularly marked in the case of the tegulae which show an average reduction of 13mm in thickness during the Roman period, representing a 36 percent reduction in overall thickness (Figure 127).

Table 89. Tile dimensions in mm and sherd count in relation to form and date for the Wellington Row excavations				
Date and form	Minimum thickness	Maximum thickness	Average thickness	Sherd count
AD 120-200 flue tile	16	30	22	13
AD 200-280 flue tile	13	32	21	7
AD 280-410 flue tile	13	28	20	37
AD 71-120 imbrices	17	32	20	12
AD 120-200 imbrices	11	30	19	127
AD 200-280 imbrices	12	32	18	238
AD 280-410 imbrices	12	28	18	187
AD 71-120 tegulae	28	49	36	12
AD 120-200 tegulae	18	39	28	48
AD 200-280 tegulae	14	42	26	83
AD 280-410 tegulae	14	41	23	105

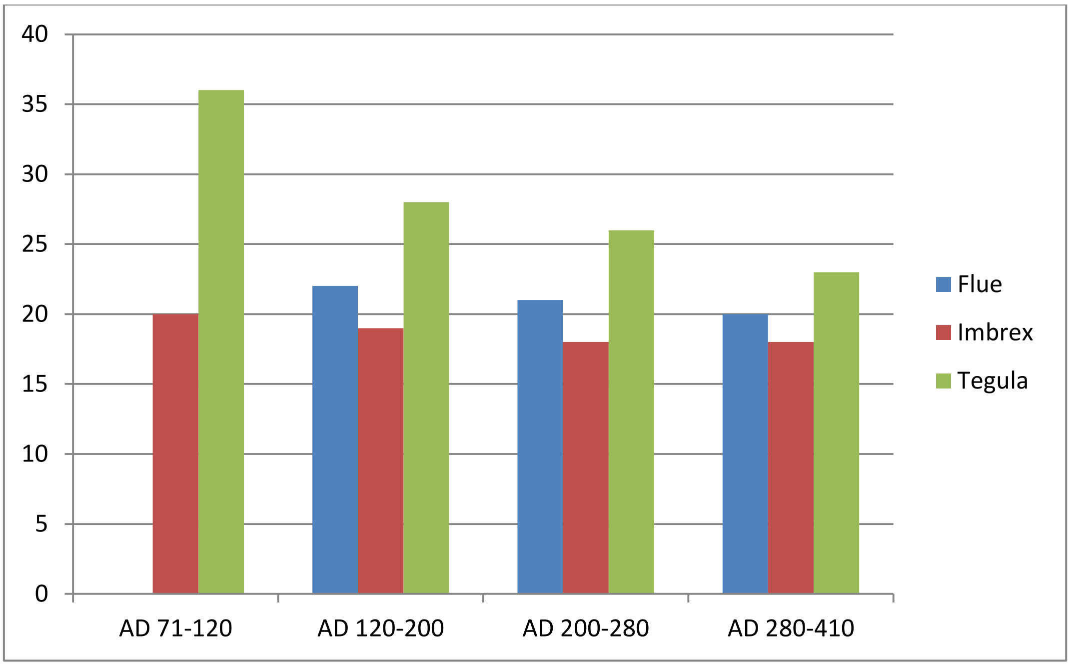


Figure 127. The average thickness of flue tile, imbrices and tegulae in mm in relation to date for the Wellington Row excavations

The lower cutaways seen on the tegulae show a gradual change over time (Table 90), though it should be noted that the sherd count is very low for types A and C. They do, however, hint that Type A was early, Type B used in all periods, and type C was later.

Table 90. Sherd count for lower cutaway forms in relation to date for the Wellington Row site					
	Type A2	Type B6	Type B62	Type C4	Type C5
AD 71-120		5			
AD 120-200	2	9	1		
AD 200-280		10		1	
AD 280-410		14		1	2
Post-Roman		46			4

Only six signatures were present in the Roman levels at Wellington Row, and these were in Types 1-3 (Betts 1985, 192). The numbers present were insufficient to determine any chronological variations (Table 91).

Table 91. Sherd count for signature types in relation to date for the Wellington Row site			
	Type 1	Type 2	Type 3
AD 71-120	1		1
AD 120-200			1
AD 200-280			1
AD 280-410	1	1	

Only five legionary stamps were present in the Roman levels. Four of these were in contexts dating to AD 120-200, one of which was a residual Legio IX stamp, one was illegible, and two related to the Legio VI, with one being insufficiently preserved to determine the type, while the second was a type 2462.9 (Collingwood and Wright 1992, 165). The fifth legionary stamp, which was illegible, occurred in a context dating to AD 280-410, and this tile is probably residual given that stamping declined on tiles from the mid-third century onwards (Darvill and McWhirr 1984, 245-6).

The weight in grams for each fabric in relation to date (excluding R0) is given in Table 92, where the weight is also expressed as a percentage of the total volume of tile at the site. The associated sherd count is given on Table 93. Figure 128 depicts the volume of all fabrics representing more than 5 percent of the total volume of tile at Wellington Row, in relation to chronological groups.

All fabrics were present at the site except for R18-R19, but given the rarity of these fabrics overall, their absence is unsurprising. The three dominant fabrics in the study area overall, namely R9-R11, were also the most commonly occurring fabrics at Wellington Row. There was some variation in the volume of these fabrics over time, with R9 being the dominant fabric up to AD 200, after which time R10 and R11 dominated (Figure 129), thus according with the suggestion that R9 largely replaced by R10-R11 in the later Roman period (see p318).

Table 92. The weight of each fabric in grams in relation to date at Wellington Row, and as a percentage of total volume

Fabric	AD 71-120	AD 120-200	AD 200-280	AD 280-410	As a % of total volume
R1	2560	6140	9260	11185	5.10
R2			200		0.04
R3	11425	15585	15755	19930	10.98
R4			175	1025	0.21
R5	475	11625	26271	8825	8.26
R6	975	2535	4705	13170	3.74
R7	500	2150	14995	11455	5.10
R8	75		490	1250	0.32
R9	9275	34460	22475	28871	16.64
R10	4425	11535	24600	84177	21.85
R11	7470	24650	19980	49355	17.76
R12	200	800	100	2710	0.67
R13	25		100	550	0.12
R14			200	700	0.16
R15	10855	10560	7755	15842	7.71
R16				125	0.02
R17		920	3110	3575	1.33
Total	48260	120960	150171	252745	5.10

Fabrics R1, R3, R5, R7 and R15 were the next most commonly occurring fabrics at Wellington Row, all of which occurred more frequently at the site than in the study area overall (as a comparison of the weight as a percentage of total volume for the site, Table 92, and for the study area overall, Table 48, shows). The pattern of disposal seen for R1, R3, R5, R7 and R15 varies (Figure 128), with both fabrics 1 and 3 show a steady increase over time, while the pattern for the other fabrics is irregular. The massive increase in volume in all these fabrics from the third century onwards, must, however, relate to the presence of a major Roman building on the site, and to the use of the site for dumping in the later Roman period.

Table 93. Sherd count used for Table 92				
Fabric	AD 71-120	AD 120-100	AD 200-280	AD 280-410
R1	9	33	57	50
R2			1	
R3	39	94	90	98
R4			1	4
R5	4	70	130	40
R6	5	17	25	40
R7	3	12	64	36
R8	1		3	6
R9	31	158	139	111
R10	17	61	161	297
R11	19	66	92	171
R12	1	2	1	4
R13	1		1	1
R14			2	5
R15	31	47	67	75
R16				1
R17		6	8	8

The remaining fabrics (R2, R4, R6, R8, R12-R14 and R16-R17) each formed a minor component of the total at Wellington Row, but these fabrics were rare across the study area as a whole. The exception was R6 which accounts for 5.78 percent of the total volume of fabric overall, but only 3.74 percent of the total at Wellington Row. R6 was a reduced fabric with a darker grey-red colour than many of the tile fabrics, and it may simply be that this colour was not desired on the buildings at Wellington Row.

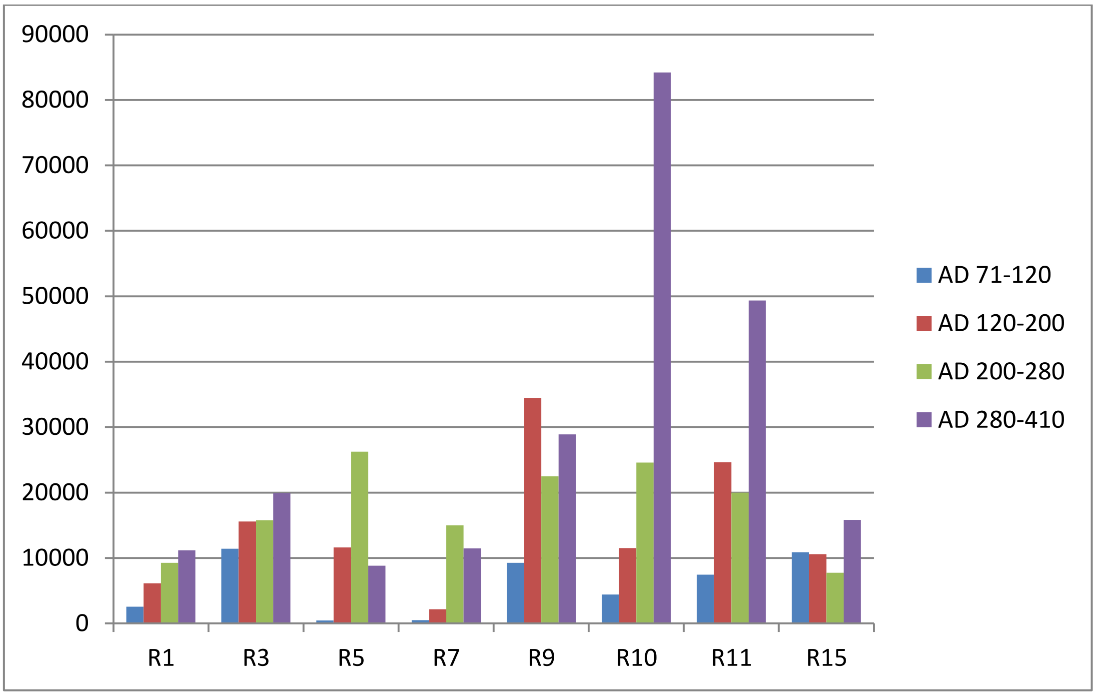


Figure 128. The weight in grams of fabrics R1, R3, R5, R7, R9-R11 and R15 in relation to date for the Wellington Row excavations

The total weight of each fabric group in relation to chronological groups is given in Table 94, and is illustrated on Figure 129, with the associated sherd count on Table 95. The pattern seen matches that for the fabric groups overall, with Group 3 dominating, followed by Group 5, with all the other groups representing minor components of the whole.

Table 94. The weight in grams of each fabric group at Wellington Row relation to date

	Fabric Group 1	Fabric Group 2	Fabric Group 3	Fabric Group 4	Fabric Group 5
AD 71-120	2585		25600	11130	8945
AD 120-200	6140	920	73205	11360	29335
AD 200-280	9360	3285	89186	8545	39880
AD 280-410	11735	4725	141678	19512	73980

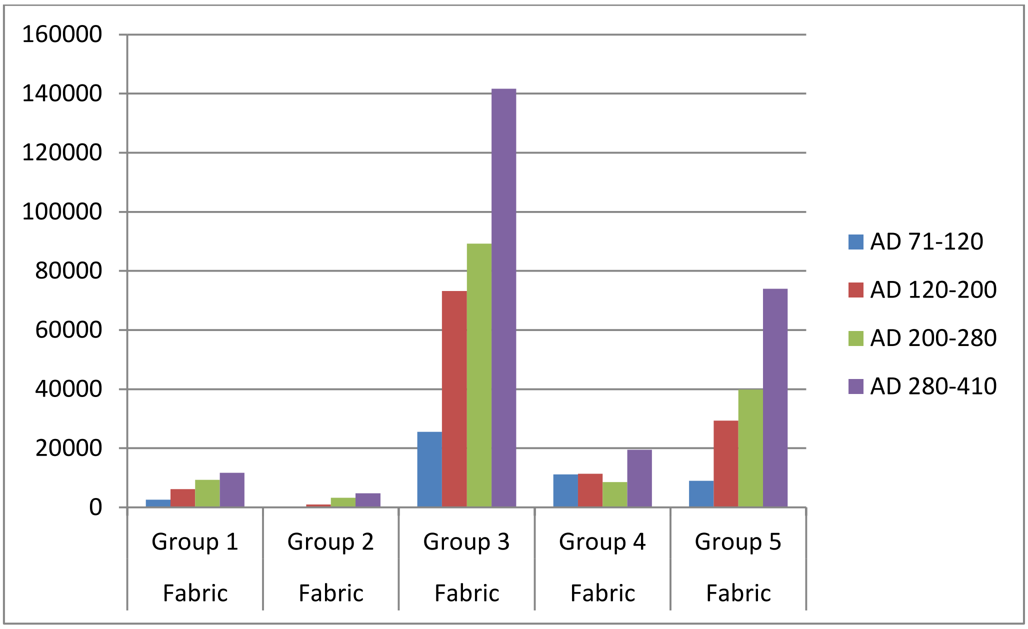


Figure 129. Weight in grams of each fabric group in relation to chronological groups for the Wellington Row excavations

Table 95. Sherd count used for Table 94						
	Fabric Group 1	Fabric Group 2	Fabric Group 3	Fabric Group 4	Fabric Group 5	Total
AD 71-120	10		91	33	27	161
AD 120-200	33	6	383	49	95	566
AD 200-280	58	9	522	73	182	844
AD 280-410	51	13	544	90	247	945
Total	152	28	1540	245	551	2516

Appendix 10 Various sites to the south-west of the *colonia*

Excavations to the south-west of the *colonia* have been on a relatively small-scale, making it impossible to find a single site which had both a large quantity of tile, and tile relating to the entire sequence of Roman occupation. For this reason the tile from three excavations was considered collectively. The excavations at 35-41 Blossom Street (YAT site code 1989.21), 14-20 Blossom Street (YAT site code 1991.11) and 28-40 Blossom Street (YAT project number 5244) were located to the immediate south-west of the *colonia* (Figure 130), and yielded 65,440g, 14,170g and 66,254g of tile respectively, a combined total of 145,864g of tile. The three sites together had a sequence of contexts relating to the entire period of Roman occupation, though there was relatively little activity prior to AD 120, and no tile relating to the period AD 71-120 was recovered.

Unpublished reports are available in the YAT archives for these sites. In the case of the excavations at 35-41 Blossom Street there are two archive reports, the first of which contains references to all the contexts excavated (Oakey 1991) while the second represents a summary intended for publication (Oakey 1992), both reports were needed to determine the phasing of the contexts which had yielded tile. A watching brief at 16-20 Blossom Street (YAT project number 161) could not be included in this group of sites as the pottery had not been analysed in detail, and the precise dates of the tile bearing contexts was therefore unknown.

The excavations were located to either side of the main Roman road from York to Tadcaster, (RCHM 1962, Road 10 Figure 2), which has been observed in various sites excavated since the late nineteenth century, both in the *colonia* (RCHM 1962, 3; Ottaway 1994, 70-1), and to the south-west of the *colonia* (Wenham 1965 527; McComish 2003, 82-3). Trenches 3-5 at 14-20 Blossom Street were located to the north of Road 10, while all the other excavation trenches were to the south of it. The extra-mural area adjacent to the north-western corner of the *colonia* is characterised by the presence of Roman cemeteries, which have been observed during building works undertaken from the eighteenth century onwards (RCHM 1962, 76, 92-106). This zone of burial extended from the Blossom Street area to that of the present

Railway Station. Earlier excavations on the 14-20 Blossom Street site uncovered a building interpreted as a wayside shrine, which underwent several phases of use (Wenham, 1965, 541).

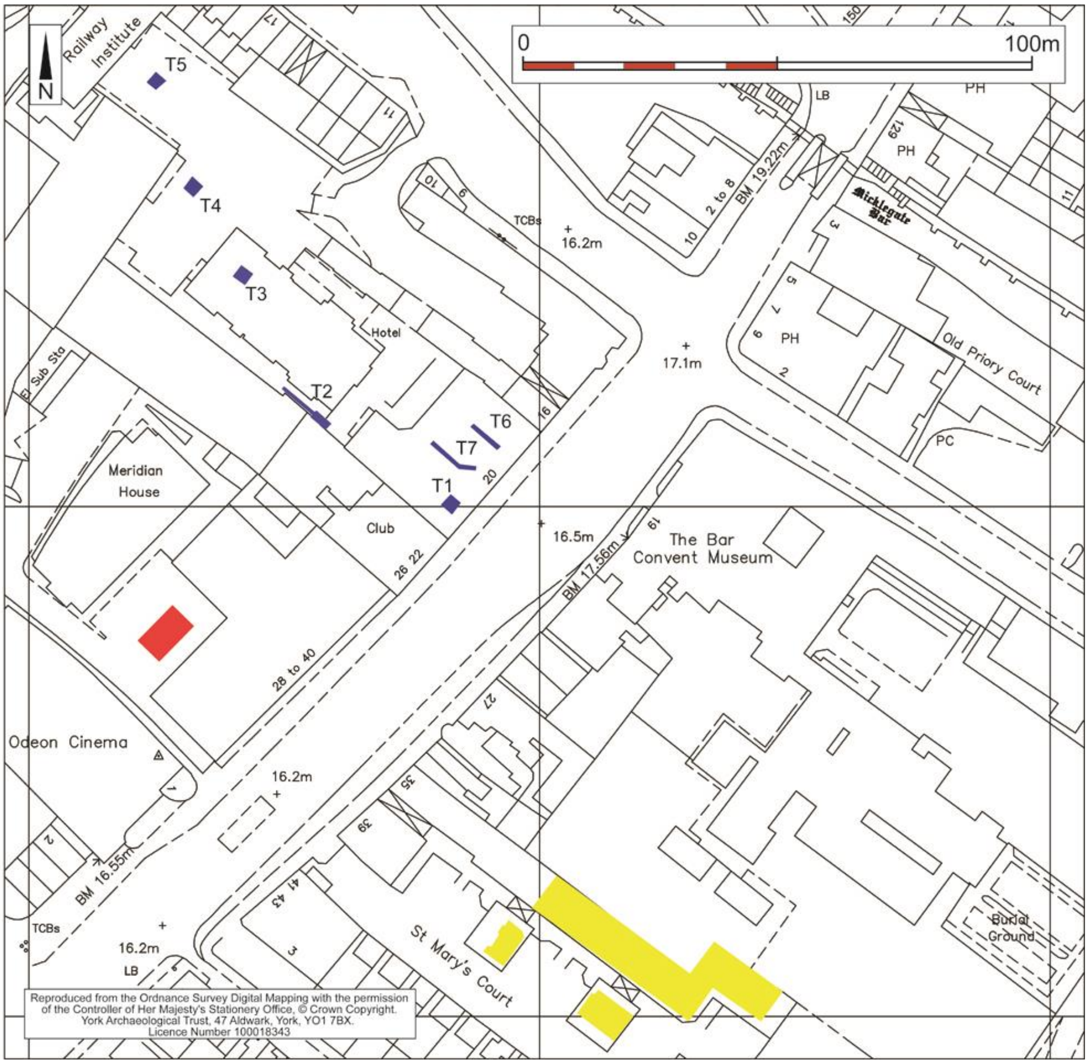


Figure 130. The location of the sites to the south-west of the colonia examined in the present study, blue = 14-20 Blossom street, red = 28-40 Blossom Street, yellow = 35-41 Blossom Street. (Based on Clarke 1991 Figure 1, Oakey 1992 Figure 1, Milsted 2009 Figure 2, ©YAT, using underlying © Crown Copyright data Ordnance Survey Licence Number 100018343).

10.1 Summary of the to the south-west of the *colonia*

10.1.1 Pre-Roman

Pre-Roman deposits at all the sites to the south-west of the *colonia* sites comprised glacial clay. No clear evidence of prehistoric activity was present.

10.1.2 AD 71-120

The natural clay was overlain at 28-40 Blossom Street by a deposit suggestive of turf-burning, which was possibly as early as AD 71-100 and was no later in date than AD 100-120 (Milsted 2009, 6).

10.1.3 AD 120-200

Deposits dating to the period AD 120-150 were seen at both 28-40 Blossom Street and 35-41 Blossom Street. At 28-40 Blossom Street there was a ditch with an associated bank, which were sealed by a deposit, Context 1131, interpreted as possible levelling to raise the ground-surface, and the presence of mixed domestic debris (including tile) and human bone in this context suggested that the soil had originated both from domestic occupation and from an area of disturbed burials (Milsted 2009, 6). This deposit was truncated by a ditch interpreted as a boundary feature, which was subsequently recut. The recut was associated with a cobbled lane surface, Context 1130, which incorporated tile sherds (Milsted 2009, 6-7). A number of deposits accrued on, and to either side of, the lane surface and within the associated ditch (Milsted 2009, 7), and some of these deposits, Contexts 1127, 1129 and 1133 contained tile.

The earliest deposits at 35-41 Blossom Street, were suggestive of domestic dumping and were dated by pottery to AD 120-140 (Oakey 1992, 12). Of these, Contexts 1030, 1068 and 2075 contained tile. These deposits were cut by a network of contemporaneous ditches, and the presence of ankle breakers in some of the ditches suggested military use, possibly as an enclosure for cavalry horses (Oakey 1992, 12-15). The ditches were infilled over a thirty year period (Oakey 1992, 14), with tile being present in many of the backfill deposits (Contexts 1028, 1046, 1048, 2162, 2164, 2168-

9, 2173, 2194, 2213, 2220-21, 2245, 2326, 2345, 2358, 2372, 2381, 2393 and 2403). A deep shaft, possibly a well, was also dug and backfilled in the later second century (Oakey 1992, 13), with tile being present in backfill deposits Contexts 1037 and 1054.

Deposits dating to the second half of the second century were present at 28-40 Blossom Street and 35-41 Blossom Street. At 28-40 Blossom Street a new boundary ditch was cut, and some tile was present in the backfill of the ditch, Context 1110. To the south of this ditch were three pits, a gravelly deposit (Context 1117, which contained tile), a posthole and a gully. These dumps and pits contained mixed industrial and domestic waste (Milsted 2009, 7-8). The site at 35-41 Blossom Street was used for dumping and the digging of rubbish pits. These contexts contained large quantities of residual pottery and tile, and it was thought possible that this soil had originated from clearance within the *colonia* prior to building works there (Oakey 1992, 15-6). Tile was present in dumps 2156-9, 2167, 2193, 2195, 2214, 2219, 2239, 2254, 2265, 2276, 2293, 2300, 2303-4, 2308, 2316, 2323, 2331, 2342, 2347, 2352, 2359, 2362 and 2402, and from pit fills 1044, 2186, 2189, 2321, 2327, 2340, 2285, 2294, 2367 and 2383.

Trench 1 at 14-20 Blossom Street contained the remains of a building of possible second century date, comprising a cobble footing and a deposit interpreted as the remains of floor planks (Clarke 1991, 10). This building was less securely dated than the second century features seen at either 28-40 Blossom Street or 35-41 Blossom Street.

The tile dating to AD 120-200 comprised flue tiles, imbrices, Rbrick and tegulae, and it accounted for 30.3 percent of the tile from the sites to the south-west of the *colonia*. The tile included seven combed flue tiles, an Rbrick sherd with a hob-nail boot imprint, two sherds of Rbrick with Type 2 signatures (Betts 1985, 15), and a further two sherds with illegible signatures. There were two tegulae with upper cutaways and three with lower cutaways, of which two were Type A2 and one was Type B6 (Warry 2006, 4).

There were three overfired sherds of which one was a flue tile, one a tegula and one a sherd of Rbrick. There was also one unusual polygonal shaped tile.

10.1.4 AD 200-280

In Trench 1 at 14-20 Blossom Street there was a number of mid-second to third century pits, at least two of which represented the robbing of the earlier building on the site. The pits contained deposits interpreted as the dumping of industrial waste, but also included sherds of head-pots, suggestive of material originating from a cemetery (Clarke 1991, 10, 27). Sealing the pits were the remains of a building of mid-second to third century date, comprising a cobble footing, possibly to support a structural timber, and a patch of cobbles interpreted as a floor (Clarke 1991, 11). Tile was present in some of the pit backfills, Contexts 1036-7, 1040 and 1045, and from the building Contexts 1029-30. In both Trenches 4 and 5 at 14-20 Blossom Street there were deposits interpreted as a gradual build-up of horticultural soil dating to the third century (Clarke 1991, 16-7); of these Contexts 4010-11, 5015 and 5017 contained tile.

At 28-40 Blossom Street the mid- to late third century was characterised by extensive levelling deposits, which contained both industrial material and pottery suggestive of the disturbance of burials, and a small gully was also dug at this time (Milsted 2009, 8). The pottery from these contexts included large quantities of residual second century material. Levelling deposits Contexts 1071, 1100-02, 1107, 1123-4 and 1128 contained tile, as did the backfill of the gully, Context 1106. Late third century activity at 28-40 Blossom Street included two areas of cobbles interpreted as a possible yard surface, which were sealed by dumped deposits including Contexts 1095 and 1077, which contained tile. The dumps were truncated by two rubbish pits the backfill of which (Context 1086) contained tile. There were also five postholes, the backfills of three of which, Contexts 1097, 1080 and 1088 contained tile, and in the case of 1097 the infill comprised underfired bricks of unusual size acting as packing (Milsted 2006, 9-10). The postholes were sealed by further dumping (Milsted 2006, 10) including Context 1076 which contained tile.

There was a major rearrangement of the landscape at 35-41 Blossom Street from AD 200-225, with the creation of a timber mausoleum, associated with two graves, a small pit for a votive offering and two associated deposits (Oakey 1992, 18-19). Tile was present in a cut associated with the mausoleum structure Context 2301, one of the grave backfills Context 2322, the fill of the votive pit Context 2312 and the associated deposits Contexts 2257 and 2271. A replacement mausoleum was constructed in the period AD 225-250. Initially soil was brought in from elsewhere to level the site, with tile being present in the levelling deposits 2201, 2360-1, 2365, 2377 and 2382. The mausoleum was 6m square, with coursed limestone rubble footings. There were four associated internal burials, with tile present in grave fills 2185 and 2204, and some internal spreads of soil (Contexts 2163 and 2222) which also contained tile (Oakey 1992, 19-20). Due to later robbing little is known of the form of this mausoleum, but the presence of plaster, *opus signinum* and tile, associated with its demolition, may suggest that it had a tile roof and lined walls (Oakey 1992, 24). The mausoleum continued in use throughout the third century with four small cuts interpreted as infant burials (Oakey 1992, 20-1); grave fill 2082 contained tile. There were a number of third century burials, a cobble path, and a stone-setting, possibly for an ossuary, located around the mausoleum (Oakey 1992, 21-2, 34). Grave fills 2241, 2272, 2277, 2325 and 2346 contained tile, as did the stone-setting Context 1019.

The tile relating to contexts of this date comprised flue tiles, imbrices, sherds termed 'other', Rbrick and tegulae, and it accounted for 23 percent of the tile from the sites to the south-west of the *colonia*. The tile included a combed flue tile, two sherds of Rbrick with a Type 1 signature, one with a Type 3 signature and one with an illegible signature (Betts 1985, 192). One tegula had an upper cutaway, six tegulae had lower cutaways, of which one was Type A2 and five were Type B6 (Warry 2006, 4). One Rbrick sherd had rain marks on the upper surface, and there were three overfired sherds of which two were imbrices and one was a sherd of Rbrick.

10.1.5 AD 280-410

At 35-41 Blossom Street the mausoleum was demolished and robbed out c. AD 300-325, and soil was then brought in from elsewhere and dumped to level the site (Oakey 1992, 22-3). The removal of the mausoleum implies that the burial rites it was associated with were no longer adhered to (Oakey 1992, 25). The demolition and levelling deposits Contexts 2132, 2019 and 2121 produced tile.

Deposits dating to AD 325-400 were present on all three excavations. In Trench 1 at 14-20 Blossom Street there was large scale levelling in the form of a dump of cobbles, stone and clay. This was truncated by a pit dug to dispose of demolition debris, the fill of which contained sherds of head pots, suggesting the disturbance of nearby cremation burials (Clarke 1991, 11). Both the dump and pit fill, Contexts 1027 and 1025, contained tile. In Trench 2 at this site a cobbled surface was present, which was interpreted as a small street of late third to early fourth century date, aligned at right angles to the main Roman road, suggesting that Road 10 might lie slightly to the north of the position as suggested in RCHM (Clarke 1991, 13, 27). The street surface (Context 2023) included sherds of tile used as hard-core. Sealing the road was a build-up of garden soil, Context 2022, which accumulated after the road was abandoned, which dated to the late third to fourth centuries.

The remains of a possible fourth century building were present at 28-40 Blossom Street, which comprised three deposits interpreted as deliberate levelling to create a platform, which was truncated by four, possibly five, postholes (Milsted 2006, 10). The levelling deposits Contexts 1060, 1067 and 1073 produced residual pottery, including funerary types, together with tile.

At 35-41 Blossom Street the site was used for the dumping of rubbish, with Contexts 2044, 2067, 2076, 2091, 2137, 2149, 2165, 2171 and 2175 containing tile. The site was then used as a cemetery, and at least twenty-five burials together with eleven probable graves were present, some with markers, and there was a possible ditch and some pits of uncertain function (Oakey 1992, 26-8). The cemetery deposits 1026, 1031, 1035, 1056, 2023, 2046, 2052, 2056, 2101, 2102, 2104-5, 2107, 2140, 2143, 2174, 2182, 2202, 2240, 2242, 2268, 2274 and 2356 contained tile. Tile was also present in the pits Contexts 2106, 2097, 2153, 2160, 2188, 2191, 2205, 2216, 2218 and the backfill of the ditch Context 2197.

The tile relating to contexts of this date comprised chimney, flue tiles, imbrices, sherds termed 'other', Rbrick and tegulae, and it accounted for 21.3 percent of the tile from the sites to the south-west of the *colonia*. The tile included fifteen combed flue tiles, one incised flue tile, two tegulae with upper cutaways, one tegula with a Type B6 lower cutaway (Warry 2006, 4), and two overfired sherds (one imbrex and one Rbrick).

10.1.6 Post-Roman

At all three sites activity from the fifth to thirteenth century comprised primarily plough soils with occasional rubbish pits and ditches. The area seems to have been little used prior to its development as a suburb from the thirteenth century onwards (Oakey 1992, 9).

The residual Roman tile in the post-Roman contexts included flue tiles, imbrices, Rbrick and tegulae, which accounted for 25.4 percent of the tile from the sites to the south-west of the *colonia*. Two of the flue tiles were combed. Two tegulae sherds had upper cutaways, three had Type B6 lower cutaways and one had a Type C5 lower cutaway (Warry 2006, 4). There was one sherd with a hoof print on the upper surface, and one tile with a possible batch number. Four tiles had signatures, two of which were illegible while one was a Type 1, and one a Type 2 (Betts 1985, 192). Two tiles had rain marks on the upper surface, while two of the tiles were overfired, and two were warped.

10.2 The tile from the sites to the south-west of the *colonia*

A total of 145,864g of Roman tile was recovered from the sites to the south-west of the *colonia*. The high levels of residuality noted among the pottery (Monaghan 1997, 1131-2) seem to be resultant from the importation of soil from elsewhere to raise the ground levels. It seems reasonable to suggest that much of the tile on the site is also residual, particularly for contexts post-dating AD 200. While these levelling deposits frequently contain funerary pottery, implying that some of the soil at least originated from disturbance to the Blossom Street cemetery, it is also possible that some of the soil originated from the *colonia*, representing the deliberate dumping of waste outside the city walls. The likelihood of high levels of residuality may limit the value of any conclusions relating to chronological variations in the tile.

Virtually none of the tile originated from *in situ* structural remains, hampering attempts to study chronological changes in the use of tile. Tile in structural contexts included underfired clay blocks used as post-packing, representing 3.3 percent of the total volume of tile seen, with a further 5.8 percent of the tile being sherds incorporated into cobble surfaces.

The weight in grams in relation to form and date is given on Table 96 and Figure 131, with the associated sherd count on Table 97. There was no tile directly relating to deposits predating AD 120, reflecting the small number of contexts of this date. This implies that the area was little used prior to the second quarter of the second century. The volume of tile was at its peak in the second century, declining slightly in the third and fourth centuries. This is surprising, as the pottery evidence suggests that the area was used extensively for dumping from AD 200 onwards. Given that the volume of dumped tile declined from the third century onwards, this implies that the use of tile for construction had also declined. The sherd counts were too low to determine changes to the distribution of individual forms over time.

No complete length dimensions were present for any of the forms. Two of the underfired clay blocks termed as ‘other’ had surviving breadth measurements of 150mm and 140mm respectively, but no other breadth measurements were present. The lack of surviving length and breadth measurement limits any conclusions which can be made regarding chronological changes to dimensions.

Table 96. Weight in grams by date and form for the sites to the south-west of the *colonia*							
	Overall	Chimney	Flue	Imbrex	Other	Rbrick	Tegula
AD 120-200	44135		970	5645		28465	9055
AD 200-280	33552		350	4850	5010	17492	5850
AD 280-410	31115	75	2060	4200	1000	18555	5225
Post-Roman	37062		725	5550		22147	8640

Table 97. Sherd count for Table 96							
	Overall	Chimney	Flue	Imbrex	Other	Rbrick	Tegula
AD 120-200	280		9	40		197	34
AD 200-280	151		2	26	4	95	24
AD 280-410	251	1	24	38	2	161	25
Post-Roman	211		5	38		131	37

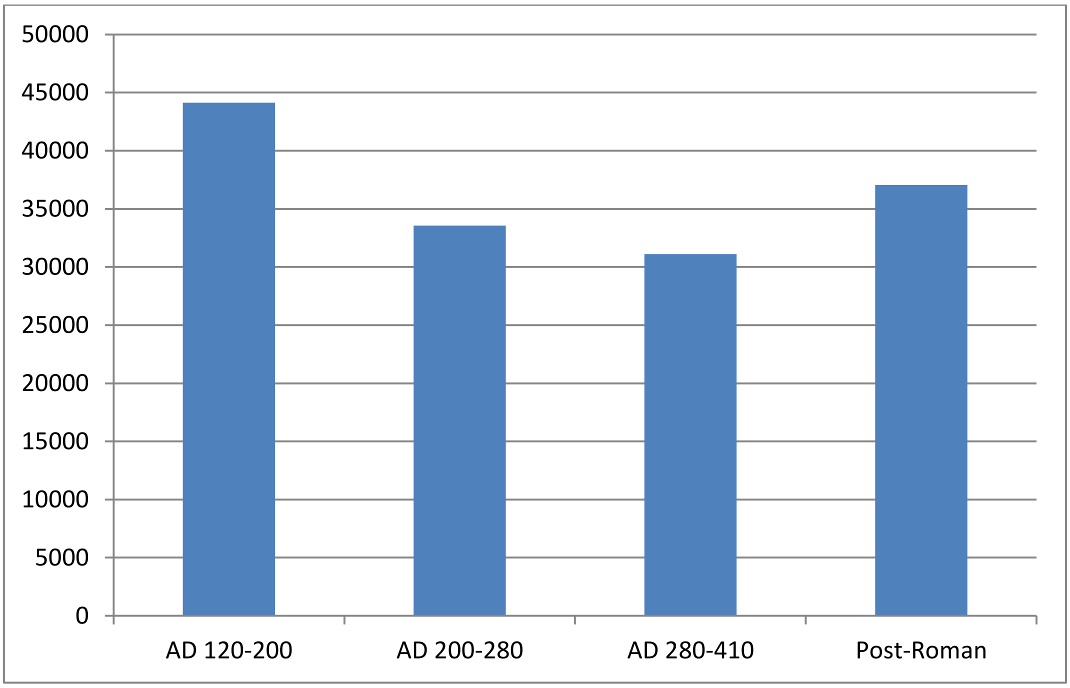


Figure 131. The total weight of tile in grams for each chronological group at the sites to the south-west of the colonia

The thickness dimensions of imbrices and tegulae are given in Table 98 and Figure 132, but too few thicknesses were present for the remaining forms to enable any analysis of changes to dimensions over time. Tegulae show an irregular decrease in thickness over time, while the imbrices remained almost constant in terms of thickness.

Table 98. Tile dimensions in mm and sherd count by form and date at the sites to the south-west of the *colonia*

Date and form	Minimum thickness	Maximum thickness	Average thickness	Sherd count
AD 120-200 imbrices	13	27	18	40
AD 200-280 imbrices	14	23	19	24
AD 280-410 imbrices	13	24	18	37
AD 120-200 tegulae	18	47	31	24
AD 200-280 tegulae	15	30	23	16
AD 280-410 tegulae	17	43	26	15

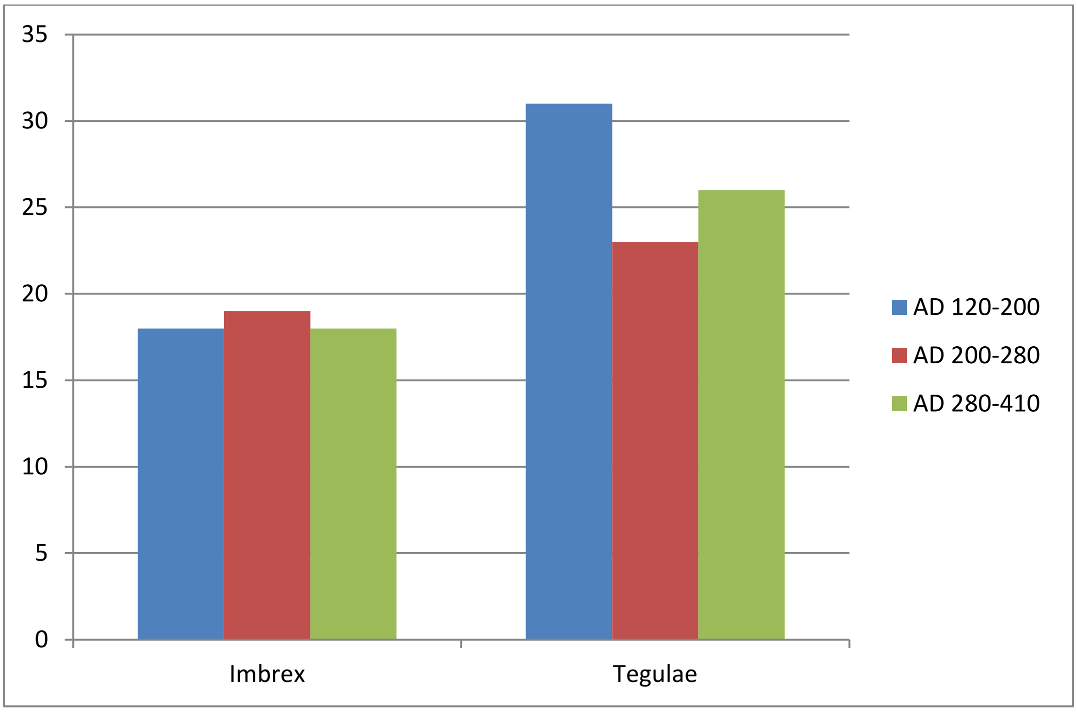


Figure 132. Average thickness of imbrices and tegulae in mm by date for the sites to the south-west of the colonia

No legionary stamps were present on the sites to the south-west of the *colonia*. Eleven signatures were present of which four were illegible, and seven were in Types 1-3 (Betts 1985, 192). The numbers present were insufficient to determine any variations over time (Table 99).

Table 99. Sherd count for signature types in relation to date at the sites to the south-west of the *colonia*			
	Type 1	Type 2	Type 3
AD 120-200		2	
AD 200-280	2		1
AD 280-410			
Post-Roman	1	1	

Though few examples were present, the lower cutaways seen on the tegulae show a gradual shift of form over time (Table 100). The date ranges of the cutaways present, suggest that the Type A cutaways were the earliest, with Type B being used throughout the Roman period and Type C being later.

Table 100. Sherd count for cutaway forms in relation to date at the sites to the south-west of the *colonia*			
	Type A2	Type B6	Type C5
AD 120-200	2	1	
AD 200-280	1	5	
AD 280-410		1	
Post-Roman		3	1

The weight in grams for each fabric in relation to date is given in Table 101, with the associated sherd count on Table 102. Most of the fabrics seen in York as a whole are present on the sites to the south-west of the *colonia*, with only fabrics R13, R17, R19 and R99 being absent, but each of these fabrics is rare so the absence is unsurprising. The relative lack of fabric R0 (that is sherds which are too small to determine the fabric) reflects the method of recovery; relatively little environmental sampling was undertaken for these sites, and it is the processing of such samples which results in abundant small sherds of tile that are too small to determine the fabric.

Table 101. The weight of fabric in grams in relation to date, and the weight as a percentage of the total volume, at the at the sites to the south-west of the *colonia*				
Fabric	AD 120-200	AD 200-280	AD 280-410	As a % of total volume
R0	750	225	650	1.5
R1	1785	3350	1050	5.7
R2	300	300	225	0.8
R3	9145	5325	5270	18.1
R4	150	25		0.2
R5	1115	1150	400	2.4
R6	1875	325	1705	3.6
R7	300		1100	1.3
R8		275		0.3
R9	22500	8307	9560	37.1
R10	1510	3765	4875	9.3
R11	3555	5260	5070	12.8
R12	275		50	0.3
R14		225	50	0.3
R15	475	10	450	0.9
R16	400		210	0.6
R18		5010	450	5.0

The only fabrics which accounted for more than 5 percent of the total volume at the sites to the south-west of the *colonia* were R1, R3, R9-R11 and R18 (Figure 133). Comparing fabrics to chronological groups showed that fabric R9 was dominant at the sites to the south-west of the *colonia* irrespective of date, being particularly common in second century deposits, perhaps implying it was manufactured before that date, occurring as residual material thereafter. Fabrics R3, then R11, then R10, were the next commonest fabrics. R3 was far more common on the sites to the south-west of the *colonia* than in the study area as a whole, the reverse being true for R10 (as a comparison the percentages of total volume on Tables 48 and 101 shows). Fabric R3 is interpreted as being of earlier date than fabric R10 or R11 (see p318), and it is possible that the lower levels of R10/R11 are because structures of these fabrics were of later date, decaying where they stood, in contrast to earlier structures including those built using R3, which were demolished and dumped outside the area of settlement. The sherd counts for the remaining fabrics were too low to enable any meaningful analysis of fabric in relation to date. For example, the seemingly high levels of fabric R18, normally a rare fabric, were due to just five heavy sherds of underfired brick used as post-packing.

Table 102. The sherd count relating to Table 101

Fabric	AD 120-200	AD 200-280	AD 280-410
R0	6	2	6
R1	18	11	11
R2	1	2	1
R3	57	33	44
R4	1	1	
R5	8	4	8
R6	13	2	16
R7	2		12
R8		1	
R9	135	52	86
R10	16	16	32
R11	13	20	24
R12	1		1
R14		2	1
R15	9	1	7
R16	1		1
R18		4	1

A comparison was made between fabric groups and chronological groups for the sites to the south-west of the *colonia*. The total weight of each fabric group in relation to chronological groups is given in Table 103, illustrated on Figure 134, and the associated sherd count is on Table 104. The sherd counts for fabric Groups 1, 2 and 4 were very low, but these groups were comparatively rare overall. Fabric Group 3 was dominant, irrespective of date, reflecting the dominance of fabric R9 (a component of Group 3) in the deposits in the area. The fabric groups overall confirm that the second century saw most of the tile dumping in the area, and it is perfectly possible sherds in later deposits represent residual material. This raises the possibility that, from the third century onwards, something other than tile became the dominant roofing form.

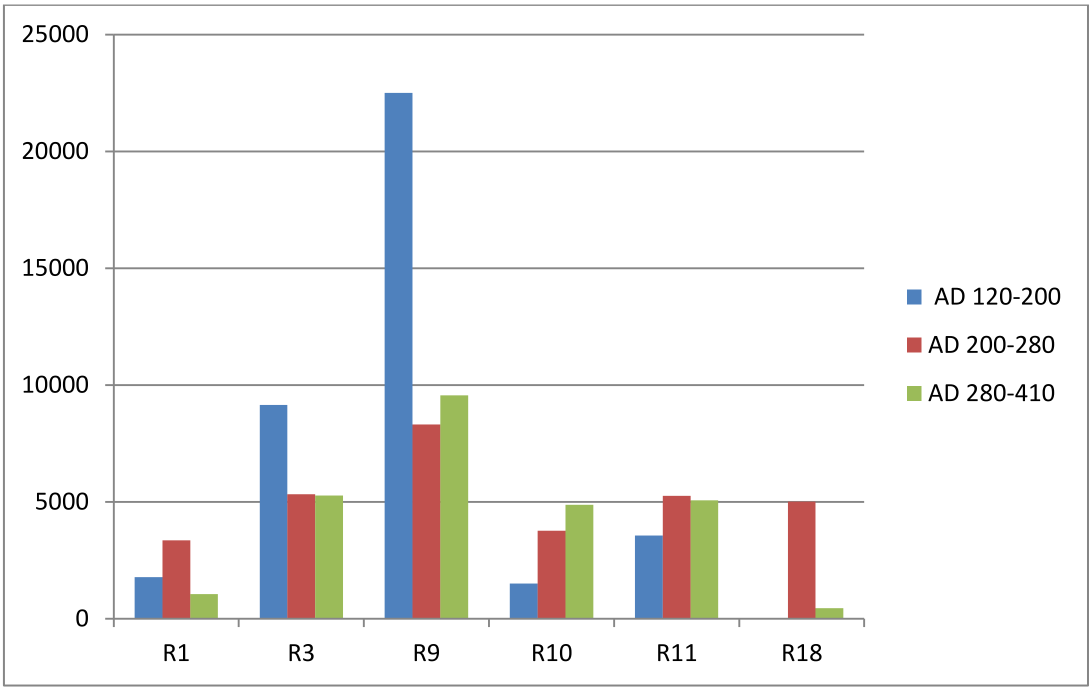


Figure 133. The weight in grams of fabrics R1, R3, R9-R11 and R18 in relation to date for the sites to the south-west of the colonia

Table 103. The weight in grams of each fabric group at the sites to the south-west of the *colonia* in relation to date

	Fabric Group 1	Fabric Group 2	Fabric Group 3	Fabric Group 4	Fabric Group 5
AD 120-200	1785	700	34270	750	5880
AD 200-280	8360	300	18547	510	5610
AD 280-410	1500	435	20105	550	7875

Table 104. Sherd count used for Table 103

	Fabric Group 1	Fabric Group 2	Fabric Group 3	Fabric Group 4	Fabric Group 5	Total
AD 120-200	18	2	216	10	29	275
AD 200-280	15	1	105	4	24	149
AD 280-410	12	1	170	9	53	245
Total	45	4	491	23	106	669

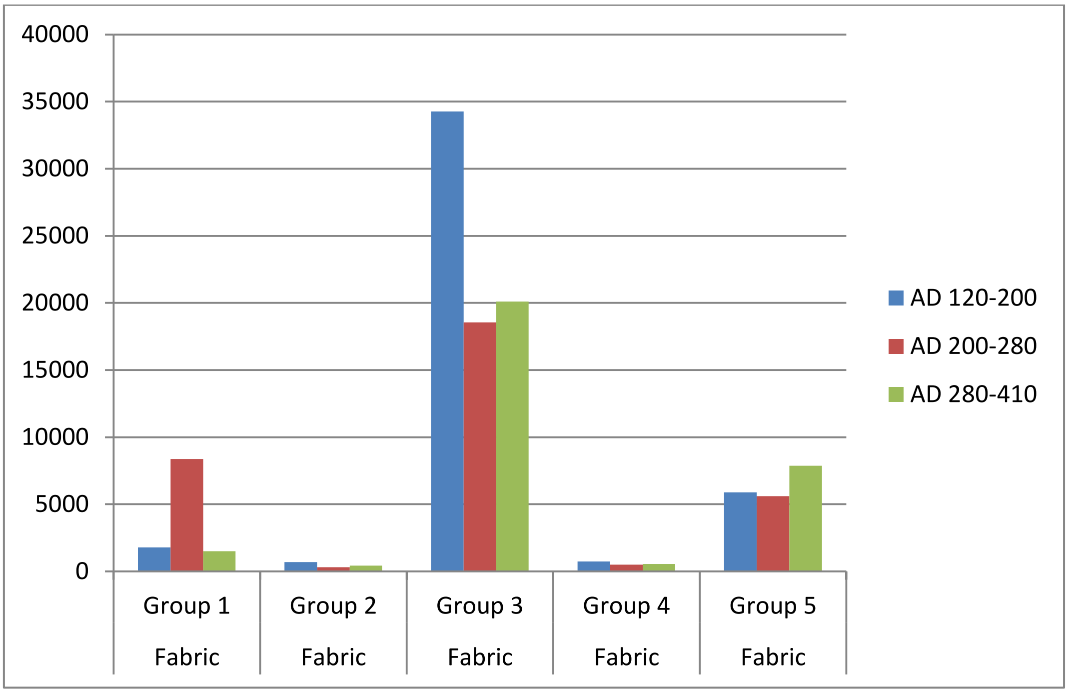


Figure 134. Weight in grams of fabric groups in relation to date for selected sites south-west of the colonia

Appendix 11 Various sites to the south-east of the legionary fortress

Although there have been a number of large scale excavations to the south-east of the legionary fortress, it proved difficult to find a single site which had yielded a large quantity of tile from stratified Roman contexts. This was partly because some excavations in the area have been of insufficient depth to penetrate Roman deposits, but also because the tile from some of the large scale excavations of the 1970/80s was transferred to the Yorkshire Museum many years ago, placing it outside the scope of the present study. For-example, just sixty-nine sherds of Roman tile remain in the YAT collections from the large-scale excavations at 16-22 Coppergate. As no single excavation had produced sufficient tile for analysis a group of six sites were considered collectively (Figure 135).

The excavations at York Castle Car Park (YAT site code 1995.58), 22 Piccadilly (YAT site code 1987.21), 38 Piccadilly (YAT site code 1992.4), 41 Piccadilly (YAT site code 1992.18), 50 Piccadilly (YAT site code 1992.10) and Dixon Lane (YAT site code 2005.32), were located to the south-east of the fortress, and collectively these sites yielded a sequence of contexts relating to the entire period of Roman occupation. These sites yielded 6,685g, 77,905g, 4,175g, 8,200g, 8,515g and 33,020g of Roman tile respectively, a combined total of 138,500g of tile.

It should be noted that the sherd counts for the excavations at York Castle Car Park, and at 38, 41 and 50 Piccadilly were low, with these sites yielding forty-six sherds, twenty-five sherds, thirty-three sherds, and thirty-nine sherds of tile respectively. At Dixon Lane two groups of features containing Roman artefacts were not closely datable, while a further group of undated features were interpreted as being of Roman date on the basis of the stratigraphic sequence; tile from these features has been included in the period AD 280-410 as this is the most recent date at which these deposits could have occurred stratigraphically.

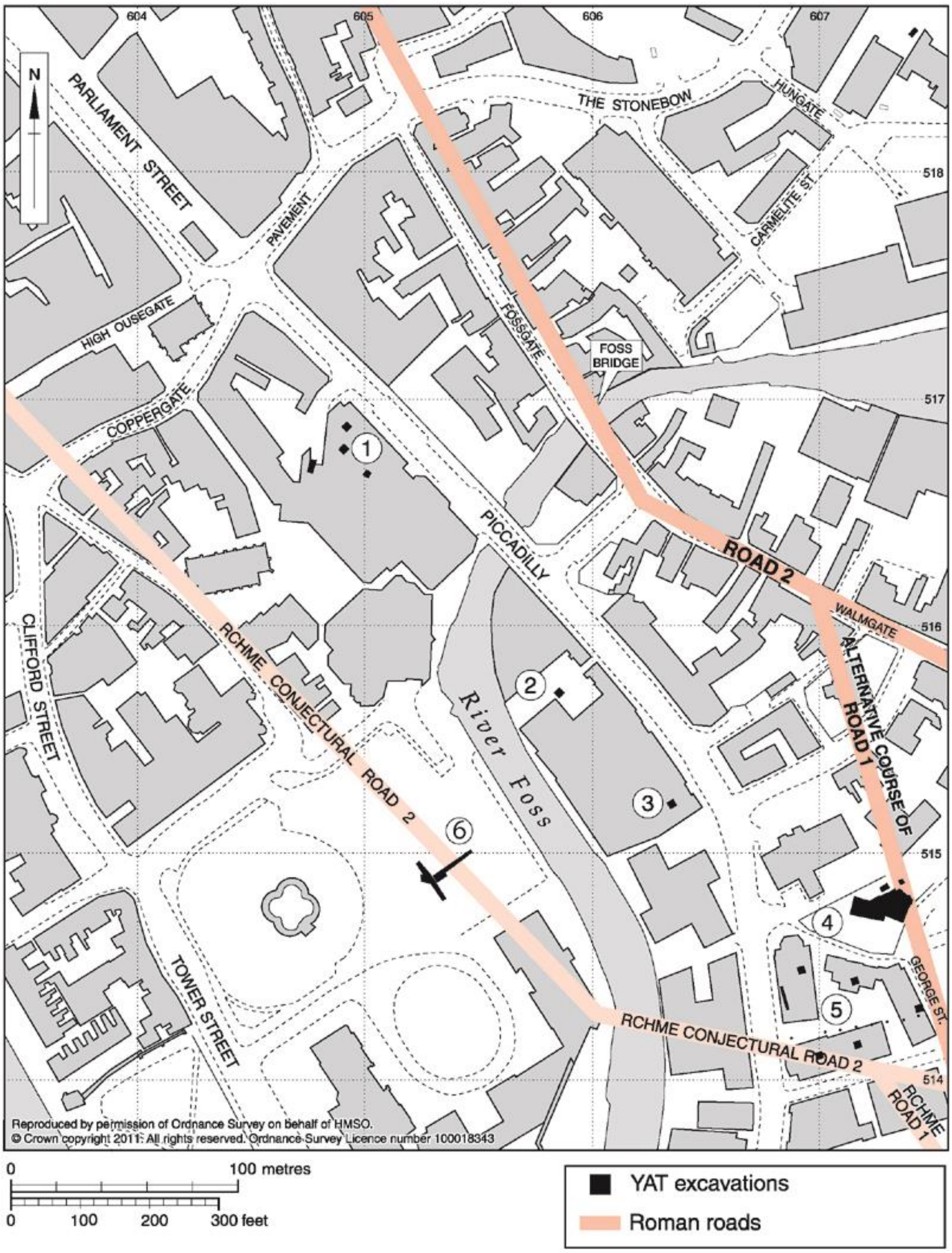


Figure 135. The location of the sites to the south-east of the fortress examined in the present study, 1 = 22 Piccadilly, 2 = 38 Piccadilly, 3 = 50 Piccadilly, 4 = Dixon Lane Street, 5 = 41 Piccadilly, 6 = York Castle Car Park. (Based on Ottaway 2011, Figure 127 © YAT, using underlying © Crown Copyright data Ordnance Survey Licence Number 100018343)

Unpublished reports are available in the YAT archives for the York Castle Car Park and Piccadilly sites (Clarke 1995, Finlayson 1988, Finlayson 1992a, Finlayson 1992b and Lilley 1992a), while a web based publication is available for Dixon Lane (McComish 2007). The York Castle Car Park site and the sites at 22, 38, 41 and 50 Piccadilly are summarised in Ottaway (2011, 222-34), while the pottery from the 22, 41 and 50 Piccadilly sites is summarised in Monaghan (1997, 1085, 1090).

The dominant topographical feature for the sites examined in Appendix 11 is the River Foss, with the site at 22 Piccadilly being located to the north of the river, York Castle Car Park being to the west of the river and the remaining sites being to the south- east of a loop in the river (Figure 135). The course of the River in the Roman period was clearly different to the present day, largely as a result of man made changes, notably the damming of the river in the late eleventh century to create the King's Fishpool, and from the canalisation of the river in the late eighteenth century (Ottaway 2011, 197). The presence of river silts in Trench 4, and the river bank in Trenches 1-3 at 22 Piccadilly, together with the remains of a structure interpreted as a wharf, which was excavated in 1950-1 at Garden Place (Ottaway 2011, 197, 222-4), show that the river channel was far wider than at present, with the northern bank of the loop in the river channel being approximately 55-60m to the north of its present location. There was also a more pronounced slope to the river banks than at present, as indicated by the level of natural deposits in a series of boreholes at 41 Piccadilly and at York Castle Car Park (Ottaway 2011, 234).

The location of Roman roads in the area is uncertain. The RCHM (1962, 2) conjectured a road running parallel to and immediately south-west of the south-western side of the fortress (numbered Road 5), which was assumed to have continued to the River Foss, while to the east of the Foss it was thought to have branched into two roads (numbered Roads 1-2), one leading south-east towards Heslington, and the second leading east towards the Roman settlement at Brough. Excavations since 1962 have suggested that this road layout is incorrect (Ottaway 2011, 198), firstly because the steep slope of the river banks of the Foss make it unlikely that the river was bridged in the Piccadilly area, and secondly as no trace of the conjectured line of Roads 2 and 5 were seen in the York Castle Car Park excavations, or in Trench 5 at 41 Piccadilly (Ottaway 2011, 225, 234). The present view is that no major Roman roads were located in the Piccadilly area (Ottaway 2011, Figure 196), the nearest road being aligned roughly with the present street of Walmgate, leading from the south-eastern fortress gate, towards Brough-on-Humber.

The largest Roman structures known from the area to the east of the Foss were a structure interpreted as a jetty, found beneath the Malt Shovel Inn on Walmgate in 1829, and a row of rough stone columns found beneath the Labour Exchange building in 1938 (this site being immediately opposite 50 Piccadilly), though the depth at which these stones occurred is unknown (Ottaway 2011, 198).

11.1 Summary of the sites to the south-east of the fortress

11.1.1 Pre-Roman

Natural clay was present across the area (Ottaway 2011, 222-3; Finlayson 1992a, 6; Lilley 1992a, 13, 17, 20-21; Finlayson 1992, 9), including exceptionally pure clay at Dixon Lane (McComish 2007, Phase 1). A single sherd of tile weighing 150g was present within the natural clay in Trench 2 at 22 Piccadilly, Context 2313, which presumably represents intrusive material.

11.1.2 AD 71-120

Very few deposits were present relating to this date. At Dixon Lane a number of domestic rubbish pits were cut, containing objects such as pottery, tile, animal bone, slag and iron nail sherds. Pit backfills 1503, 1951-52 and 1975 contained tile, though in the case of 1503 this was a single sherd of thirteenth to sixteenth century roofing tile which represented intrusive material (McComish 2007, Phase 2).

A total of 6,280g of tile was present in the contexts dating to AD 71-120, representing 4.5 percent of the total from the sites to the south-east of the fortress. The tile comprised a mixture of imbrices, tegulae and Rbrick.

11.1.3 AD 120-200

Evidence of second century activity in the area to the south-east of the fortress came from the excavations at 50 Piccadilly, where there were two drainage ditches dug at an oblique angle to the River Foss, which were shown from analysis of environmental samples to have been permanently wet (Finlayson 1992, 9-10). These were sealed by a series of dumped deposits of silty-clay, interpreted as the deliberate raising of the ground level in the area (Finlayson 1992, 10), and Context 2126 within these dumps contained tile. The dumps were truncated by a posthole, and sealed by a deposit, Context 2124, which was thought to be possible *in situ* burning indicative of industrial activity in the area (Finlayson 1992, 10); this context contained tile. The area was then truncated by a linear cut.

Elsewhere in the Piccadilly area there was very little evidence for deposits of this date. A pit in Trench 5 at 41 Piccadilly was dated by pottery as AD 150 or later (Lilley 1992a, 21), but no tile was present in the pit backfill.

A total of 707g of tile was present in contexts dating to AD 120-200, comprising three sherds of Rbrick, representing 0.5 percent of the total volume of tile from the sites to the south-east of the fortress.

11.1.4 AD 200-280

The York Castle Car Park yielded some evidence for third century activity, including a layer of disturbed natural and a shallow cut, the backfill of which, Context 2024, contained late second-early third century pottery (Ottaway 2011, 233) and tile.

At 22 Piccadilly there was a build-up deposit in Trench 1, Context 1086, which contained tile (Finlayson 1989, 94). The context has been phased here as it is the most recent date at which the deposit could have occurred.

Directly above the natural deposits at 38 Piccadilly there was a well-worn cobble surface, Contexts 1060-62, which incorporated un-abraded large sherds of third century pottery and tile (Finlayson 1992, 35).

In Trench 1 at 41 Piccadilly third century activity comprised a series of stake-holes and a small pit, the pit being dated to the early third century (Lilley 1992a, 17). This was sealed by a dumped deposit and a gully, which contained residual Roman pottery (Lilley 1992a, 18). In Trench 1 there was also an undated dump truncated by two stake-holes (Lilley 1992a, 9), which were clearly Roman in terms of the stratigraphic sequence, and these contexts have been phased here, as it is the most recent date at which they can occur. Of these, Context 1084 contained tile.

At 50 Piccadilly an earlier linear cut was backfilled (Finlayson 1992b, 10-1), with backfills Contexts 2019-22 containing tile. The site was then sealed by a series of dumps incorporating domestic rubbish, indicating settlement activity nearby (Finlayson 1992b, 11), and Contexts 2112-18 within this sequence contained tile. The dumps were truncated by a posthole and three aligned stakes suggesting structural activity, these were sealed by a cobble surface of mid-third century date (Finlayson 1992b, 11). Contexts 2105 and 2111 within the cobble surface contained tile.

At Dixon Lane a number of features were present which were dated by pottery to the mid-late third century (McComish 2007, Phase 2). There was a linear cut which may represent a terracing operation to create useable flat-land on a steeply sloping site. The terrace was beneath a deposit and a row of postholes which could either represent part of a timber revetment, or part of a timber building. The terrace was then sealed by deposits and pits. To the west of the terrace was a butt-ended boundary ditch with an 'ankle-breaker' profile, which was later re-dug. Above the ditch were a small pit and an isolated posthole. Contexts 1675, 1989, 2049 and 2068 in this group contained tile.

A total of 14,985g of tile was present in the contexts dating to AD 200-280, representing 10.8 percent of the total volume of tile from the sites to the south-east of the fortress. The tile comprised imbrices, tegulae and Rbrick sherds. Two of the tegulae had Type B6 lower cutaways (Warry 2006, 4), one Rbrick sherd was pierced by a hole 10mm in diameter, one sherd had a hob-nail boot imprint on the upper surface and three sherds (one imbrex, one tegula and one Rbrick) were overfired.

11.1.5 AD 280-410

At York Castle Car Park there was a build-up, Context 2016, which contained late fourth century pottery and tile (Ottaway 2011, 223).

At 22 Piccadilly there were a number of deposits dated to the late third century. In Trench 1 there was a flat based drainage ditch which was sealed by a number of deposits interpreted as possible flood debris (Ottaway 2011, 222). In Trench 2 there was a series of deposits interpreted as possible river silts, which were truncated by a shallow cut (Ottaway 2011, 224). A series of deposits interpreted as river silts were also present in Trench 4 (Ottaway 2011, 224). Contexts 1060-61, 1068, 1084, 2309, 2311-12 and 4008-10 within this group contained tile.

At 38 Piccadilly there was a well-worn cobble surface, Contexts 1060-62, containing tile, which was of third century date (Finlayson 1992, 6, 35).

In Trench 1 at 41 Piccadilly there was a series of dumps dated by pottery to AD 360 or later (Lilley 1992a, 9), two of which, Contexts 1077 and 1081, contained tile. Above the dumps there were structural remains including two limestone post-pads, three stake-holes, a clay surface and a linear slot, the backfill of which contained fourth century Roman pottery (Lilley 1992a, 9). The slot was sealed by a pebble surface with pottery dating to AD 280-450 (Lilley 1992a, 10). An undated pit in Trench 4 was also interpreted as possibly Roman (Lilley 1992a, 20), and it has been phased here as it is the most recent date at which the feature could have occurred.

At Dixon Lane there were several features of late Roman date (McComish 2007, Phase 2). Three narrow vertically-sided slots were present, and the sharp nature of their edges implied that these cuts were only in use for a short period before being infilled in the fourth century. A build-up deposit 0.4m thick was present, which contained mid-fourth century pottery. This was truncated by a small rubbish pit and a group of stake/postholes, which were later removed and infilled. Slightly to the south-east of these features there was a severely truncated pit, which contained pottery of fourth century date, together with a small jet pendant in the shape of a bear and a shale bracelet. Contexts 1454, 1987, 1948, and 2107 in this group contained tile.

A total of 36,518g of tile was present in the contexts dating to AD 280-410, representing 26.3 percent of the total from the sites to the south-east of the legionary fortress. The tile included flue tiles, imbrices, parietalis, pipes, Rbrick and tegulae. One of the flue tiles was incised, while four had combed keying. One tegula had an upper cutaway and one Rbrick was pierced by a firing hole. A single legionary stamp was present relating to the Legio VI, which was of type 2460.8 (Collingwood and Wright 1992, 150).

11.1.6 Post-Roman

At Dixon Lane there was a series of badly truncated Anglian buildings and associated rubbish pits dating to the eighth to ninth centuries. The site continued in use in the Anglo-Scandinavian period with the cutting of a ditch and rubbish pits, and a cemetery was established at the site in the later Anglo-Scandinavian period (McComish 2007). At the York Castle Car Park site there was an Anglo-Scandinavian pit (Ottaway 2011, 233). From the ninth to twelfth-centuries attempts at land reclamation were made in the channel of the river Foss, with dumps and build-ups raising the ground level present at 22, 38 and 50 Piccadilly (Finlayson 1997, 787-8, 791, 794).

At 41 Piccadilly there were eleventh-twelfth century rubbish pits and dumps (Finlayson 1997, 802), while at the York Castle Car Park site there was a wall thought to be of medieval date (Ottaway 2011, 233). From the time of the Norman Conquest the Dixon Lane site was used as a cemetery for the church of St Stephen, which became redundant in the mid-fourteenth century (McComish 2007). The process of land reclamation in the river channel continued throughout the medieval and into the post-medieval periods at 22, 38 and 50 Piccadilly where riverbank revetments were constructed (Finlayson 1997, 787-8, 791, 794).

At 38 Piccadilly the modern features included a drainage ditch, a drain and various buildings (Finlayson 1997, 791). The remains of a nineteenth century brewery were present at the Dixon Lane site (McComish 2007), at 22 Piccadilly there were the remains of a twentieth century cinema (Finlayson 1997, 787-8), at 41 Piccadilly there was a modern cellar (Finlayson 1997, 802), and a modern car park surface was present at York Castle Car Park (Ottaway 2011, 233).

A total of 79,087g of tile was present in the post-Roman contexts, representing 57.1 percent of the total from the sites to the south-east of the fortress. There was also 775g of tile, 0.5 percent of the total, from boreholes on the 41 Piccadilly site, but this borehole material could not be closely phased (and is classed as unknown on Tables 104-5). Features of interest relating to manufacture include three tegulae with upper cutaways, a further three with Type B6 lower cutaways (Warry 2006, 4) and one with a rain mark on the upper surface. Six of the flue tiles had combed keying. There was one overfired imbrex. The Rbrick sherds included one with a cat's paw print, one with a dog's paw print, one with a hob-nail boot imprint, one pierced by a small hole, one with finger drawn keying lines and one with combed keying lines, while two sherds were overfired. Two signatures were present on the Rbrick which were a Type 1 and possibly a Type 30 (Betts 1985, 192-3); in addition, there were two legionary stamps one relating to the Legio IX, a type 2462.9, and one relating to the Legio VI, a type 2460.81 (Collingwood and Wright 1992, 164 and 171).

11.2 The tile from the sites to the south-east of the fortress

A total of 138,500g of Roman tile was recovered from the sites to the south-east of the fortress (Table 105 and Figure 136, with the associated sherd count on Table 106). None of the tile from these sites originated from *in situ* structural remains, though a small number of sherds were used as hard core in a cobble surface at 38 Piccadilly. There was relatively little tile predating AD 200, with the volume of tile increasing notably in the late Roman period, this suggests that development only occurred, on what would have been marginal land, when pressure on space occurred in the area closer to the fortress (Ottaway 2011, 237).

No complete length or breadth dimensions were present for any of the tiles in Roman contexts at the sites to the south-east of the fortress, preventing any analysis of chronological changes to these dimensions. Although thickness dimensions were present on a number of forms, the sherd counts were too low to enable any analysis of changes to dimensions over time (Table 106).

Table 105. Weight in grams by date and form for the sites to the south-east of the fortress, the tile listed as unknown was from undated bore-hole deposits								
	Overall	Bessalis	Flue	Imbrex	Parietalis	Pipe	Rbrick	Tegula
Natural	150			150				
AD 71-120	6280			778			4277	1225
AD 120-200	705						705	
AD 200-280	14985			1425			8585	4975
AD 280-400	36518		1400	6725	225	250	21088	6830
Post-Roman	79087	2050	1725	10015			53407	11890
Unknown	775						775	

Table 106. Sherd count for Table 105								
	Overall	Bessalis	Flue	Imbrex	Parietalis	Pipe	Rbrick	Tegula
Natural	1			1				
AD 71-120	31			4			23	4
AD 120-200	3						3	
AD 200-280	74			12			42	20
AD 280-400	158		8	25	1	3	78	32
Post-Roman	428	1	10	79			290	48
Unknown	5						5	

Six signatures were present of which three were illegible, three were of Type 1 and one was a possible Type 30 (Betts 1985, 192). Three legionary stamps were present on the sites to the south-east of the fortress, of which one related to the Legio IX and two to the Legio VI. All three stamps were designs which have previously been recorded in York, namely types 2462.9a, 2460.8 and 2460.81 (Collingwood and Wright 1992, 150, 164 and 171). All three stamps occurred residually, the type 2460.8 stamp was in a Roman deposit which dated to AD 280-410 (that is the period when tiles were no longer stamped), while the remaining two stamps were in post-Roman deposits. The numbers of signatures and stamps present was insufficient to determine any variations over time in relation to fabric or forms.

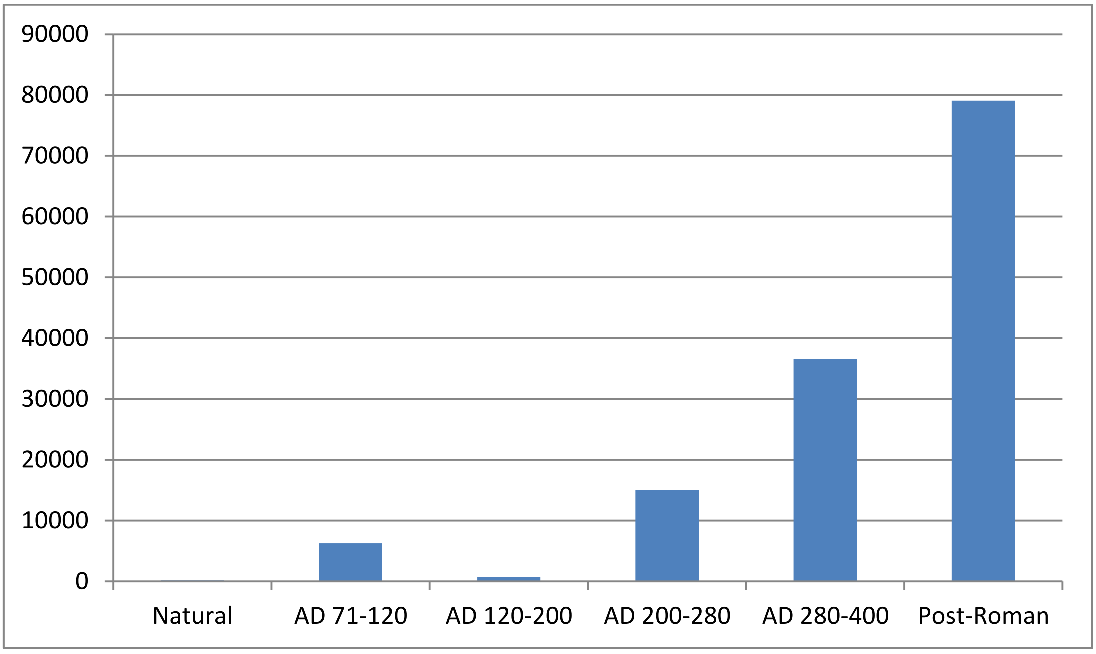


Figure 136. The total weight of tile in grams for each chronological group at sites to the south-east of the fortress

Eight lower cutaways were present but the precise form of four of these was unclear. The remaining four were all Type B6 (Warry 2006, 63), two of the cutaways occurred in deposits dated to AD 200-280 and two in post-Roman deposits. Clearly there were insufficient examples to determine changes to cutaway forms over time.

The weight in grams for each fabric in relation to date is given in Table 107, with the associated sherd count on Table 108. Fabrics R4, R13 and R17-R19 were absent, but this is unsurprising given the rarity of these fabrics overall. Some of the fabrics (R5, R12, R15 and R16) were only present in contexts of post-Roman date. The sherd counts for the fabrics were too low to enable any comparison of fabrics over time, and the same was true for fabric groups (Tables 109-10).

Table 107. The weight of fabric in grams in relation to date for the Roman deposits at the sites to south-east of the fortress				
Fabric	AD 71-120	AD 120-200	AD 200-280	AD 280-410
R0	125	5	425	6065
R1	25	500	2700	4300
R2				250
R3	313		125	500
R6			1025	
R7			100	1425
R8				3600
R9	5667	200	5485	15338
R10	150		1100	2285
R11			3850	2480
R14				225
R99			175	

Table 108. The sherd count relating to Table 107				
Fabric	AD 71-120	AD 120-200	AD 200-280	AD 280-410
R0	1	1	3	16
R1	1	1	15	19
R2				3
R3	2		1	3
R6			5	
R7			1	7
R8				16
R9	26	1	28	68
R10	1		8	13
R11			12	11
R14				2
R99			1	

Table 109. The weight in grams of each fabric group at the sites to the south-east of the fortress in relation to date				
	Fabric Group 1	Fabric Group 3	Fabric Group 4	Fabric Group 5
AD 71-120	25	6130		
AD 120-200	150	200		
AD 200-280	2700	6710		4975
AD 280-410	4300	18123	3825	4205

Table 110. Sherd count used for Table 109					
	Fabric Group 1	Fabric Group 3	Fabric Group 4	Fabric Group 5	Total
AD 71-120	1	29			30
AD 120-200	1	1			2
AD 200-280	15	37		18	70
AD 280-410	19	84	18	21	142
Total	36	151	18	39	244

Appendix 12 Various sites to the east of the legionary fortress

The excavations at 2 St Maurice’s Road, 40-48 Monkgate, County Hospital Monkgate, 21-33 Aldwark, 36 Aldwark and the Adam’s Hydraulics site Peasholme Green, were selected for analysis as being representative of the area to the east of the fortress (Figure 137). These sites yielded 15,035g, 6,060g, 7,880g, 5,649g, 12,337g and 59,075g of tile respectively, a combined total of 105,036g of tile. The excavations at 21-33 Aldwark and 36 Aldwark are described in Brinklow et al. (1986, 33-48), while the sites at 2 St Maurice’s Road, 40-48 Monkgate, County Hospital Monkgate and the Adam’s Hydraulics site Peasholme Green, are summarised in Ottaway (2011, 160-95), and the pottery for most of these sites is discussed in Monaghan (1997). It should be noted that in the case of the 21-23 Aldwark site the bulk of the finds were transferred to the Yorkshire Museum at the time of the original post-excavation work (Brinklow et al. 1986, 5) with only thirty sherds remaining in the YAT collections.

There have been a number of other large-scale excavations in this area of York, which were not included in Appendix 12. The sites at County Hospital Fossbank (YAT site code 1982.10) and Jewbury (YAT site code 1983.5) were not included because, although Roman features cutting into the underlying natural were present at both sites, these could not be closely phased due to a lack of datable artefacts and a lack of vertical stratigraphy (Ottaway 2011, 164; Monaghan 1997, 1094). The excavations at the Haymarket Car Park were not included as the archive report for the site concentrated on the medieval deposits from the site, there being little analysis of the earlier Roman features. Three smaller archaeological interventions were excluded as they produced insufficient tile (YAT site codes 1989.26, 1990.12 and 1997.103).

The excavations at 2 St Maurice’s Road comprised three small test trenches, while at 40-48 Monkgate there were four small trenches and a number of boreholes, and at the County Hospital Monkgate site the excavation comprised a single trench 18 x 13m in size (Ottaway 2011, 175-85). The site at 21-33 Aldwark comprised one large and two small trenches, while the 36 Aldwark excavations comprised a single small trench (Brinklow et al. 1986, 32). The Adam’s Hydraulics site at Peasholme Green was excavated in three stages, and comprised a large number of trenches one group being aligned to the present street frontage, three further groups of trenches being aligned at right angles to the street frontage, and a group of boreholes being aligned parallel to, and 90m south of, the Peasholme Green street frontage, and the largest trench at the site, which was 30 x 2m in size, was close to the line of boreholes (Ottaway 2011, 189).

The lack of structural remains in this area prior to the third century, suggests that it was not used for civilian settlement at that stage. It is possible that the presence of the legionary kilns in the Peasholme Green area discouraged settlement in the vicinity. Although no direct evidence of the kilns was found on the sites in the present study, their presence is indicated by the deposition of wasters on the 21-3 Aldwark and 36 Aldwark sites (Brinklow et al. 1986, 39-40, 48), and by a massive dump interpreted as deriving from the kilns on the Adams Hydraulics site (Ottaway 2011, 191), and there was a feature interpreted as a Roman clay pit at the Haymarket Car Park site (Finlayson 1997, 770). The abundant residual pottery (including wasters) and tile at the Jewbury and County Hospital Fossbank excavations, may also have originated from the dumping of waste from the legionary kilns (Monaghan 1997, 1095). The area between Monkgate and Peasholme Green was largely characterised by ditches with occasional pits, postholes and burials, again suggesting that the area was not heavily developed.

Structural remains and roads of late Roman date were present at 21-3 Aldwark and 36 Aldwark (Brinklow et al. 1986, 39-40 and 48). The development of the Aldwark area for settlement in the later Roman period indicates that the legionary kilns had gone out of production by this stage. A deposit of demolition debris at the 2 St Maurice's Road excavation probably originated from a building which related to the main approach road into the north-eastern side of the fortress; the building is indicated by a tessellated pavement recorded in 1911 (RCHM 1962, 65).

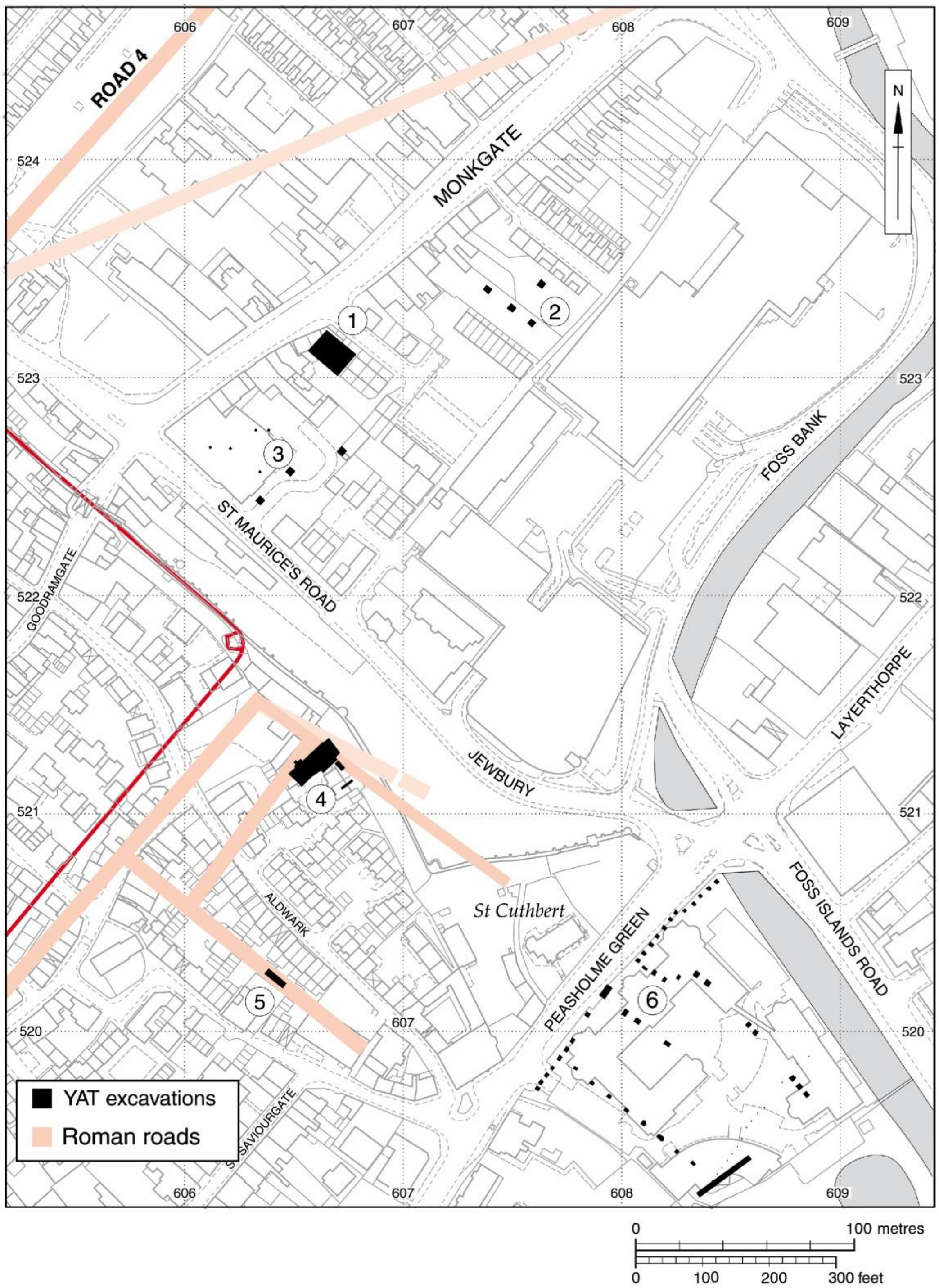


Figure 137. The location of sites to the east of the fortress examined in the present study. 1 = County Hospital Monkgate, 2 = 40-48 Monkgate, 3 = 2 St Maurice's Road, 4 = 21-3 Aldwark, 5 = 36 Aldwark, 6 = Adam's Hydraulics (Based on Ottaway 2011 Figure 94, ©YAT, using underlying © Crown Copyright data Ordnance Survey Licence Number 100018343)

12.1 Summary of the sites to the east of the fortress

12.1.1 Pre-Roman

Natural clay was present at all the sites (Ottaway 2011, 163-4, 185, 190).

12.1.2 AD 71-120

A pit was present at 36 Aldwark, which pre-dated the later second century (Brinklow et al. 1986, 48). In Trench E2 at the Adam's Hydraulics site there was a deposit of clay, sealed by a limestone flagged surface, which was in turn beneath organic layers that were dated by pottery to the late first century (Ottaway 2011, 191). Tile was present in Context 308.

A total of 350g of tile, in the form of three sherds of Rbrick, were recovered from contexts of this date, representing 0.3 percent of the total volume of tile from the sites to the east of the fortress.

12.1.3 AD 120-200

At 21-33 Aldwark a road with flanking ditches was present, and the metalling of the road surface incorporated crushed brick and tile interpreted as originating from the legionary kilns to the south-east, though it was unclear whether the road represented an access road to the legionary kilns (Brinklow et al. 1986, 36). The roadside ditches silted up in the late second century (Monaghan 1997, 1068). A second road surface incorporating sherds of tile (Context 1039) was seen at 36 Aldwark (Brinklow et al. 1986, 40). A single build-up deposit, Context 3004, of later second century date was present at 2 St Maurice's Road, which contained pottery and tile (Ottaway 2011, 185).

A total of 3,510g of tile was recovered from contexts of this date, representing 3.3 percent of the total volume of tile from the sites to the east of the fortress. No features of note were present on the tile.

12.1.4 AD 200-280

The 21-33 Aldwark site seems to have been abandoned for a time, resulting in a build-up of soil across the area, this was later truncated by several features including an isolated burial (Brinklow et al. 1986, 36). A new road with an associated roadside ditch was constructed on the site after AD 225, the surface of which was heavily worn suggesting prolonged usage (Brinklow et al. 1986, 38). A cobble surface, and enigmatic traces of structures adjacent to the road, were also present, including a spread of kiln waste suggestive of dumping from the nearby legionary kilns (Brinklow et al. 1986, 36). A second accumulation of soil across parts of the site suggests a second period of abandonment (Brinklow et al. 1986, 37). The road was subsequently re-metalled, and a new road was constructed at right angles to it (Brinklow et al. 1986, 38-9). A layer of soft highly fired orange clay on the site was interpreted as the dumping of kiln wall material, suggesting dumping from the legionary kilns located to the south-east (Brinklow et al. 1986, 39).

At 40-48 Monkgate there was a build-up of deposits, which were truncated by a ditch, two pits, a posthole and a gully (Ottaway 2011, 185-9). The pit fills Contexts 3005 and 3014, together with gully backfill, Context 3003, contained tile.

In Trench 1 at 2 St Maurice’s Road there was a deposit of mortar and two deposits of silt containing third century pottery (Ottaway 2011, 181), of these Contexts 1021-22 contained tile. In Trench 2 a build-up of silty clay, Context 2017, contained third century pottery (Ottaway 2011, 182), together with tile.

At the County Hospital Monkgate site there was a build-up of silt with cobbles, which was beneath small patches of sand and mortar, dated by pottery to the late second to third centuries (Ottaway 2011, 177, 180), of these, Context 404 contained tile.

In Trench F1 at the Adams Hydraulics site there was a build-up of deposits, which were truncated by a ditch with organic backfills containing stable manure, hay and straw, cattle radii with the marrow extracted, leather objects, wooden objects and seven dog’s skulls (Ottaway 2011, 191). Ditch backfill Context 11045 also contained tile. The ditch was sealed by a cobble surface, also seen in Trench E3 (Contexts 11044 and 305) which incorporated tile. This surface was sealed by dumped deposits over a metre thick, Contexts 11036-42, which contained abundant tile and pottery, including wasters which had clearly originated from the nearby legionary kilns (Ottaway 2011, 191). The organic deposits were in turn beneath two deposits of clay, Contexts 11028 and 11032, which were clearly intended to raise and level the uneven ground surface (Ottaway 2011, 191), both these deposits contained tile.

A total of 43,290g of tile was recovered from contexts of this date, representing 40.8 percent of the total volume of tile from the sites to the east of the fortress. The Rbrick sherds included two illegible legionary stamps, and two stamps relating to the Legio IX (both occurring residually), two signatures, two with finger marks on the upper surface and two overfired sherds. There were also two overfired imbrices. Two of the tegulae had upper cutaways, while two had lower cutaways in Types A2 and B6 (Warry 2006, 4), both cutaways occurring residually.

12.1.5 AD 280-410

The 21-33 Aldwark site yielded a sophisticated town house with a mosaic floor and a tessellated pavement (Brinklow et al. 1986, 40). Nearby there was an area of *opus signinum* on a bedding of broken sandstone roofing slabs, and three ovens or hearths, including a tiled hearth which were suggestive of a kitchen area (Brinklow et al. 1986, 42). Collectively the features were dated by pottery to the fourth century (Monaghan 1997, 1068). The final phase of Roman activity at the site saw the collapse of the kitchen buildings, comprising a layer of broken stone roofing tiles and wall plaster (Brinklow et al. 1986, 42). There were various robbing pits, a possible well, and an accumulation of soil above the roads, which were also dated by pottery as fourth century or later (Monaghan 1997, 1068). One of the pits cut through the earlier building floor, and the backfill (Context 767) contained a number of disturbed tesserae.

At 2 St Maurice’s Road various deposits were present which contained either late third century or fourth century pottery (Ottaway 2011, 181-5). There was a plank-lined ditch which was subsequently recut, and a nearby contemporaneous pit. The backfill of the ditch, Context 2019, and the pit fill, Context 1025, both contained tile. The infilled ditch was later truncated by a gully the backfills of which, Contexts 1015-16, contained demolition material including tesserae, mortar, tiles and limestone. The gully was beneath a series of pits and ditches, with backfills 2002-03, 2007, 2012 and 2014 containing tile.

At the County Hospital Monkgate site there was a series of patchy cobble spreads, a ditch, and three burials aligned to the ditch (Ottaway 2011, 176-80). Although very little dating evidence was present, a fourth century coin was recovered from one of the cobble spreads. Tile was present in the ditch (Context 311), and in one of the cobble spreads (Context 439).

A total of 13,469g of tile was recovered from contexts of this date, representing 12.7 percent of the total volume of tile from the sites to the east of the fortress. Features relating to manufacture included two signatures, one of which was illegible and the second was a Type 1 (Betts 1985, 192), there was a tegula with an upper cutaway and a second tegula with a Type B lower cutaway (Warry 2006, 4). Two of the tesserae were overfired and might represent wasters, and a third tessera had a scored line presumably to indicate where cutting should take place.

12.1.6 Post-Roman

The road at 36 Aldwark seems to have been repaired in the Anglo-Scandinavian period, after which time a number of pits were dug which contained tenth century pottery (Monaghan 1997, 1075). Further early medieval activity in the area was seen at the Adam's Hydraulics site where there was an Anglo-Scandinavian pit (Finlayson 1997, 777), and at 21-3 Aldwark where the church and burial ground of St Helens was established in the mid-tenth century, and the church continued in use until the mid-sixteenth century when it became redundant (Dawes and Magilton 1980, 17).

Later medieval activity included a well at the County Hospital site and build-up deposits at both 40-48 Monkgate and 2 St Maurice's Road, while the Adams Hydraulics site had a medieval jetty and road (Finlayson 1997, 623, 777, 918). From c. 1177 to 1290 the Jewbury site was used as a Jewish burial ground after which time the site was used for horticulture (Lilley et al. 1994, 309).

Post-medieval and modern deposits on the sites to the east of the fortress included the remains of the eighteenth century hospital at the County Hospital Monkgate site together with a ditch, limekiln, ice pit and burial, while at 2 St Maurice's Road there was a modern cellar and drain, and at the Adams hydraulics site there was a modern industrial building (Finlayson 1997, 623, 777, 918).

A total of 45,417g of tile was recovered from contexts of this date, representing 42.8 percent of the total volume of tile from the sites to the east of the fortress. Two sherds of flue tile had combed keying. A parietalis brick was present, which is an unusual find, and this had finger drawn keying lines. Sherds of Rbrick included one with a dog's paw print, one with a hob-nail boot imprint, and four that were overfired which were possibly wasters. Two imbrices were also overfired wasters. The tegulae included one with an illegible signature, two with Type A2 lower cutaways and two with Type B6 lower cutaways (Warry 2006, 4).

12.2 The tile from the sites to the east of the fortress

A total of 106,036g of Roman tile was examined from the sites to the east of the fortress (Table 111 and Figure 138, with the associated sherd count on Table 112). There was very little tile pre-dating AD 200, implying that the area was little used prior to the third century.

Table 111. Weight in grams by date and form for the sites to the east of the fortress

Date	Overall	Chimney	Flue	Imbrex	Parietalis	Rbrick	Tegula	Tessera
71-120	350					350		
120-200	3510			300		2825	385	
200-280	43290		1980	6325		27035	7825	125
280-410	13469			2025		5100	5300	1044
Post-Roman	45417	100	3255	4005	375	29552	8080	50

Table 112. Sherd count for Table 111

Date	Overall	Chimney	Flue	Imbrex	Parietalis	Rbrick	Tegula	Tessera
71-120	3					3		
120-200	22			2		18	2	
200-280	158		9	28		88	26	7
280-410	107			14		23	16	54
Post-Roman	235	1	5	28	1	161	37	2

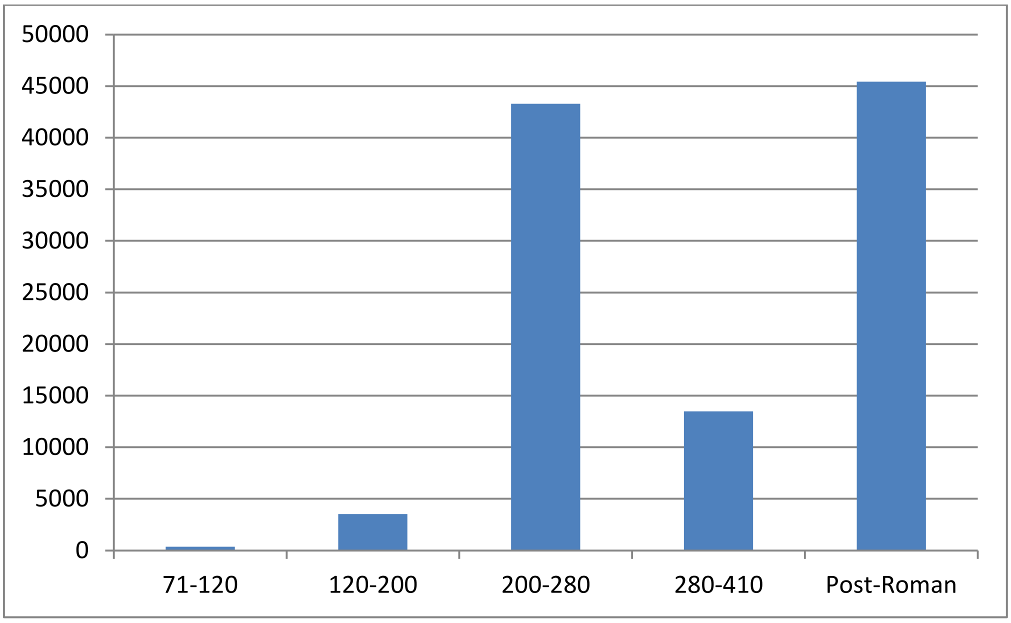


Figure 138. The total weight of tile in grams for each chronological group on the sites to the east of the fortress

The sherd counts were too low to determine if there were any changes in the forms present over time (Table 112), though tesserae were only present in later Roman contexts, and their presence indicates that this part of York was a settlement of some importance in the fourth century.

Most of the surviving length and breadth measurements were on the tesserae which were from two sites, 21-3 Aldwark and 2 St Maurice's Road. Those from St Maurice's Road were slightly larger than those from 21-3 Aldwark (Table 113). The sizes seen are typical for tessellated pavements (Ward 1999, 45). The only other complete surviving length and breadth dimensions occurred on a flue tile, which was 310mm long and 207mm broad; this tile occurred residually in a context of post-Roman date. Although surviving thickness measurements were seen on a number of forms, the sherd counts were low (Table 112). The lack of surviving length and breadth measurements, and low numbers of thickness measurements, on the sites to the east of the fortress, limits any conclusions which can be made regarding chronological changes to dimensions.

Table 113. Tesserae dimensions for sites to the east of the fortress		
	2 St Maurice's Road	21-3 Aldwark
Length range	20-38mm	22-28mm
Breadth range	18-31mm	21-27mm
Thickness range	14-24mm	13-27mm
Average length	26.7mm	25.3mm
Average breadth	23.7mm	21.8mm
Average thickness	18.6mm	17.1mm

Five signatures were present, all on sherds of Rbrick, two were from contexts dating to AD 200-280, which were of Type 5 and Type 8 (Betts 1985, 192), two were from contexts dating to AD 280-410, of which one was illegible and the second was a Type 1 signature (Betts 1985, 192), and a Type 1 signature was present in a post-Roman context (Betts 1985, 192). Five legionary stamps were present on the sites to the east of the fortress, four were from deposits dating to AD 200-280, and one occurred residually in a context of post-Roman date. Two of the stamps were illegible with the remaining three relating to the Legio IX. One of the Legio IX stamps was illegible, while one was a type 2462.9A (Collingwood and Wright 1992, 168-74), and one was of a type not previously recorded. Seven lower cutaways were seen on the tegulae three were Type A2 and four were Type B6 (Warry 2006, 4). Too few stamps, signatures or cutaways were present to determine any links between forms, fabrics or date.

The weight in grams for each fabric in relation to date is given in Table 1114 with the associated sherd count on Table 115. Most of the fabrics seen in York as a whole were present to the east of the fortress, with only fabrics R4, R13, R17, R18 and R19 being absent, but as these fabrics are rare their absence is unsurprising. The sherd counts were too low to enable any analysis of fabric in relation to date, and the same was true for the fabric groups (Tables 116-17)

Table 114. The weight of fabric in grams in relation to date				
Fabric	AD 71-120	AD 120-200	AD 200-280	AD 280-410
R0		1000	1325	665
R1		25	2950	1180
R2			425	499
R3			6725	640
R5		75		
R6		50	100	
R7			700	275
R8			125	
R9	350	1710	24830	3470
R10			2875	3225
R11		650	1335	2795
R12			150	
R14			125	70
R15			575	850
R16			250	150
R99			800	

Table 115a. The sherd count relating to Table 114				
Fabric	AD 71-120	AD 120-200	AD 200-280	AD 280-410
R0		2	6	6
R1		1	17	11
R2			2	
R3			29	
R5		1		
R6		1	2	
R7			3	
R8			1	
R9	3	12	711	
R10			10	23
R11		5	11	31
R12			1	
R14			1	2
R15			2	3
R16			1	1
R99			1	

Table 116. The weight in grams of each fabric group for the sites to the east of the fortress overall in relation to date					
	Group 1	Group 2	Group 3	Group 4	Group 5
AD 71-120			350		
AD 120-200	25		1785		700
AD 200-280	2950	250	34430	975	2560
AD 280-410	1180	150	6985	920	3569

Table 117. Sherd count used for Table 116					
	Group 1	Group 2	Group 3	Group 4	Group 5
AD 71-120			3		
AD 120-200	1		13		6
AD 200-280	17	1	110	5	18
AD 280-410	11	1	47	5	37
Total	29	2	173	10	61

Appendix 13 Various sites to the north-west of the legionary fortress

The sites to the north-west of the legionary fortress yielding tile were all small-scale excavations and it was therefore necessary to examine a group of sites collectively in order to have sufficient tile for analysis. The excavations at 45-57 Gillygate, 26-28 Marygate, 108-110 Bootham and Wentworth House, The Avenue, Clifton were located externally to the north-west of the legionary fortress (Figure 139). These sites yielded 5,712g, 57,705g, 2,485g, and 635g of tile respectively, a combined total of 66,537g of tile. These excavations are summarised in Ottaway (2011, 160-95). It should be noted five other excavations in this area were not examined in detail due to the small quantity of tile recovered (YAT site codes 1997.95, 1996.169, 1996.1066, 2000.4287 and 2000.572).

The area was dominated in the Roman period by the main approach road into the north-eastern gate of the legionary fortress (RCHM 1962, Figure 2 Road 7), with an almost parallel road lying to the south-west that connected to the gate on the south-western side of the fortress (RCHM 1962, Figure 2 Road 5). A connecting road at an oblique angle was also present (RCHM 1962, Figure 2 Road 6). In the past there has been speculation that a military annexe existed on the north-western side of the fortress (RCHM 1962, 45-7), but a recent review concludes that there is little evidence to support this idea (Ottaway 2011, 123). As was common practice in Roman times the roads acted as a focus for burials, which have been found at a number of sites to either side of Road 7 (Ottaway 2011, 124-5). Two Roman camps are also known to have existed at Bootham Stray (Ottaway 2011, 125).

13.1 Summary of the sites to the north-west of the fortress

13.1.1 Pre-Roman

Natural clay was present across the area (Ottaway 2011, 126, 133-4, 140 and 151).

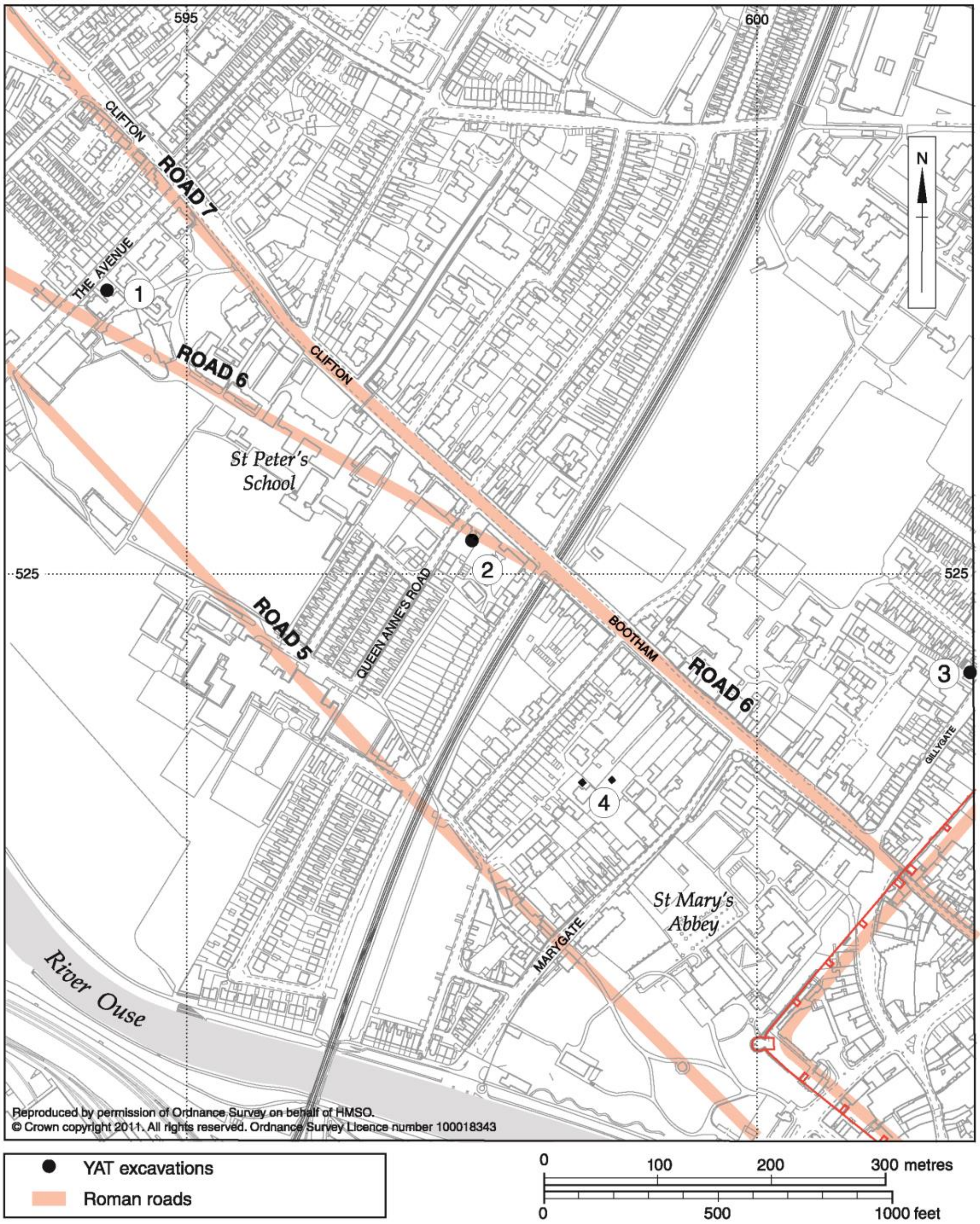


Figure 139. The location of the sites to the north-west of the fortress examined in the present study. 1 = Wentworth House, The Avenue, 2 = 108-110 Bootham, 3 = 45-57 Gillygate, 4 = 26-28 Marygate. (Based on Ottaway 2011 Figure 58, ©YAT, using underlying © Crown Copyright data Ordnance Survey Licence Number 100018343).

13.1.2 AD 71-120

No deposits of this date were present.

13.1.3 AD 120-200

At 45-57 Gillygate the earliest Roman deposits were silts which contained second century pottery (Ottaway 2011, 126). At 26-28 Marygate there were deposits which were truncated by a pit (Ottaway 2011, 133), and of these deposits Contexts 1013-14 and the pit fill Context 1012 contained tile. The remains of Road 6 and an associated ditch were present at 108-110 Bootham, which were dated by pottery to the second century (Ottaway 2011, 140-21). Of these deposits road surface Context 1021 and ditch fill Context 2013 contained tile.

A total of 1,940g of tile was present in contexts of this date that is 2.9 percent of the total volume for the sites examined to the north-west of the fortress. The tile included flue tiles, imbrices, tegulae and Rbrick. Two of the flue tiles had combed keying.

13.1.4 AD 200-280

At 45-57 Gillygate there were a number of features dated by pottery as late second to early third century (Ottaway 2011, 126-31) the earliest of which were a ditch and a shallow cut; ditch backfills Contexts 1084 and 1091 contained tile, as did the fill of the cut Context 1086. Overlying the ditch and cut were deposits, of which Context 1077 contained tile. The site was then truncated by a second ditch which was subsequently infilled. Slumping into the ditch were a deposit of mortar and a deposit of silt, Context 1061, which contained tile. These deposits were then sealed by a spread of sand and cobbles, Context 1053, which incorporated tile. South of this, and unrelated to it, was a band of clay with limestone fragments that may represent the foundations of a building. This was truncated by a series of pits and a slot. Two of the pit fills (Contexts 1066 and 1081) contained tile.

Most of the activity at 26-28 Marygate dated to the third century (Ottaway 2011, 133-8). In Trench 1 there were two deposits Contexts 1010-11, which were cut by a posthole infilled with Context 1008. The posthole was in turn sealed by deposits of clay, Contexts 1004 and 1006. All of these contexts contained tile. In Trench 2 there was a pit sealed by a series of deposits which were rich in building debris such as tile, limestone fragments, sandstone fragments and mortar, and of these Contexts 2014, 2025, 2041, 2047, 2042 and 2044 contained tile. The area was then used for a succession of deposits, small cuts (some of which were interpreted as resulting from the tearing up of bushes or trees), a posthole, and three burials. Of these Contexts 2003, 2010, 2012, 2015, 2020-24, 2026, 2028 and 2032 contained tile.

The bulk of the tile from the sites examined to the north-west of the fortress (57,467g or 86.4 percent of the total) was from deposits dated to the third century. The tile included flue tiles, imbrices, pipes, tegulae, Rbrick and a sherd of voussoir. The pipes represent a comparatively rare form, while the voussoir is exceptionally rare. Features of note relating to manufacture were rain marks on the upper surface of an imbrex and a tegula, and a dog's paw print on the upper surface of an Rbrick sherd. Five signatures were present, there was a possible batch mark, an illegible legionary stamp, and a stamp relating to the Legio VI of type 2460.51 (Collingwood and Wright 1992, 158). Tegulae were present with lower cutaway forms A2, B6 (four examples), and two examples of Type C5 (Warry 2006, 4), with eight examples of upper cutaways present. Two sherds were overfired, one a tegula and one an Rbrick.

13.1.5 AD 280-410

At Wentworth House there was a ditch overlain by a build-up of silt, Context 125, which contained tile (Ottaway 2011, 151). While the silt was accumulating the site was used as a burial ground, with at least twenty burials present, the cemetery was dated by a coin to the mid-fourth century (Ottaway 2011, 151). Contexts 102, 109, 111, 113, 124, 133, 135, 143 and 146 within the cemetery contained tile.

Contexts dating to AD 240-410 yielded 635g of tile, representing 1 percent of the total volume for the sites examined to the north-west of the fortress. The tile was all Rbrick, and the only feature of note was that one sherd had finger prints on the upper surface.

13.1.6 Post-Roman

At 45-57 Gillygate there was a medieval demolition dump, pit and drain, together with the remains of a modern building, hearth, drain and air raid shelter (Finlayson 1997, 375). At 108-110 Bootham the Roman deposits were sealed by build-ups of horticultural type soil, which were in turn truncated by modern services (McComish

2003). At Wentworth House and 26-28 Marygate all the post-Roman levels were removed by machine (Ottaway 2011, 139 and 150).

The post-Roman deposits yielded 6,495g of tile, representing 9.8 percent of the total volume from the sites examined to the north-west of the fortress. The tile comprised flue tiles, tegulae, imbrices and Rbrick. Very few features of note were present, two of the flue tiles had combed keying, and there was also a tegula with a lower cutaway, but this was too damaged to determine the original form.

13.2 The tile from the sites to the north-west of the fortress

There was no tile in deposits dating to AD 71-120, and very little dating to AD 120-200, implying that the area was little used prior to the third century. Activity clearly peaked in the third century trailing off rapidly thereafter (Table 118 and Figure 140, with the associated sherd count on Table 119). The lack of post-Roman deposits is due to the excavation methodology at two of the sites, whereby all post-Roman deposits were removed by machine. The sherd count was too low to enable any comparison of the variations in the forms present over time.

Table 118. Weight in grams by date and form for the sites to the north-west of the fortress

	Overall	Flue	Imbrex	Pipe	Rbrick	Tegula	Voussoir
AD 120-200	1940	125	255		1085	475	
AD 200-280	57467	180	11285	100	26327	19450	125
AD 280-410	635				635		
Post-Roman	6495	525	475		4145	1350	

Table 119. Sherd count used for Table 118

	Overall	Flue	Imbrex	Pipe	Rbrick	Tegula	Voussoir
AD 120-200	22	2	2		15	3	
AD 200-280	254	2	70	2	120	59	1
AD 280-410	23				23		
Post-Roman	40	3	7		25	5	

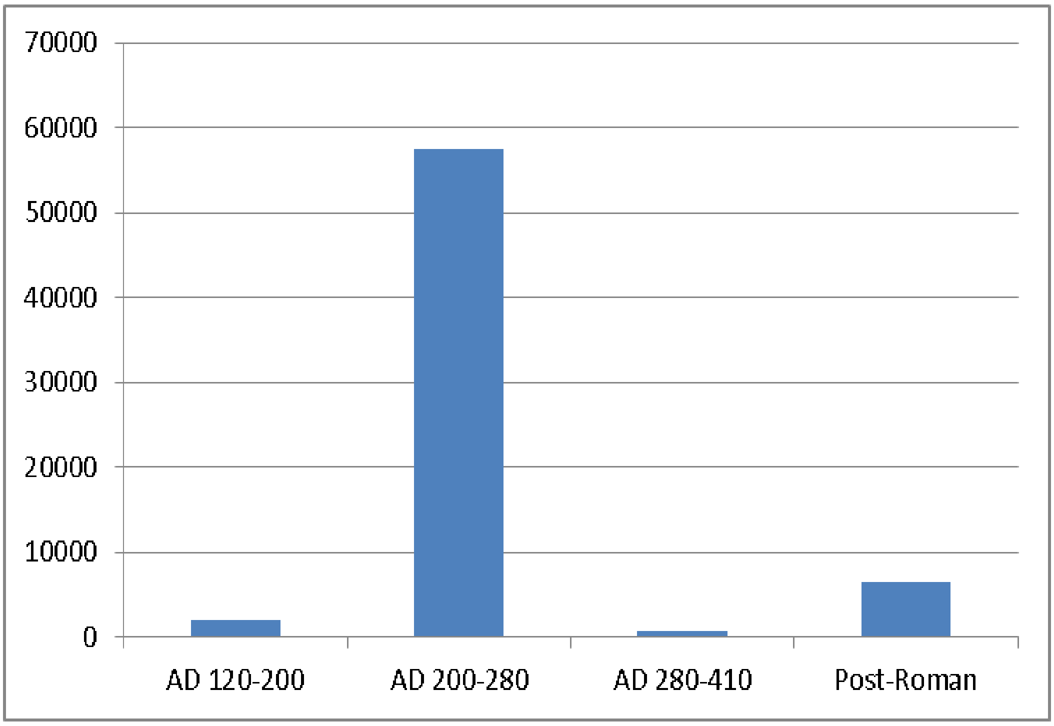


Figure 140. The total weight of tile in grams for each chronological group on the sites to the north-west of the fortress

No complete length or breadth dimensions were present for any of the forms. Although thickness measurements were present on sixty-eight imbrices and forty-four tegulae dating to AD 200-280, there were insufficient examples in the other chronological groups to enable any analysis of changes to thickness over time.

Only one legible legionary stamp was present, this related to the Legio VI and was of type 2460.51 (Collingwood and Wright 1992, 158), and occurred in a context dating to AD 200-280. Five signatures were present, of which three were illegible and two were a design not noted by Betts (1985, 192-4). The number of legionary stamps and signatures present was insufficient to determine any variations over time, or in relation to fabric.

Only seven lower cutaways were present, one Type A2 cutaway, four Type B6 cutaways, and two Type C5 cutaways (for cutaway types see Warry 2006, 6), all of which were in contexts dating to AD 200-280. The numbers were too low to determine any changes to cutaway forms over time.

The weight in grams for each fabric in relation to date is given in Table 120 with the associated sherd count on Table 121. Most of the fabrics seen in York as a whole were present on the sites to the north-west of the fortress with only fabrics R4, R5, R13, R17-R19 and R99 being absent, but each of these fabrics is rare so the absence is unsurprising. The sherd count for the individual fabrics was too low to enable a comparison of fabric to date and the same was true for fabric groups (Tables 122-3).

Table 120. The fabric weight as a percentage of each chronological group, of the tile on the sites to the north-west of the fortress			
Fabric	AD 120-200	AD 200-280	AD 280-410
R0	1	7	1
R1	3	23	2
R2		1	5
R3		24	3
R6		23	1
R7		4	
R8	1		1
R9	7	82	3
R10	1	61	
R11	8	18	2
R12	1		
R14		2	1
R15		9	
R16			1

Table 121. The sherd count for Table 120			
Fabric	AD 120-200	AD 200-280	AD 280-410
R0	1	7	1
R1	3	23	2
R2		1	5
R3		24	3
R6		23	1
R7		4	
R8	1		1
R9	7	82	3
R10	1	61	
R11	8	18	2
R12	1		
R14		2	1
R15		9	
R16			1

Table 122. The weight in grams of each fabric group for the sites to the north-west of the fortress overall in relation to date					
	Group 1	Group 2	Group 3	Group 4	Group 5
AD 120-200	195		640	200	780
AD 200-280	5612		35570	2400	13200
AD 280-410	150	50	200	100	85

Table 123. The sherd count for Table 122					
	Group 1	Group 2	Group 3	Group 4	Group 5
AD 120-200	3		8	2	8
AD 200-280	23		167	11	46
AD 280-410	2	1	3	2	8
Total	28	1	179	15	62

Glossary

IADB Integrated Archaeological Database (YAT's internal computer system)

Rbrick An abbreviation of Roman brick, used for sherds of indeterminate form

RCHM Royal Commission on Historic Monuments

UOY University of York

YAT York Archaeological Trust

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