THE TRADING AND CONSUMPTION OF ROMAN GLASS IN BRITAIN

50 BCE – 500 CE

By

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Abstract

The Romans traded and consumed more glass than any other previous civilisation. From 50 BCE, the glass industry expanded across the empire using safe trade routes and was introduced to Roman Britain c. 43 CE. At this time with the introduction of new glassblowing technology which widened the range of drinking vessels, tableware, and containers, glass had changed from luxury objects to include also common domestic products.

One of the unique characteristics of glass is that it can survive in the ground for long periods and, like pottery, it can be a valuable source of archaeological data. For this research, a database of dated Roman glass fragmentary finds has been designed, created, and then populated with the data of glass characteristics from selected excavation site reports of Romano-British cities, rural settlements, towns as industrial settlements, and military bases. Selected datasets of glass on sites and across the region have been analysed for patterns of glass types and characteristics that can reveal socio-economic and trade trends over time and geography.

This study of glass distribution across Roman Britain has shown that large cities and military fortresses that were important to the economy had also similar broad ranges of glass types and forms. This is an indication that they were significant trading centres. There are differences in the composition of the glass types on sites that reflect different material cultures. The glass compositions on the industrial settlement and rural farming sites varied largely due to their proximity to large cities. The distribution patterns of glass across Roman Britain have revealed fresh insights into the dynamics of trade and transport routes into and within Roman Britain.

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1 INTRODUCTION

> ‘I should like to show Posidonius some glassblower who, by his breath, molds the glass into many shapes which scarcely could be fashioned by the most skilful hand’

(Seneca, *Moral Letters to Lucilium* XC.3I in (Fleming, 1999, p. 37))

1.1 The Research Aims

The Romans traded and consumed more glass than any other previous civilisation. They invented glassblowing, which was the most significant innovation in manufacturing technology since the introduction of core-formed glass objects some 1500 years earlier. With the spread of the Roman Empire, the glass industry rapidly expanded using safe trade routes. The major regions of glass production were the Phoenicio-Syrian Coastline from 63 BCE and Egypt from 30 BCE. Over this period, glass rapidly changed from being luxury objects to include also common domestic products just at the same time that the new glassblowing technology was introduced into the industry. The transparency, impermeability and durability were intrinsic qualities of glass that quickly made it a preferred substance for tableware, windows, storage, preservation, and distribution of products (Grose, 1977, pp. 9–10).

More than any other material, glass can survive for long periods in the ground. It can be a valuable source of dateable archaeological data as it existed in many product forms and can reveal cultural insights at all levels of ancient societies through analysing, characterising, and interpreting artefacts (Price and Cottam, 1998; Fleming, 1999; Shepherd and Wardle, 2009).

Glass vessels were also seen as luxury goods with associations with power and status and therefore relevant to the assessment of the socio-economic circumstances (Koster, 2006, pp. 48–52; Morley, 2007c, pp. 39–54).

The study scope was based on glass class vessel groups because of their value to communities in social lifestyle situations and their role as traded goods compared to other materials offering similar uses (e.g. metal and pottery). Other glass class groups include construction glass such as windows and tiles, utensils such as stirring rods, and personal objects such as gaming counters and jewellery. These are discussed where they can add additional context (Erdkamp *et al*., 2020, pp. 1–36).

The aims of this research are to gain insights into the capability of the glass industry when to make, move and trade glass products and to better understand the socio-economics of Roman Britain that drove the glass trade from 50 BCE to 500 CE. This study used typological and epigraphical evidence to investigate the patterns of the movement of glass into and within Roman Britain from manufacturing sites across a network that spanned the Roman Empire over the period 50 BCE to 500 CE. The following research questions and objectives were developed associated with these aims.

1.2 Research Objectives

The objectives included analysing the fragmentary glass evidence of the profiles of glass vessel compositions on sites and of the distribution of glass vessels across Roman Britain regions.

The research objectives were to:

1. Carryout comparative proportional analyses of the compositions of the sites' glass
2. Analyse the glass types and the sites' contexts
3. Assess the association of glass types across the civil and military sites
4. Carryout comparative proportional analyses of the regional distribution of glass
5. Assess the distribution of glass to military and city sites
6. Investigate the production of glass from glass working centres

Objectives 1-3 are related to profiles of glass on sites in Roman Britain that could define the types of settlements as urban or rural, civil or military and the patterns of glass that can be associated with the material cultures of these communities together with an understanding of the economic, social, and trading models in Roman Britain from glass.

Three analysis techniques were used to reveal patterns that could reflect trade and social models for settlement sites. The first technique was to perform comparative proportional qualitative analysis of glass vessel types as site profiles that could define the patterns of glass types on sites. The second technique was to interpret statistical associations of glass types with site types through using correspondence analysis. The third technique used was a ranking system of site scores developed for this study to compare sites and based on the presence of glass forms.

Objectives 4-6 are directed towards revealing patterns of distribution across regional Roman Britain. Analyses of the Romano-British corpus were used to confirm the regional proportional vessel distributions which could be relevant to understanding the Roman economy and trade.

This included the likely trade routes for the transportation of heavy bulky goods between sites using roads, rivers, and sea. Patterns of distribution could also reveal possible trade routes to military sites and to large cities and material movements into and within Roman Britain. Finally, the study investigated the glass types produced in Roman Britain, the locations of known glass-working centres in Britain and the trade and transport scenarios related to the distribution patterns across the regions.

1.3 The Research Questions

In the modern world, the use of technologies provides near real-time visibility of the market demand for products, the movement of goods over long distances in relatively short timeframes, and the conversion of currency and use of world-wide finance systems. My proposition was that the Romans were no less ingenious than we are today. However, they operated within the constraints of those times without modern technology but still innovated to overcome those challenges. This research lifted the cover on such ancient practices by researching the end-to-end global supply chain management of glass.

This research addressed questions related to the socio-economics and material cultures associated with the communities on Romano-British settlements and the ability of the traders and producers to meet a market demand for glass. The focus was on two groups of questions.

The first group of questions were concerned with the glass fragmentary evidence on each of the settlement sites. These questions were essentially related to the proportional compositions of glass vessel fragments on settlement sites that could be assumed to represent the original population of glass vessels. The analysis of the patterns of glass vessel assemblages on settlement sites provided insights into the material cultures of the ancient communities and indications of the economic prosperity of settlement site types. The questions posed were the following:

1. What are the analytic profiles of glass that can indicate a characteristic profile of a settlement type?
2. Are we able to distinguish between a military and civil settlement?
3. How was glass used on the settlements and what can the materials tell us about the drinking, eating and storage cultures?
4. Can glass provide an indication of the cultures of the settlement communities?
5. How did Continental glass supply drive demand in Roman Britain?
6. What can glass tell us about the economic, social and supply models in Roman Britain?

The second group of research questions explored the production, movement and trade of glass into and within Roman Britain. They focussed on the role of glass manufacturing and the supply of glass vessels in Roman Britain which provides a better understanding of the trading and transport mechanisms that could have been in place. The questions were the following:

7. What was the distribution of glass in Roman Britain?
8. What can that tell us about the movement of glass into and around Roman Britain?
9. What was the role of glass manufacturing in Roman Britain and on the Continent?
10. How was glass transported on the Continent?

11. What could have been the relationships between the glass workshops in Germany, France and Roman Britain?

1.4 Research Approach

The research approach was based on addressing the aims, the objectives and the research questions. The purpose of the literature review was to establish the current academic body of knowledge of the topics relevant to this research, including any gaps in knowledge that could have implications for this study. The topics covered in Chapter 2 ‘The Current Knowledge of the Markets for Glass Vessels and the Roman Glass Industry’ include a review of the Roman economy and trade, the value of glass in the Roman world, the consumer demand for glass products with the background to the glass-working industry, the trade in Roman glass and the historical context of Roman Britain.

The principles of using the material record for analysis are set out in Chapter 3 ‘Methodology’. Compiling the study data included the collection and collation of glass vessel accession line data from the excavation reports of the sites selected for the study. The methodology encompassed defining the typology that would be used to organise the glass fragmentary data. This was completed as finds were collated from the excavation reports that usually included the narrative of the observations and inferences from the finds plus the catalogued accession line details of the fragmentary finds. The availability and access to archaeological glass data was a significant factor when selecting sites and this is discussed in this chapter. The methodology also included the means to capture relevant aspects of the taphonomy of the fragment evidence as the deposition context and the dating details. The relevance of the use of qualitative and quantitative techniques, comparative proportional analysis and multi-component statistical correspondence analysis techniques are covered in this chapter. Finally, the principles of the data model, the database design and managing the database are set out with the details for the site profile model and the distribution model.

The practicalities arising from matching the material data to the archaeological context are set out in Chapter 4 ‘The Presentation and Assessment of Data for Analysis’. The requirement for this study was to be able to confirm that the quality and quantity of the glass from the sites’ assemblages was sufficient for analysis. It was also necessary to be able to confirm the relevance of the sites’ glass data to the study through matching the archaeological deposition and dating information to the glass finds. This was used to analyse the origins of the finds and assess the potential root causes of any data bias from matching the glass data with the archaeological contexts. The data associated with each of the sites was evaluated and is presented as a tour of the military sites, starting with London, and then describing the forts and fortresses in order of Wales and the Marches, Lancashire and Yorkshire, Cumbria and Northumberland, Hadrian’s Wall and finally Scotland. This is both a geographical and chronological tour following the occupation of Britain northwards. This section is followed by the presentation of the data from town industrial settlement and rural farming settlement sites, large cities and finally sites representing shrines and temples. The next three sections in this chapter detail the glass vessel characteristics, dimensional data and the overall study Romano-British corpus. These sections position the relevance of the data for the analysis in Chapter 5 as the ‘Characteristics of Sites Glass Profiles’ and Chapter 6 ‘The Trade and Distribution of Glass’.

Chapter 5 addresses the research questions 1-6. The approach was to first establish the site glass profile for Colchester, as the largest selected settlement site, by analysing the separate city internal sites as well as the city overall. This included defining the sites' chronological profiles for the periods pre-Boudican and post-Boudican. These analyses were then applied to the other large city, fortress, town and industrial settlement, rural and military fort sites using comparative proportional analysis and correspondence analysis. A site scoring model developed to qualitatively rank sites based on the inventory of glass types is described in this chapter. The analyses of the civil and military sites' glass evidence and associated archaeological contexts were compared for patterns that could suggest socio-economic differences. The analysis of the shrines and burial sites with a summary concludes this chapter.

Chapter 6 'The Trade and Distribution of Glass' addresses the research questions 7-11, through the analysis of the distribution of the glass evidence across Roman Britain. The chapter sections include interpreting the overall distribution of glass to establish how far vessel types travelled and for any patterns associated with a proximity to road, river or sea access and including historical contexts. The trade in particular vessel types such as drinking vessels and bowls, and large container bottles was then assessed. The relevance of glass manufacturing and distribution was assessed through an analysis of glass production in Roman Britain, in detail for London, and comparisons with Aix-en-Provence in the Roman province of *Gallia Narbonensis* in the south of France (McGowen, 2014). The evidence related to the production of large glass bottles, transport networks and trading interconnectivity are discussed. These sections finally are brought together as a discussion of the trading models for Roman Britain and the role of the military supply organisation.

The final Chapter 7 ‘Conclusions’ returns to the aims, and the research questions with a review of the contributions from this research to the body of knowledge of the Roman economy, the social and material cultures in Roman Britain, with insights of the trade, distribution, glass production and transport systems based on the study of glass. This chapter includes a section that sets out the learnings from this research including that for data management that is such a cornerstone of this study. Finally, the chapter has concluding statements with further research opportunities identified.

2 THE CURRENT KNOWLEDGE OF THE MARKETS FOR GLASS VESSELS AND THE ROMAN GLASS INDUSTRY

The aim of this literature review was to establish the current state of knowledge of the broader questions: What was the economic basis of industry in the Roman period and how did the wider economy function? What were the factors influencing demand? How was trade conducted? What do we know of glass production and how was it organised?

The approach was to first review the Roman economy to establish the importance of wealth and agriculture on trade, with the influence of events, societal norms, and culture on the consumption of goods and the impact of manufacturing in Roman times. By identifying the key assumptions underpinning the models of the Roman economy that influenced trade, it may be possible to utilise the archaeology of glass as evidence of the demand, and the supply of glass as a way to respond to the questions.

The following literature review includes the academic knowledge associated with the Roman economy and trade, the consumer markets for glass, glass manufacturing and the trade in Roman glass. These are presented as a general academic context of glass vessels, consumers of glass, and the glass industry trade across the Roman Empire. The final part is of this review includes the Roman influence in the socio-economics in Britain following the invasion in the mid 1st century CE and for the following four hundred years. The invasion was the trigger to introduce glass vessels into Britain and as such offers a unique opportunity to explore how the trading practices across the empire were extended into Britain, and how the changes from Roman occupation influenced society and trade.

A summary of the key hypotheses and issues that have been raised is finally presented which outlines the research areas of this study, together with the methodology, presentation of the core data, analyses, and conclusions.

2.1 Roman Economy and Trade

There are two main competing theories of the functioning of the Roman economy. The so-called modernist approaches of Mikhail Ivanovich Rostovtzeff and his peers, compared the economy and peoples of the ancient world with the modern world (Rostovtzeff, 1928). In his book, the *Social and Economic History of the Roman Empire*, Rostovtzeff applied capitalist principles of profit to Roman society that included the commerce of credit, loans, industry, combined with an assumption of social evolution and urban development. He considered that these resulted in an unprecedented development of commerce, industry, agriculture, and the growth of capital in the cities. Rostovtzeff proposed that a prosperous merchant and industrialist class existed between the working *proletariat* and the *bourgeoisie* upper class. The apparent lack of innovation of technology in Roman times was due to wealth not generally being invested in industry, that slave labour did not offer any real incentive to improve their situation and that the standard of living was generally low. This was considered a major work of the time.

Frederick West (West, 1932) picked up the capitalist themes in his paper *The Collapse of the Roman Economy* and postulated the causes of the early centuries economic growth were from an expanded empire, a government that collected taxes but was not involved in business, increased security with the seas cleared of pirates, the discovery of new gold fields, and the unity of language, coinage, and law. Industrial activity had developed through increasing specialisation of work in the cities and the growth of industrial activities in the country, including brick works, potteries, weaving and glass. With wars in the late 3rd century and the debasement of the currency that adversely impacted commerce, he suggested trade withdrew to just the local supply of local markets, with local production supplying local needs for agricultural products and a decrease in the interchange of manufactured products exacerbated by political events and changes in social conditions. This work is similar to Rostovtzeff's generalised concepts of capitalism without considering any limitations to trade driven by profit motives, although social aspects were recognised.

In contrast, Moses Finley (1985) wrote *The Ancient Economy* and argued that the primitivist agrarian Roman economy had little surplus, was not a large market for trade, nor was it a capitalist society. He argued that it was not driven by merchants and industrialists but landowners who exploited their land for wealth for themselves. With no evidence of technology innovation, it would have been difficult to generate a surplus from agriculture and mining to create any urban manufacture and trade. His views were based on a society with a single political unit and a common cultural framework, where wealth was created not for profit but for status and just for the privileged classes. Whereas Rostovtzeff noted a general population having a 'low standard of living', Finley considered most of the population lived barely above a minimum subsistence level and instead of a market for trade, ancient society was an enormous conglomeration of local independent markets. As major population centres on the perimeter of the Mediterranean Sea were agriculturally and environmentally similar, he argued there was little intra-regional demand as everywhere had the same main products of grain, wine and olive oil. With the expansion into the western and north-western provinces the socio-economics changed, but as ancient cities had farmers at the core of its citizens, with an insufficient agricultural base they would have had a mixed economy of agrarian, manufacturing and crafts in order to be self-sufficient with any trade to the benefit of the landowners (Finley, 1985, p. 205).

This is the primitivist view of the Roman economy and trade. It counters the Rostovtzeff and West perspective of private industry, based fundamentally on the fact that the Roman economy was mainly agrarian, not able to create a sufficient surplus for inter-regional trade and economic growth, with the structure of society based on positions of different status of privileges, rights, and duties that did not allow or encourage change and innovation. The ancient city became a centre of consumption not of production. This was then an empire of city states as autocracies, with the governing state having absolute authority, providing decisions were held valid by a legitimate authority. The debate, therefore, could be seen as an agrarian state economy versus a capitalist economy of private enterprise.

The economic historian Polanyi (Polanyi, 1977) also argued against a competitive market profit view of the Roman economy and that the purpose of the economy was to fulfil the material needs of society through the institutions of society and through the activities to acquire the materials it needed to survive. He called this the 'integration of the human economy' with activities to acquire materials termed reciprocity, redistribution and exchange (Polanyi, 1977, pp. 35–37). In simple terms, reciprocity is the transfer of materials for an agreed equivalent material value, redistribution is for a recognised authority to collect and distribute materials, and exchange is to acquire materials by barter or cash. These terms have been used frequently in other studies from Peacock and Williams for the trade in amphorae (D. P. S. Peacock and Williams, 1986, p. 35) to the study of transactions at Vindolanda (Grønlund Evers, 2011). This concept of integration is important as it allows for cash-less transfers of materials and economising as ‘the maximal adaption of scarce means to the achievement of graded ends’ (Polanyi, 1977).

While Polanyi’s view was that the ancient world was one of private ownership, product markets and the economic functions of society were relevant but were not sufficiently defined to describe how the ancient society functioned. Hopkins broadly accepted the hypotheses of Finley, but modified some assumptions based on an analysis of the quantitative estimates of the volumes, value and costs of trade to develop a ‘Rough Model’ of the economy (Hopkins, 1980). He assumed that one of the main stimuli to inter-urban trade was taxation, which created a necessity within each town to make a surplus. He disagreed with Finley that all peasants lived at the minimum level of subsistence but that small overproduction at an individual level created a significant surplus to create trade. Hopkins recognised a proportion of the taxes and rents would have been paid in kind, probably delivered as grain, but that this would have been local short-haul supply. There was uncertainty as to whether the Roman authorities supplied food for soldiers at fixed prices or on the open market or if it was redistributed as there is evidence that all mechanisms were possible.

Hopkins introduced three main hypotheses. Firstly, that the large cities of Rome, Alexandria, Antioch and Carthage were high-cost zones within the economy. The population of Rome was supported with state subsidies, but the other large cities did earn money to pay for imported food as they were all too large to be supplied from locally produced surpluses. These large cities were on or near the sea, traded food such as grain, oil, wine and so required a transport infrastructure, systems for shipping, fiscal credit, contracts, with goods handling and storage facilities that could have been used for the inter-regional trade. Secondly, towns had the capacity to produce and export goods for sale and import goods from other towns, as staples, non-staples and other goods including craft products, such as glass. He argued that the bulk of Roman staples moved between towns because of regional fluctuations in crops and harvest sizes and modelled possible scenarios with significant trade movements for transfers of goods to meet unplanned needs. Thirdly, large cities would have been important for the money flows through a complex network of trade, with towns as intermediate nodes. Local trade had the greatest proportion of all transport, that fed into medium-range and inter-regional trade and vice versa. The model of the trading network revealed considerable movements, costs and would have involved merchants to manage the trade and the upper classes to provide the finance for the inter-regional trade. This analysis and modelling by Hopkins modified the hypotheses of Finley (1985) in proposing that when considering the populations as a whole, small local variations can result in significant differences to the Roman economy, in the areas of urban trade and land utilisation with a surplus from agriculture as the main economic driver.

Further sources of academic research have been reviewed that either support or counter the modified Hopkins' hypotheses. Duncan-Jones (1990) challenged the Hopkins model with regard to the tax generation surplus from the provincials. He argued that from coin-populations there would have been a variance in their ability to pay tax across the provinces. This disparity in wealth in the provinces, cities and urban centres would have been another stimulus for trade and so the model was not dependent only on tax as a fiscal stimulus. He also proposed that large urban centres also generated significant levels of demand for metals, timber, building-stone and slaves, which if not met locally would be met by imports. Van Minnen (2000) modelled the economy and proposed that the volume of trade was possibly more than that necessary to meet tax obligations and that a trade-profit motive was the driver. The hypotheses adopted for this research is that large cities were important for money flows as centres of demand but not necessarily as centres of production, and that towns would have been trading nodes in a Romano-British network.

Nevertheless, there were further important questions relevant to shipping, the trading organisations particularly for long distance trade and the inter-connectivity between economic regions. Mediterranean trade had already been vigorous for centuries, or even millennia and so the expansion in trade was not necessarily a response to new fiscal stimuli. The Hopkins (2017a) analysis indicated the potential for significant sea trade and the huge costs to both build and operate shipping across the Mediterranean. An earlier academic study by Casson (1971) detailed the discoveries in ships and sailing in Roman times, including the Isis, one of the large grain ships used on the Alexandria-Rome run in 2nd century CE, that was comparable to a Venetian man of war of the 16th century CE and with an estimated displacement of 1,228 tonnes (Casson, 1971). This was a huge vessel for those times, with most Roman grain ships in the range 300-500 tonnes displacement based on studies of wrecks found in the Mediterranean. Greene (1986) found that the ship building techniques changed in the Roman era from shell-first to a skeleton construction with better strength and increased maintainability (Greene, 1986, p. 23). According to Greene, this would have necessitated a scale of organisation of the shipyards rather than the ability of the shipbuilders. As a consequence of larger ships, artificial harbour-works were needed, constructed with Roman concrete that set underwater and that are still visible today, with also river transport an integral part of trade and communications (Greene, 1986, pp. 29–34). In contrast, transport by road was limited in load-carrying capacity and higher costs, but the extent of rural settlements ‘implies active and effective local transport systems' (Greene, 1986, p. 42). The evidence from shipwrecks does provide indications of long-distance movements of materials and goods that would not have been expected from local inter-town trade in a self-sufficient minimum subsistence economy (Finley, 1985, pp. 132–3). Greene (2000) concluded that Finley underestimated the spread of technological improvements that were opportunities for technology transfer by the Romans. An important hypothesis is that river / sea trade across the Mediterranean would have been important to Britain for the Iron Age and into the Roman era, given transport by road would have had load capacity constraints and higher costs (Greene, 1986; Allen and Fulford, 1996; Davis, M., Freestone, 2018).

Finley (1985) considered the Roman *collegia* ('associations') played an important part in social and religious life of the lower classes but that they never became regulatory agencies in respect of trade. Cooley corroborated this view with epigraphic evidence of community associations (Cooley, 2012, pp. 21–22). In contrast, Rathbone (2007) describes shippers under regular contract to supply grain for the state to Rome, that were allowed to form *collegia* ('associations') for main routes to which 'the state granted a corporate legal entity (*corpus*), apparently to aid its own management of them' (Rathbone, 2007, p. 311). This would have been true for grain supply as a special case as this was critical to the state for shipments from Alexandria to Rome. However, glass and other products would have attracted less state interest other than for tax and duties and there could have been commercial opportunities for goods to return to Alexandria and the east (Rathbone, 2007). Rathbone noted that while most of the epigraphic evidence of these associations publicised the social aspects, there is other evidence that some trade associations members had contractual as well as social connections and that these were merchant trading networks for maritime commerce (Rathbone, 2007, p. 314). These trading network roles could have facilitated the business of shippers and merchants that included agents of the state as tax collectors, private individuals, freedmen and slaves. That such institutions were developed and supported by the state was advanced by Morley (2007b, 2007c) who argued that they had the greatest ability to establish, regulate and enforce, and were also vital for the development of complex, impersonal exchange and regular connectivity (Morley, 2007a, pp. 59–60, 2007b). Indeed, Morley considered the largest consumers of resources were the state and community institutions, particularly for large cities and towns, and that this consumption would have required the assistance of private shipowners and distribution systems. Paterson argued that traders, merchants and entrepreneurs were not marginal but at the heart of a system to provide for the needs of the consumers and the state (Paterson, 1998b). The role of institutions in Roman Britain related to the glass industry has noted two elements, namely the institutions related to the establishment of the glass-working industry and the institutional role of the state regarding the funding and control of the military supply of materials.

Bowman and Wilson (2009) proposed that a network of economic institutions or patterns of integrated behaviours would be the equivalent of a Roman economic policy (Bowman and Wilson, 2009, p. 13). This connection to money supply was illustrated with evidence of credit, loans and institutions that would have enabled material economic movements, including banking (Bowman and Wilson, 2009, p. 14). Peter Temin (2006) provided evidence that loans were used to finance trade in Rome with insurance also available to be purchased by shippers (Temin, 2006, p. 144). Using the Muziris papyrus as an example, Temin proposed these mechanisms introduced the possibility of nominal charges for sea transport for small loads as supplements to the main cargoes. If this was a normal business practice, a shipowner might have calculated his costs, considering the investment in his boat, the cost of upkeep and the likely risk, while perhaps subsidising his voyages by also transporting the goods of others. Bowman and Wilson (2009) also considered the economic integration of Roman industry would be an indicator of the maturity of the supply chain operation and presented cases in the textile industry of vertical integration of the cloth dying weaving manufacturing processes, and horizontal integration across industries between food producer and amphorae manufacturing (Bowman and Wilson, 2009, p. 17). They regarded strong institutional frameworks were fundamental to economic growth at the peak of the empire and would impact economic decline if weakened. They considered that the state was a major stakeholder in both scenarios, even if not directly active in economic activities. The debate around the extent and nature of economic growth achieved in antiquity reinforced the principles related to performance and structure included in the New Institutional Economics (NIE) promoted in *The Cambridge Economic History of the Greco-Roman World* (Scheidel *et al*., 2007). Performance referred to the economic outputs and structure included the characteristics of society that determine performance and was defined as the political and economic institutions, technology, demography, and ideology of a society. Bowman and Wilson (2009) while not disagreeing, also included the markets as a significant economic institution that is not in the NIE.

These studies all reasserted that the social aspects of institutions were important, along with connections for commercial trading that involved state, private and community stakeholders. The counter argument is that the evidence potentially illustrates the exceptions, or 'the argument of silence and its twin, the generalisation from insufficient data' (Finley, 1985, p. 195). Finley challenged the modifications to the primitivist model, noting that 'the mere presence of trade over long distances is of course a condition for interdependence, but it is not a sufficient condition' and 'economic interdependence requires something more (qualitatively) than what we are able to discern in this particular field' (Finley, 1985, pp. 177–178). To what extent was trade fully integrated across the whole network or was it 'a system of interconnected sub-economies?' (Wilson, 2009, p. 17). While the trade could have been fully integrated in the Mediterranean provinces, it was more likely to have been interconnected through sub-economies driven by large trading centres.

Wilson and Bowman (2009) proposed that the economy would have developed from what they termed "pre-capitalist and capitalist features". 'Pre-capitalist' would apply to areas that were eventually to come under Roman control and the consideration is whether that change transformed the economics of the areas. They considered a condition of integration would be based on the structure of the markets, where the rationale of supply and demand needs to be separated from controlled requisitions for military or other state purchases. Tchernia in *The Romans and Trade* discusses the role of the state in trade suggesting that participation in the long-distance trade of consumer goods was relatively restricted, as the government rarely intervened in distribution (Tchernia, 2016b). However, it is important not to underplay the role of the state. The state did supply Rome and the army's service corps and funded the army and collecting taxes. State cargoes were exempt from the *portoria*, a 5% tax between provinces, and this exemption would have included grain cargoes and perhaps also subsidised olive oil import to Rome (Wilson, 2009, p. 5). Having glass as additional cargo with what was being officially shipped could have been a way to ship glass as a low value commodity, possibly as ballast like pottery, and still make a profit. The relatively restricted role of the state in controlling the military would have been critical to the long-distance supply and trade of consumer goods following the invasion of Britain and for the remainder of the 1st century as the occupation progressed north.

The role of the landowners and traders in the use of capital in the Roman economy was discussed by Tchernia (2016b), who considered landowners were able to exploit their estates for non-agricultural ventures and were able to profit from the commercial enterprises they financed, often by heavily taxing these ventures through 'high interest rates on loans, thus avoiding the risks and constraints associated with such activities' (Tchernia, 2016b, p. 1).

Landowners were recognised as respectable in Roman society, even landowner-traders that sold their own produce, whereas traders and manufacturers were not (Tchernia, 2016b, p. 10). The wealth acquired by landowners was conducted through intermediaries, including slaves, with evidence of legal organisations established (Tchernia, 2016b, p. 19). Traders and merchants were a diverse group that actively engaged in the trading activities, took risks, promoted trade and some made fortunes from the unity of the Empire. These could have been the trading entrepreneurs of the Roman world, but without political power unlike the landowners and traders could be regarded negatively in Roman society (D'Arms, 1981). Tchernia proposed that there was a spectrum of trading roles from the small traders who carried goods across the region to the merchant-traders of larger ventures that involved the transport of goods over long distances. For shipping there were traders that were shipowners, traders relying on ships owned by other people, or ship-owning traders. These views regarding landowners were relevant to the Mediterranean regions but may not have applied particularly in the early decades of Roman occupation with the influx of military, colonists, and traders. The expansion of trading networks into the Continent could be explained through the 'Roman bazaar' model that was based on local traders initially imitating imports before then becoming self-sufficient (Bang, 2008). Bang argued that the 'Roman bazaar' was based on poor information, low standardisation and disconnected organisations that could define Roman trading (2008, pp. 197, 198). Any relationships between landowners and traders may then be revealed through insights of the prosperity of rural settlements in the economy. What would have been likely is that the connections to the established glass industry and traders on the Continent would have been key for the trade in glass into Roman Britain.

The literary review indicates that Roman economics were more complex and less clear cut than either the modernist or primitivist theories. The main question raised is how the economy enabled wealth to drive the development of product types to meet consumer demand and what were the drivers in society that created a demand for goods.

There are two parts to the response to this question. The indications are that there were freedoms to trade given to freedmen in particular as these were not constrained by social conventions, but instead more than likely would have been motivated by the need to generate wealth themselves for a better life (Andreau, 2020; Broekaert and Zuiderhoek, 2020, pp. 136–138). While wealth would have been generated through an agrarian economy to landowners, this would not have necessarily restricted investing in trade given the potential to generate profit was there. In addition, freedmen, like Trimalchio, could act for landowners to generate profit and in so doing would have been able to be landowners themselves. They were, of course, a highly experienced often rich ‘class’ accustomed to success in business. To establish a glass-working centre, would have needed investment capital for the equipment that would have been managed by master craftworkers with freedmen and slaves employed in the industry (Erdkamp *et al*., 2020; Monteix, 2020). The second part concerns the consumers that were able to prosper through the expansion of the colonies and the growth of the cities that used the display of products to satisfy their aspirations for status.

Other questions about Roman trade are whether the economy was independent urban-economies or a set of interconnected city-state economies, with the implications of tax boundaries, and how was trade organised particularly over long distances and for low-cost goods?

The interconnectivity of the economy really depends on the trading industry type, the role of the state and the interdependency between sub-economies whether urban or city-state which can be subject to the laws of variation in supply and demand for products across regions as drivers for the movement of goods, people skills and capital. There were variations across the region and presumably through time regarding the ability to provide staples (grain, wine, oil and metals) and this would have been true for non-staples, particularly if there were specialised skills involved. The state taxation system was specific to provinces that would have recognised the ability to pay across the Empire (Fulford, 1992). While the state was responsible for the provision of supply for the military, the state would not have paid much of a part in the management of the finances and movements of goods (Bowman, 1989). With these conditions, sub-economies would not have been independent, that trading between them would have been profitable and with the institutions and financial mechanisms of coinage and credit it would have been entirely possible to move goods from Alexandria to Vindolanda.

To summarise, it is best to return to Tchernia who simply says (2016b, p. 4 (6)), ‘trade in the Roman world cannot be described by a single model’.

2.2 The Value of Glass in the Ancient World

The Romans were expansive traders and consumers of glass. Central to an understanding of the trade in glass are the glass forms that were made and consumed. The pioneering foundations of Roman glass studies were laid by Donald Harden, who published volumes of works between 1926 to 1988 (Newby and Painter, 1991). This significant body of knowledge of glass was picked up by further studies and ranged from articles on the invention of glass blowing (Stern, 1999b, 1999a; Prior, 2015; Larson, 2016, 2019), the manufacture of the Portland Vase (Freestone, 2019), the analyses of glass forms (Grose, 1977; Cool and Price, 1995; Price and Cottam, 1998) with the definitive compilation of groups of glasses by Clasina Isings who published a classification of glass forms based on artefacts from the regions and presented them in chronological order (Isings, 1957). This work was important as it set down the knowledge of glass forms at that time, with each glass form described, drawn and related examples from the regions included. This structured classification of forms has been used by successive archaeologists allowing identifications and comparisons of specific forms (Allen, 2011) for Silchester; (Howard-Davis, 2009) for Carlisle; (Cool and Price, 1995) for Colchester. Catalogues of Roman glass vessels have categorised such techniques as blobbed, applied trails and cut and engraved (Harden *et al.*, 1987). These are illustrated in Figure 2.1.

Blue. Blown, blobbed (Two-Handled Jar) | Small Flask with White Trails | Glass Cut and Engraved

(Harden 1987, p. 112) | (Metropolitan Museum of Art) | (Metropolitan Museum of Art)

Figure 2.1 Roman High-value Glass Examples

Wallace-Hadrill, (2008, pp. 435–436) in reference to the link between luxury ware and status, noted glass wares coming from Syria and Alexandria developed into a significant industry in Puteoli under Augustus, then Aquileia, followed by Lyon, Belgium and Cologne. This was an industrial revolution that transformed production and revolutionised consumer appetites (Stern, 1999b; Larson, 2016). The presence of particular high-value forms could then reflect high-status identities and would be expected to be found in locations associated with wealth and high-status including settlements and graves associated with elite individuals (Fleming, 1999; Jackson, 2005; Silvestri, 2008). As most ancient glasses did not have decoration or marking as evidenced by every large museum collection, an assumption is that glass with decoration, markings and special features would represent high-value glass and a display of the ability of the glass worker (Harden *et al.*, 1987, p. 7). This research will include whether glass could have status value including possibly as vessel markings and decorations.

Evidence of the many uses and value of glass have been illustrated in excavated Roman wall paintings. (Naumann-Steckner, 1991) classified the uses of glass as objects for display such as bowls on a shelf near a window, glass used for food and drink such as a bowl fruit or a glass of wine on a table, and glass used in a tavern with jugs and beakers. Window glass was also frequently represented in iconography (Velo-Gala and Garriguet Mata, 2017) that showed it was valued for its translucency, weather proofing and as a status symbol. Grose (1977) used the reference from the ancient writer Strabo 'many inventions for manufacture (of glass) as for example in glassware where a glass bowl or drinking cup may be purchased for a copper coin' that he takes to be an indication of the variety of glass forms and priced for common domestic use (Grose, 1977, pp. 13–14).

There is a connection between material culture and social identities that has been described as 'Romanisation' but that was much more nuanced. Gardner has proposed a stratification model in which identities are on different levels where individual identity was bound to communities with gender, age, status and religion and these could have had military, civil and state boundaries (Gardner, 2002). People in the Roman Empire's regions were essentially bilingual or possibly multi-lingual, living in periods of dramatic change, where the role of women, slaves and children were invisible and yet the standard of living increased over a 400-year period as did the populations (Revell, 2016, pp. 15–17). Consumers' behaviours and fashions became a reality and to respond to that the evidence in the innovations in glass-working are seen with the use of glass containers for cosmetics, bath-house scents, oil and wine and in the 1st century a huge increase in the number of glass vessel forms (Isings, 1957; Price and Cottam, 1998). The hypothesis is that glass-working vessel forms changed to respond to consumer fashions with an increase in the 1st century CE.

In summary, glass forms can be associated with many ways of life in ancient societies. These can include high-value glass vessels with an emphasis on the form marking and decoration but can also include common glass forms. We do not know for certain what the different ancient lifestyles were that used glass but may be able to make some informed judgements by examining the many patterns of dated forms from places (sites) with known contexts.

2.3 Consumer Demand for Glass Products

What were the drivers for the changes in the demand for glass? Grose (1977) proposed that the Augustan *Pax Romana* 'facilitated and stimulated the dissemination of new products and ideas in the Mediterranean while promoting the unhampered movement of the craftsmen who gave rise to the other two. The fact that new markets, glass included, were being established in the newly conquered provinces of northern and western Europe enhanced the market for blown glass (Grose, 1977, p. 10). This was also seen for marble and pottery (Rizzo, 2014). With the invention of blown glass around the middle of the first century BCE, glass as a luxury item became a much more common material and the spread of the technique took place very quickly throughout the Empire (Larson, 2016, pp. 295, 317). Using glass to imitate high value objects (e.g. crystal) could have been a significant factor in the development of glass products, however the spread of closed vessel forms (e.g. flasks, jugs, bottles) and that glass was impervious to contamination were more likely reasons for the increase in use of glass (Prior, 2015, pp. 336–342). This was an important advantage of glass over pottery that was not normally internally glazed. This is an important point and central to the study. These changes would have brought new territories and people into the Roman tax regime and so could support the Hopkins propositions regarding tax stimulating trade, with the conditions of security and political stability also met (Hopkins, 2017a, pp. 286–7).

Social change was driven by successive elite groups that gained political power that between 100 BCE to 100 CE led to changes in social prestige based on wealth (Wallace-Hadrill, 2008, pp. 36–37). Augustus introduced a more widely based elite as part of his ascendancy in Spain, Gaul and Africa. He made freedmen as part of the elite with social prestige and material culture. This was an industrial revolution that transformed production, revolutionised consumer appetites and was a wealth and consumption boom (Silver, 2007). This was relevant to the expansion of the markets for glass in Roman Britain and the capability of the glass industry to meet the demand from those markets in the 1st century CE. The main contribution to the consumption of glass would be from exposure of new markets to glass. Fleming (1997) considered that bringing together a 'concentration of crafts in Italy with the import of craftsmen and slaves from the newly acquired territories of Judea and Syria, would have exposed more people to glass and allowed for vessels to be produced locally in the heart of the Roman world' (Fleming, 1997, p. 3). The archaeology of sites dated in the 1st century CE showed increased numbers of glass forms with new shapes and sizes that comprised the traditional cast vessel types as well as the new blown glassware (Grose, 1977, p. 14). This trend is of course also seen with Samian pottery (Willis, 2011, p. 189).

The demand for glass forms can point to consumer behavioural traits. In 'Roman Glass: Reflections on Cultural Change', Fleming (1999) discussed how glass related more than any other material to the behaviours of people at all levels in society with the different forms made and the value placed on glass, whether common use or as a status symbol (Fleming, 1999, p.

ix). Cool and Baxter (1999) in their study comparing vessel glass assemblages in Roman Britain, found differences between military and civil sites, between *coloniae* towns such as Colchester and *civitas* towns such as Wroxeter, and different patterns between urban and rural. They suggested that the differences could be due to the adoption of 'Romanised' ways, more likely found in the army and immigrant peoples and possibly less in native populations. This is an hypothesis that will be relevant to assess in this study.

There are relevant comparisons with the trading of textiles which started to serve the so-called prestige economies more regularly through a means of differentiating individuals and groups in ancient societies (Marin-Aguilera *et al*., 2018). Cool and Baxter (1999) suggested that closed forms such as bottles, flasks and jugs that came to Britain following the Roman invasion may have been less common in the later Roman period. This could have been an indication of a rejection of a 'Roman' way of life (this point is returned to in Section 7.3 Social and Material Cultures) . They noted that this pattern was more rural and the higher proportion of closed finds in cities and villas was perhaps where Roman standards were retained. Rural assemblages were not just scaled down versions of urban ones, but with different shapes implying they were used for different functions. Further studies relevant to the discursive construction of identity contribute to this theme (Dalby, 2000; Wallace-Hadrill, 2008; Revell, 2016).

These studies reinforce that insights from material culture are central to an understanding the socio-economics in regional locations. In *The Archaeology of Ethnicity*, Jones considered material culture as an active constitutive dimension of social practice as it structures human agency and is a product of human agency (Jones, 1997). Larson (2019) studied the period of the most dramatic changes in ancient material culture between the 1st *c.* BCE and 1st *c.* CE with the widespread adoption of glass vessels for tableware and storage. She attributed this to changes in consumer behaviour pointing to a complex process of experimentation, development, and then gradual adaptation on the part of both producers and consumers. Revell in *Ways of Being Roman*, noted that material culture not only provides evidence for past identities but is also a medium through which identities were negotiated and expressed (Revell, 2016). There is no direct one to one relationship between specific items of material culture and aspects of identity that means that a contextual reading of all the data is needed. This is an important point in that it can perhaps provide an explanation of why the producers transitioned from centuries-old technologies to glass blowing, in response to consumer demand for lifestyle changes.

2.4 Glass Manufacturing

Understanding the origins of the glassmaking processes, locations and the raw materials used could provide insights into the Roman economy and trade. Matson (1951) reviewed the sources of analysed samples of Roman, Egyptian and Babylonian glasses for chemical composition and suggested grouping types would need the chronology, the manufacturing technology, the shape and colour as well as the chemical composition statistically assessed (Matson, 1951, p. 86). W. E. S. Turner (Turner, 1956) followed by E. V. Sayre and R. W. Smith (Sayre and Smith, 1961) proposed that Roman glasses were a cohesive group based on chemical composition, made from low impurity sands with the evaporite salt called 'natron', and that the composition was homogeneous throughout the Roman world for over six centuries. Theoretical scientific archaeology broadened the definition of compositions with a greater range of elements using techniques such as X-ray fluorescence analysis (Clarke, 1968; Sanderson *et al.*, 1984). From large data sets of glass context, date, colour and shape, and major and trace element analyses, they showed that Roman glasses were actually not compositionally homogenous at an elemental level.

Brill *et al*. carried out chemical analyses and oxygen isotope analyses of a range of glass samples, including from Jalame in western Galilee, that strongly confirmed the source of the glass silica and soda as being from the nearby Belus River beach sands (Brill *et al*., 1999). These analyses included calculations to account for changes in the oxygen isotopes at the original glassmaking and re-melting stages with also adjustments from any weathering. They considered that this isotopic technique held 'great promise for investigating glass problems that cannot be resolved by chemical analyses alone (Brill *et al*., 1999, p. 303). Rehren adopted this methodology for analysed glass samples that showed variations in compositions associated with glass melting temperature eutectic phases of the original furnace melting processes (Rehren, 2000). He concluded that the homogeneity of early glasses 'is understood not as an indicator for a highly centralized or extremely conservative glass making industry, but simply due to the inherent melt-forming behaviour of the batch as a result of a particular glass making tradition (Rehren, 2000, p. 1233).

A more substantial perspective was positioned by (Aerts *et al*., 2000) in the study of a large Roman glass collection, dated the 1st century CE, and with comparisons with other samples from other Roman sites in Britain, France, Germany, Italy and Israel. While a broad consistency in composition of the elements of the glasses was seen, distinct groups were found based on the ratios of major and trace combinations. They concluded that from the similarities of the raw materials that there were a few raw glassmaking centres that supplied many glass-working centres with 'ingots of glass' (2000, p. 119) and that colourisers, and decolourisers were used at the re-melting stage to make the final glass objects. This was further progressed by (Freestone *et al*., 2000) who investigated the major and trace elements of glasses from Israel and Egypt of the 4th century CE and western Europe and proposed glass groups that were from Egypt or the Levantine regions based on the geology and origins of the raw materials. They argued that the glassmakers of the late 1st millennium used a standard recipe to make glasses with a consistent composition supplied by a few large-scale glassmaking centres from the Eastern Mediterranean region (Freestone *et al*., 2000, p. 74).

However, this association of composition and glassmaking origins was also investigated by Wedephol and Baumann (2000) with an assessment of the analytical data with strontium isotope analysis of vessels and window glasses from the Eifel region in Germany dated the 4th & 5th centuries CE, Roman glasses from Britain dated 1st and 2nd centuries CE and glasses from Italy dated 1st to 4th centuries CE. They concluded that the Roman glassmakers used molluskan shells as the calcium carbonate raw material (2000, p. 129) and that the Roman glassmaking centres in the Hambach Forest area in West Germany 'most probably used local sand from the Rur River for their production' (2000, p. 132). (Freestone *et al.*, 2003) did not agree that the shell raw material was added intentionally and that it could have been included with the coastal sands (2003, p. 29), and they argued against local raw glassmaking in the 4th century CE.

These studies thus surfaced two raw glass manufacturing possibilities for the 4th century CE and later, with the centralised model of a few raw glassmaking centres that supplied raw glass to many glass-working centres in the regions (Freestone *et al*., 2002) and the alternative being the dispersed regional model that had regional glassmaking centres distributing raw glass to local glass-working centres (Wedepohl and Baumann, 2000).

The centralised model was advanced by studies that identified several composition groups from Byzantine glass from Cyprus (Freestone *et al*., 2002), and from Eastern Mediterranean glass (Freestone and Gorin-Rosen, 2002). Major groups include a Levantine glass group with provenance thought to be from the Syria-Palestine sand area and another group called HIMT – "high iron, high manganese, high titanium" identified originally by Freestone (1994), that was recognised as a type seen across the Mediterranean (Freestone *et al.*, 2018). These studies suggested raw glass production in the Mediterranean region was supplied from a few glassmaking sites to glass-working centres in the regions. The greater visibility of HIMT over the Levantine type was noted for regions outside the Levantine area (Freestone and Gorin-Rosen, 2002, p. 173). Freestone (2005) determined the provenance of the HIMT glass to be in the eastern Mediterranean probably Egypt or North Sinai and that this glass type was found to be common in places such as in Italy and Britain.

The recognition that production was divided into primary and secondary workshops resolved the debate over the two manufacturing models by associating the compositional data on glass from the period of interest to be interpreted in terms of the origin of glassmaking and the underlying glassmaking technology (Freestone, 2005, pp. 008.1.7-10, 2006, p. 213). By separating primary raw glassmaking from the secondary glass-working, the evidence indicated the majority of raw glass originated from primary glassmaking sites in the Levantine region or Egypt, as in the centralised model (Freestone, 2006, p. 211; Schibille *et al*., 2017).

Freestone further recognised that recycling could impact composition and that the composition of glass could be further complicated from colourants, de-colourants and the glass furnace conditions, reinforcing the association to the technology noted earlier by Matson (1951). Foster and Jackson (2009, 2010) confirmed the majority of 4^{th} century CE glass in Britain as HIMT 4^{th} century CE type, with evidence for recycling in the 3^{rd} to 4^{th} centuries CE, a point corroborated for Cyprus by Ceglia *et al.* (2019) for the 5^{th} and 6^{th} centuries CE. With recycling ubiquitous across the Empire there are potential insights from investigating the social and commercial ways glass was recycled, with the events and the efficiency of the glass industry that exploited glass (Freestone, 2015, p. 40).

There was general agreement that centralised glassmaking was in place after the 4^{th} century CE, but the debate continued for the preceding centuries. Jackson (2005) studied colourless glasses from Britain from the 2^{nd} and 3^{rd} centuries CE with the majority in a group that were made from high purity sand, no evidence of recycling, likely to be from the Mediterranean coast as defined by Freestone (Freestone *et al*., 2002), and so a high possibility that the centralised model was relevant (Jackson, 2005, p. 773). Other colourless glass groups were similar in composition to coloured glass, had signs of recycling, were made from different sources of raw glass and suggested the dispersed manufacturing model. Further investigations of sand sources including strontium and neodymium isotopic research were carried out by Brems (2012; 2013; 2013; 2014) to distinguish glass made in Europe from Syria-Palestine showed promise but more work is needed to be conclusive. Other studies have corroborated the strong possibility that for the periods before the 4^{th} century CE, there were a small number of glassmakers, probably mainly of eastern Mediterranean origins, supplying raw glass blocks to the glass-workshops in the western Empire (Wedephol *et al*., 2003; Degryse and Schneider, 2008, p. 1999; Follmann-

Schulz, 2015; Rehren and Brüggler, 2020). This is a gap in the knowledge of the development of the glass industry from the 1st to 4th centuries CE with implications for how the trading network for raw glass developed over this period of history. This underlines the focus for this study of the secondary glass-working stage in which raw glass was converted into vessels for traded distribution across the network.

2.5 The Glass-working Industry

There is little information regarding glass manufacturing in Roman Britain. The evidence of glass manufacturing suggests that this was glass-working and not glassmaking (Jackson, 1992, p. 91; Cool and Price, 1995, p. 226; Price and Cottam, 1998, p. 10). The glass-working sites generally were small furnace centres that were in some cases associated with other high-temperature craft industries. The main evidence of sustainable glass-working was in the London sites.

The following Table 2.1 includes places considered to have been glass-working sites in Roman Britain with summaries of the evidence and chronologies.

Table 2.1 A Summary of Glass Manufacturing Sites in Roman Britain

Site	The Evidence of Glass-working (source)	Site Occupation Period
London	(1) 35 Basinghall Street: glass-working materials as cullet and glass fragments from glass-working	2nd century CE
	(2) The Guildhall: glass-working debris consisting of furnace fragments and a cullet dump	3rd - 4th century CE
	(3) 20-28 Moorgate: glass-working furnace and glass residues	2nd century CE
Mancetter	(4) Furnace materials and melted glass	2nd - 4th century CE
Leicester	(5) Glass vessels, window glass, glassblowing waste materials and	1st - 3rd century CE
York	(6) York glass furnace and Coppergate glass melting pots	Late 2nd - early 3rd century CE
Colchester	(7) glass waste asociated with glassblowing	2nd - 4th century CE

Sources: (1) (Wardle, 2015a); (2) (Bateman *et al.*, 2008); (3) (Seeley and Drummond-Murray, 2005); (4) (Jackson, 1992; Hartley, 2020); (5) (Cool and Price, 2021); (6) (Jackson, 1992; (Jackson, 1992; Jackson *et al.*, 2003); (7) (Cool and Price, 1995, pp. 209, 226)

The importance of the glass-working centres in the trading network is illustrated by a statistical analysis of Romano-British glass specimens found in Colchester which found compositional variations within four vessel types from chronologically different periods (Baxter *et al.*, 1995; 2005). These differences relate to the 'volatility' of composition within types rather than 'typical' compositions. For example, cylindrical cups were stable compositionally, cast vessels also but to a lesser extent, whereas wheel-cut beakers were much more volatile. This was considered to have been likely based on the glass-working related to specific glass types. Two different explanations were suggested for the greater compositional stability of the cylindrical cups. The glassmakers of the north-western provinces could have devised a more standard recipe for their glass. Alternatively, if the glass blowers were working with imported raw glass, greater stability could have come about through a small number of glassmaking centres becoming the dominant sources of supply. This suggests the hypothesis that glass-working centres were of importance to compositional stability.

This line of research was picked up by (Freestone *et al*., 2009) who found a very close link between vessel form and composition and rather than attribute the form-fabric associations to workshops, they attributed them to individual batches of glass. The ability to recognise individual batches of glass has implications for archaeological studies in that it allows us to recognise the behaviour of the consumer in acquiring glass in sets and also provides insights into the glass worker who selected the materials for a batch. This should be seen in context with the origins of the raw glass which was discussed in the previous section. However, the identification of vessels from the same batch is unlikely to surface for this study.

Roman glass workshops were based on traditional manufacturing methods of hot casting of glass forms using moulds and cold finishing by grinding surfaces, with raw glass production located in Egypt and Syria-Palestine using local sourced raw materials. Glass blowing enabled glass workers to make additional vessel shapes more easily, using this more versatile process (Stern, 1999b, 1999a; Tatton-Brown, 2012; Larson, 2019) . The combination of glass blowing with glass-casting and pottery-moulding technologies created the so-called mould-blowing process that had the added advantage of reproducibility, as an early form of mass production. The initial view that glassblowing was the driver for the widespread use of Roman glass has been modified by several academics (Cool and Baxter, 1999; Cool, 2006) arguing that the traditional techniques using moulds would have continued with glassblowing adding to the variety of glass forms and the growth of the glass industry. Jonathan Prior (2015) considered that using glass widely meant that the demand could outpace production by any method aside from glassblowing, potentially making it the most common method by necessity. He noted that it is entirely possible that demand drove the use of this new technology.

The glassblowing process was very versatile in the shapes that could be produced with the addition of handles, spouts formed, and decorations added during this operation (Prior, 2015). Applied trails would have been applied by the glass worker as a thread of hot glass applied to the hot vessel during the glass-working process. A similar effect can be achieved by rolling the hot vessel onto a thread of hot glass on a flat surface; this is called the marvering technique. Both techniques can be recorded simply as trailing in the archaeological record. Applied blobs are simply hot pieces of glass attached to the vessel body during glass making, which can be left unmarvered. Coloured streaks can also be achieved by rolling the hot vessel onto powdered glass materials on a flat surface; this marvering technique results in the powdered colours incorporated into the vessel body surface. These effects are illustrated in Figure 2.1. Such decorated vessels would have been prized possessions (Cool and Price, 1998).

2.6 The Trade in Roman Glass

2.6.1 Introduction

The market value for glass has been discussed earlier in Section 2.2 that noted the association of glass vessels with status and culture by consumers and in Section 2.3 that discussed the consumer demand for glass products. The monetary value of glass products would have been influenced by the market demand for glass, the product forms, their availability and cost. The purpose of this section is to present the academic perspectives of the two main components of trade, namely the market value of glass vessels, and the commercial viability of the glass industry with the ability to satisfy the market demand.

2.6.2 Market Value of Glass Vessels

In the 1st century, glass imitated expensive mineral vessels with translucent strongly coloured monochrome and polychrome tableware. Then from the late 1st century, colourless glass was used extensively as drinking and serving vessels (Price and Cottam, 1998, pp. 14–16; Fleming, 1999, pp. 45–46). The 1st century has been recognised as the peak of the different vessel forms with the 2nd century defined by the fashions for elaborate vessel forms (Fleming, 1999, p. 76). Glass vessels were used as common drinking vessels, everyday tableware and small containers to hold scents and medicines that were associated with a Roman lifestyle (Fleming, 1997, p. 3). In the 4th century, glass drinking cup and beaker forms were associated with the elite elements of Roman society (Cool, 2006, p. 226). The evidence of glass across the settlement types could be seen as an indication of the affordability and market value of glass vessels.

2.6.3 Commercial Viability of the Trade in Roman Glass

The commercial viability of the glass-working industry would have been driven by the costs of the glass-working centres to secure supplies of glass for melting, the production costs, and the ability to trade finished glass vessels for subsequent transportation and distribution to the consumer markets. That glassmaking and glass-working was commercially viable is illustrated by the expansion of the glass industry in the western Empire. What is not clear is the basis for profitable glassmaking, glass-working and the distribution of glass in particular over long distances. That glass trading was commercially viable is supported by the evidence that secondary glass workshops were prolific across the Empire with more than seventy workshops excavated in France (Price, 2005), more than twenty-five in Germany (Grünewald and Hartmann, 2014) and more than twenty in Britain (Jackson *et al.*, 2003; Price, 2005; Paynter, 2008; Shepherd and Wardle, 2009; Shepherd, 2015). A study of glass workshops in northern Gaul and the Rhineland (Grünewald and Hartmann, 2014) details the increasing numbers of glass workshops from the 1st through to the 3rd centuries CE with the same distribution pattern. In Gaul, some glass workshops were sited in rural settlements, whereas in the Rhine region nearly all the 1st century workshops were in urban centres that included the large cities of Cologne and Bonn (Grünewald and Hartmann, 2014, p. 45). This study also provided a case of the exploitation of poor agricultural land taken over by pottery, glass and metal workshops that all needed a supply of wood and from the 3rd century, agriculture declined further with evidence of regenerating wood supply in the area. Taylor and Hill (2008) designed and constructed Roman-style glass-working wood-fired furnaces based on the archaeological furnace remains found in the western provinces of the Roman Empire. Their conclusions were that their experimental furnaces were easy to build and maintain glass-working conditions while economically minimising the use of wood fuel. They also recognised that specialised furnaces could have been used for different products as reflected in the archaeological record.

The production cost of Roman glassblowing techniques was studied by Stern (2000) who came to the view that they were developed over the centuries, that the scale of glassblowing centres was always small with one or two workers and a small furnace, with the furnace size a limiting factor and with raw glass supplied from other sites. Stern made assumptions on glass-working, with prices calculated using Diocletian's *Price Edict* issued in 301 CE and concluded that the glassworker would have had great difficulty in making a profit (Stern, 1999b; Whitehouse, 2004). This was revisited by Larson (2019) who judged that glass workshops were incentivised to make vessels larger and heavier, not smaller and lighter, and so could see the same rate of return by producing and selling half as many heavier vessels as lighter vessels, as opposed to Stern (2000), who assumed the major cost of glass production was the raw material cost. Diocletian's *Price Edict* was issued at a period of inflation particularly in the eastern regions of the Roman Empire with the intention to control prices and has been widely used to assess the costs of manufacture and supply goods across transport modes (Fluckiger, 2021). It has also been a source for the assessment of the supply, consumption and recycling of glass that concluded that there was availability of glass for manufacture and that glass-working was therefore commercially viable (Jackson and Paynter, 2016).

The growth in inter-regional trade through the expansion of the economy of the Roman Empire created the conditions for commercial viability of production and distribution of goods to military and civil markets (Bang, 2008, pp. 73–79). A factor associated with the commercial viability of the glass industry is the increase in the capability to make standardised domestic glass vessels and large bottles as product containers (Foster and Jackson, 2009). The expansion of common forms of glass vessels in the 2nd century has been seen as an indication that trade in glass products was profitable (Larson, 2019). This could have been through glass-working centres consisting of several glass-working furnaces mass-producing standardised forms and smaller glass workshops supporting local markets (Cool and Price, 1995, p. 226; Price, 2005; Grünewald and Hartmann, 2014).

The costs of the production and distribution to the markets would have been variable across regions in a largely agrarian economy and with seasonal implications (Morley, 2007b). The transport of raw glass from Egypt and the Levantine would have followed sea and river routes to the northern provinces as shown in Figure 2.2.

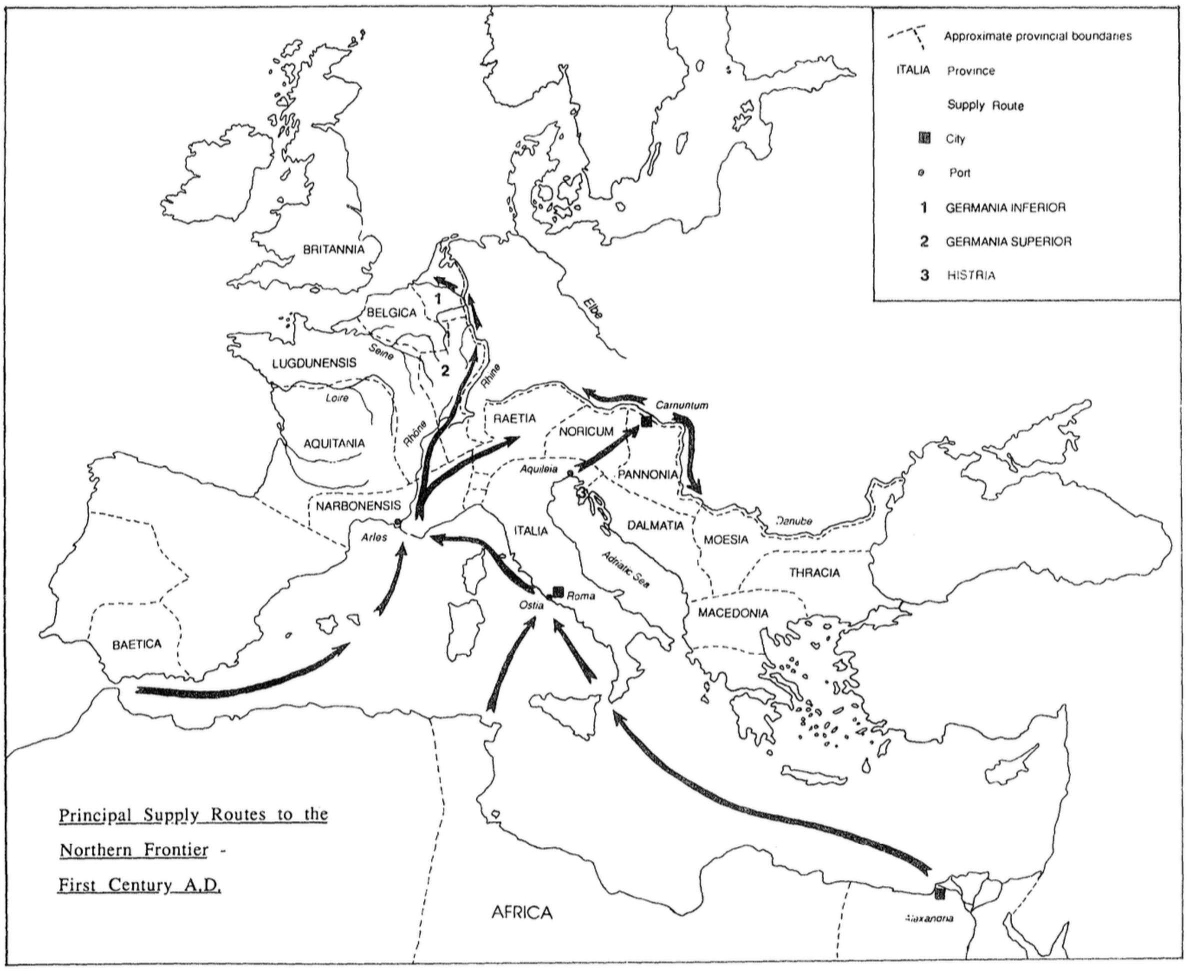


Figure 2.2 Principal Supply Routes in the Northern Frontier 1st Century CE

Source: (Fulford, 1992, p. 298)

The costs of transport of glass as a heavy material would have been valued as ships ballast that could have off-set the cargo cost. The relative costs of transport by road, river and sea have been assessed with water transport the most cost effective (Duncan-Jones, 1974; Greene, 1986). The glass-working centres in the northern provinces, Lyons, Cologne and Bonn were close to the Rhine with river access to the Channel and with also possible connections to the Rhone and the Mediterranean (Wedepohl and Baumann, 2000; Fontaine and Foy, 2007).

The trade in glass containers would have been based on the contents that would have probably been oil, wine or possibly a fish preserve (*garum)* given the impermeable properties of glass (Arthur and Oren, 1998; Foy, 2017). The use of pottery amphorae as containers for oil and wine has been comprehensively documented and assessed to map distribution routes of those particular goods over long distances (Panella and Tchernia, 2002; Monteix, 2020). Glass bottles did not have the capacity of the pottery amphorae that were used to transport bulk quantities and were produced in large numbers in two common shapes, the cylindrical and square bottle (Fleming, 1999, pp. 62, 63). It is likely that the original contents of the glass bottles were premium products that could have been commercially viable to be transported perhaps long distances (Duncan-Jones, 1974, p. 364). There are references to premium wines from Spain and Italy, such as Falenian from Pompeii, that could have been selected for glass bottle transports (Duncan-Jones, 1974, fig. 46; Cool, 2006, p. 131). Rathbone referred to a tablet contract of an importer of *garum* from Spain to Pompeii for 'sealed freight' (2007, p. 315). These are illustrations of the trade and transport of foodstuffs in Roman times.

2.6.4 Summary

These archaeology glass studies then supported the Hopkins' propositions of inter-urban trade, large cities as drivers for trade and the exploitation of land, but more studies would be needed to show the patterns across different regions. The role of the military with regard to transport, trade and the supply of materials to the army is a further factor relevant to Roman Britain following the invasion in 43 CE.

2.7 Roman Occupation of Britain

The changing Roman influence from 43 to *c.* 400 CE in Britain needs to be considered. There are three phases suggested for this review: the conquest phase that includes the invasion in 43 CE and the subsequent occupation of Britain; the consolidation phase during which the frontier boundaries were established and the control of the territories consolidated; and a further co-existence phase that involved more autonomy and less rule from Rome. These phases have been based on Wacher (1998, pp. 18–56) and will be described in order to provide the political context for Britain that can be associated with the archaeology of glass consumption and trade in Britain across the chronologies of the phases of conquest, consolidation, and coexistence. A chronology of glass vessel design changes is also included with reference to common vessel forms in each phase and is based on guides to Roman glass in Britain (Allen, 1998; Price and Cottam, 1998). These outline trends of changes to vessel types and forms will be picked up in Chapter 4, 5 and 6 by associating design changes to the archaeological evidence from the sites in Roman Britain.

2.7.1 Conquest

With little evidence of any pre-Roman occupation (Dunwoodie *et al*., 2015, p. 13), the Roman city of *Londinium* was stated to have been founded *c.* 47/48 CE on what was the lowest crossing point for roads running linking the south-west with the roads to the north of England, to *Camulodunum* (Colchester) on the east-west road, and west to *Verulamium* (St. Albans) and

Calleva (Silchester) (Dunwoodie *et al*., 2015, p. 5). The archaeological evidence was of clay and timber buildings on cross-roads with buildings that possibly had commercial use and occupation as an early town. There was evidence of destruction by fire, presumably associated with the Boudican revolution of 60/61 CE and it is following this event that there were signs of the Plantation Place fort that was constructed *c.* 63-70 CE. By the 2nd century, London had become an administration centre and a large population area as shown in Figure 2.3 that shows the Cripplegate fort, public buildings including baths, the amphitheatre, forum, a bridge across the river and the location of the earlier Plantation fort.

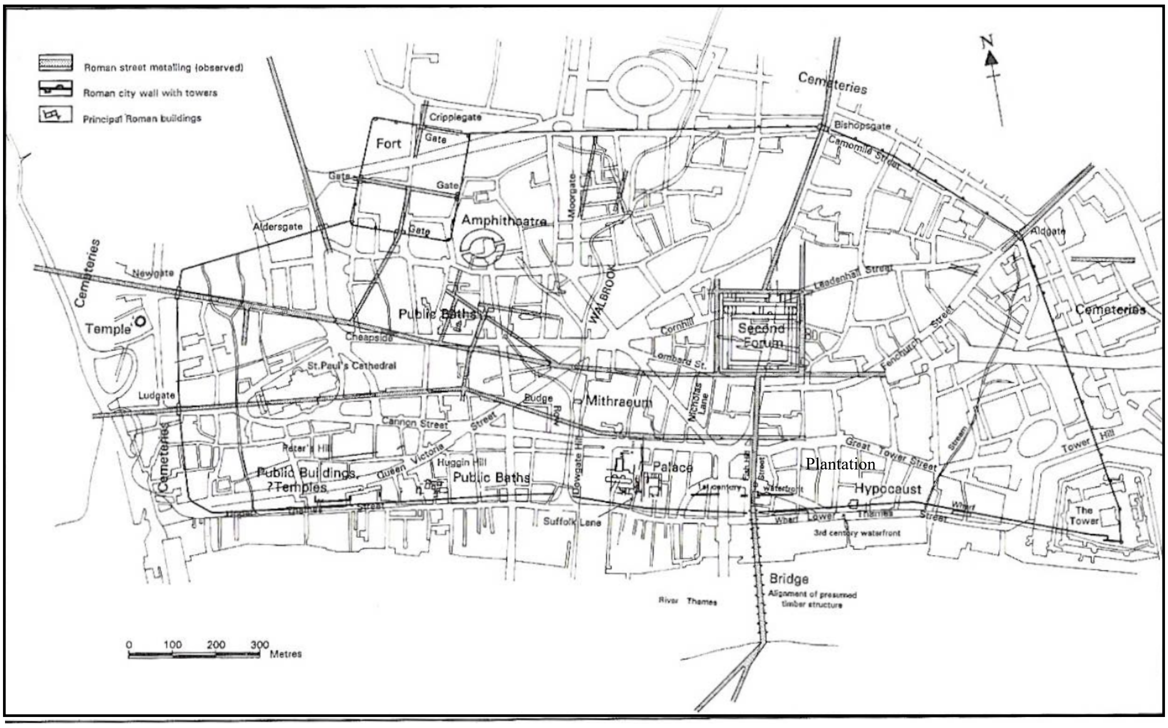


Figure 2.3 Plan of London (Londinium) c. End of the 1st Century CE

Source: (Wacher, 1998, p. 164 Fig. 78)

The location of *Londinium* on the River Thames and the strategic military importance particularly early in the Roman occupation that connects the south-east with England to the north is shown in Figure 2.4.

Figure 2.4 The early towns of Britannia and nearby provinces showing selected roads
Source: (Wallace, 2014 Fig. 1)

The initial role of the *Londinium* area has been debated as a military staging post, a military supply base and a civilian trading centre (Wallace, 2014). The military fort at Plantation Place was not built until after the Boudican revolt of 60/61 CE and was a relatively small structure, although there is a debate about the existence of an earlier Claudian fort (Perring, 2011; Wallace, 2014). There have been Iron Age finds recovered from the River Thames and from the north and south banks that include coins, pottery sherds, weapons such as daggers, and the Waterloo Bridge helmet (Hingley, 2018, p. 17). Hingley considered that the distribution of such finds is an indication that London was a meeting place, with no evidence of structures or land works in the pre-Roman period (Hingley, 2018, p. 23). The commonality of the finds on both banks does suggest that a Thames crossing point existed that would have been significant for the movement of goods from the south of England and also from the Continent (Hingley 2018:25-30). During the early period of Roman occupation, there is evidence of timber wharfs, jetties a bridge and main roads constructed by the mid 50s CE. *Londinium* was most likely made a colony in the early 2nd century CE, possibly during the visit to Britain by Hadrian in 122 CE (Hingley, 2018, pp. 121–2).

Just before the time of the Roman invasion, Silchester (*Calleva*) was regarded as the capital of the 'Southern Kingdom' of the *Atrebates* and Colchester (*Camulodunum*) was the centre of the 'Eastern Kingdom' of the *Catuvellauni* (Fulford, 2021, p. 50). The Eastern Kingdom assimilated Calleva and the region into what would have been then a significant political region. Following the Roman invasion, the military forces first went to Colchester to set up a legionary fortress and later designate the city as a *colonia* administrative capital for the south of England. Silchester was established as *civitas* capital in the mid-Flavian period (Fulford *et al.*, 2020). The question of military occupation has not been confirmed; however, it would be unusual if there was not some military force in residence as suggested by the archaeological evidence of soldiers' hob-nailed boots and broken armoury and weapons (Fulford, 2021, p. 54).

Following the invasion in 43 CE, the Romans established administration centres in the south of England based on the model of urban Roman cities. Colchester was the location of the first administration and the city was built on the site of the fortress as the territory was established. Colchester became the base for the *Legio XX* and a fortress covering 20 ha was built (Crummy, 1984, p. 3). In 49 CE, the legion moved to Usk, leaving the fortress and associated buildings to be the basis of the new *colonia*, a recognised term for a designated administration centre in the Roman Empire. This was developed into a large city that replaced the defensive structures with public buildings, temples, theatre to become an example in Britain of a large Roman city. The revolt by the Iceni in 60/1 CE was triggered by the death of the Icenian king and that the tribe was not part of the Roman province, but the Roman authorities decided it should be incorporated without meeting any of the claims by the Iceni, then under Queen Boudica. Colchester was destroyed along with the towns of London and St. Albans (*Verulamium*) during the Boudican revolt in 60/1 CE. This provided an archaeological horizon across part of these towns for the earliest use of glass, before and after the time of destruction.

St Albans has been recognised as an oppidum at the time of the Roman conquest that would have included industrial and commercial areas separated from community dwelling areas (Niblett, 2010, p. 47). There is evidence of metal working, weaving and pottery production as well as buildings. At the start of the 1st century CE, the extraction of bog iron in the area would have been significant to the local economy and would explain the roads and trade with Gaul that existed at that time (Niblett *et al*., 2006; Niblett, 2010, p. 48). The settlement at St Albans was founded in the 1st century BCE by Cunobelin, the king of the *Catavellauni*. He transferred the capital administration to Colchester *c.* 10 CE, with St Albans remaining a significant centre in the region (Niblett, 2010, p. 52). When Cunobelin died in 40 CE, his sons were powerful tribal leaders and resisted the Roman invasion that continued until the tribal forces were defeated in a battle with the surviving son, Caratacus eventually captured (Wacher, 1998, p. 26,27; Niblett, 2010, p. 53,54). The Roman administration recognised the importance of St Albans and the title municipium was granted in the mid 1st century CE (Niblett, 2010, p. 66).

With that status, the native elites had status and property. There is no structured evidence of a military presence at St Albans unlike the veteran communities at Colchester, although military finds have been recovered of armoury, weapons and an early Roman helmet (Niblett, 2010, p. 57).

The conquest involved staged campaigns that started with the invasion from the south coast and continued with the incursion in Wales and The Marches with main roads constructed to supply fortresses at Usk, Chester, Gloucester and Caerleon by 70-80 CE (Burnham *et al.*, 2010). In the mid 1st century CE, military campaigns were run against some of the tribes of Wales and the Marches and it was against this backdrop that military bases were built in Wales and the Marches through 50s' CE including the fortresses at Wroxeter (White and Barker, 1998), Exeter (Wacher, 1998), Usk (Manning, 1981) and Caerleon (Mason and Macdonald, 2010) .

These legionary fortresses were part of several military bases comprising also campaign bases, large forts, auxiliary forts and in some cases reused hill forts and would have been destinations for military supplies of construction, weaponry, and supplies. The Roman fleet was considered to have been used to supply the expeditionary forces prior to the establishment of land routes (Burnham *et al.*, 2010, p. 94). While the main legionary fortresses could be supplied by river and sea as well as roads, there were in addition a large number of military bases that could be supplied by roads (Burnham *et al.*, 2010, p. 43). We should not underestimate the volume of the movements of materials and people in these early decades of the conquest in the mid-1st century.

The Boudican revolt in 60/61 CE led to the deployment of the army to defeat the rebels and hold the invasion lines. The Agricola campaign of 77/78–83/84 then continued the conquest with a military presence that could maintain order across the regions of England . There were by 79 CE, the active legionary fortresses at Caerleon, Chester and Wroxeter, with the latter being reorganised and moved to the Inchtuthil fortress. The movement into Scotland was accompanied by reductions in the deployments in Wales, the creation of the York fortress and the creation of a military zone in the north-west with the Tyne-Solway line as a timber defence (Wacher, 1998). This included the construction of the forts at Lancaster and Carlisle (Potter, 1979, p. 356). The campaign by Agricola started with the subjugation of the Brigantes in the north-east of England and then the invasion into Scotland to the Moray Firth and the conquest of south-west Scotland by *c.* 82 CE. The invasion was accompanied by the construction of roads, fortifications and buildings and the construction of the Inchtuthil fortress *c.* 83 CE (Pitts and St. Joseph, 1985, p. 267).

The extent of the military zones between 70-85 CE is shown in Figure 2.5 that is an indication of the occupied areas (Wacher, 1998, p. 29). These zones also represent the areas of military supply to the forts and fortresses that require the transport of military weaponry, equipment, construction materials and supplies to the army and individuals in the army. The campaign was impacted by events elsewhere in the Empire that led to forces being moved to reinforce other campaigns and this led to the northern frontier drawn back to the Tyne-Solway line by *c.* 105 CE. The construction of the York, Caerleon and Chester fortresses was also undertaken during this frontier adjustment period. With the accession of Hadrian in 122 CE, work was started building a more permanent stone wall with mile fortlets, called Hadrian’s Wall, as shown in Figure 2.6 (Wacher, 1998, p. 32).

Figure 2.5 The Military Zones in Britain between 70 – 85 CE

Source: (Wacher, 1998, p. 29 Fig. 16)

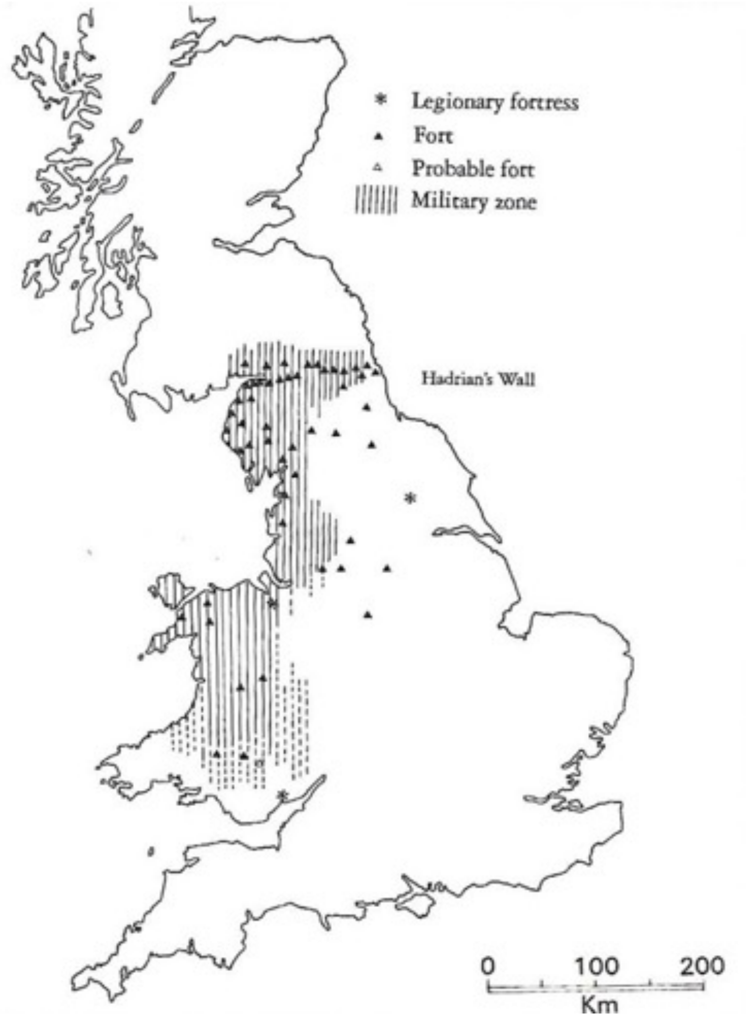


Figure 2.6 Hadrianic Frontiers and Military Zones
Source: (Wacher, 1998, p. 32 Fig. 18)

The military supply chain would have prioritised supplies to the invasion forces into the military in the 1st century phase of conquest. The military transports would have been by river and sea initially into new areas and originated from the Continent. The military would have required transports from the east Kent coastal ports to London (Margary, 1973, p. 497). There are views that the advance troop movements would have been supplied by coastal routes to the frontier zones, particularly into the north of England and Scotland (Anderson, 1992, p. 88; Ferraby and Millett, 2020, p. 94). The transports inland then would have required roads from the ports rather than the other way round. The network of the main roads was constructed between 43-81 CE to facilitate this tranche of military campaigns (Margary, 1973, p. 504). These included the roads from London, the north-west route Watling Street to Wroxeter, the north Ermine Street to Lincoln and York, and further north via Dere Street to Corbridge.

This phase of military conquest and control was a period of an increase in the movement of a population that would have been familiar with glass vessels from their countries of origin into all the regions of Britain. It was also a time where a significant movement of traded materials and traders came into Britain. The glass industry at this time was expanding with the production of a large variety of glass forms in the 1st and 2nd centuries CE (Isings, 1957; Price and Cottam, 1998, p. 5). The development of large cities at Colchester, Silchester and St. Albans in the Roman town template was a significant change in Britain as they would have been centres of Roman material culture change and markets for the adoption of glass.

2.7.2 Consolidation

The granting of *civitas* status to the Silures in the 2nd century was an indication of a change in Roman rule. The period 122-200 CE included the start of the consolidation of territory and deployment of the army as a policing force primarily for the north-west Britain and Wales. A further incursion into Scotland to the Forth-Clyde line to build the Antonine wall was made in the mid-2nd century CE (Wacher, 1998, pp. 33–40). This was a temporary occupation as a rebellion in *Brigantia* perhaps in 154 CE led to a withdrawal of troops from Scotland to Hadrian's Wall (Wacher, 1998, pp. 41–42). The downsizing of the operational bases and garrison strength was carried out through decommissioning forts and reducing the size of individual forts through building new defences or abandoning barrack buildings (Burnham *et* *al.*, 2010, p. 51). The use of forts as centres for an administrative system was based on the tribal civitas boundaries (Burnham *et al.*, 2010, p. 54). While the evidence is of forts being completely abandoned, there are other examples of continued occupation and use as at Caersws II with a late 2nd century tile kiln installed and operational to the late 3rd century CE (Burnham *et al.*, 2010, pp. 226–229). The military deployments in Britain and the military zones in the 2nd century CE are shown in Figure 2.6 that shows the consolidation of military forces to establish the Hadrian's Wall frontier (Wacher, 1998, p. 36).

2.7.3 Coexistence

The 3rd and 4th centuries include the establishment of the provinces of Roman Britain as a phase of 'coexistence' (200-400+ CE). The start of the 3rd century started with a Roman civil war that ended with the Emperor Severus restoring order and setting up a capital in 208 CE and provincial administration into two political regions, *Britannia Superior* with the legions at Chester and Caerleon and including the administration centre London, and *Britannia Inferior* with the legion at York, the bulk of the *auxilia* (Wacher, 1998, p. 44,63; Wallace, 2014, p. 2). The Emperor Severus died in York in 212 CE and was succeeded by his eldest son Caracalla, who agreed terms and withdrew forces from Scotland (Wacher, 1998, p. 45).

The occupation of Britain in the 3rd century is shown in Figure 2.7 that was established for over a century (Wacher, 1998, p. 45). The forts in the north-west and Wales are still occupied and with the frontier at Hadrian's Wall are the main military bases, with the legionary fortresses at Chester, Caerleon and York. There are signs of forts and naval bases on the east coast, in place to defend from threats from the Continent (Wacher, 1998, p. 47).

There were other social changes in the 3rd century that could have influenced the trade and consumption of materials. Roman citizenship was granted to all free-born men and women, and serving soldiers legally allowed to marry and own land that could be farmed. The landscape as shown (Figure 2.7) changed in the 3rd century with networks of walled towns, villa farmsteads and farms in the south and middle England.

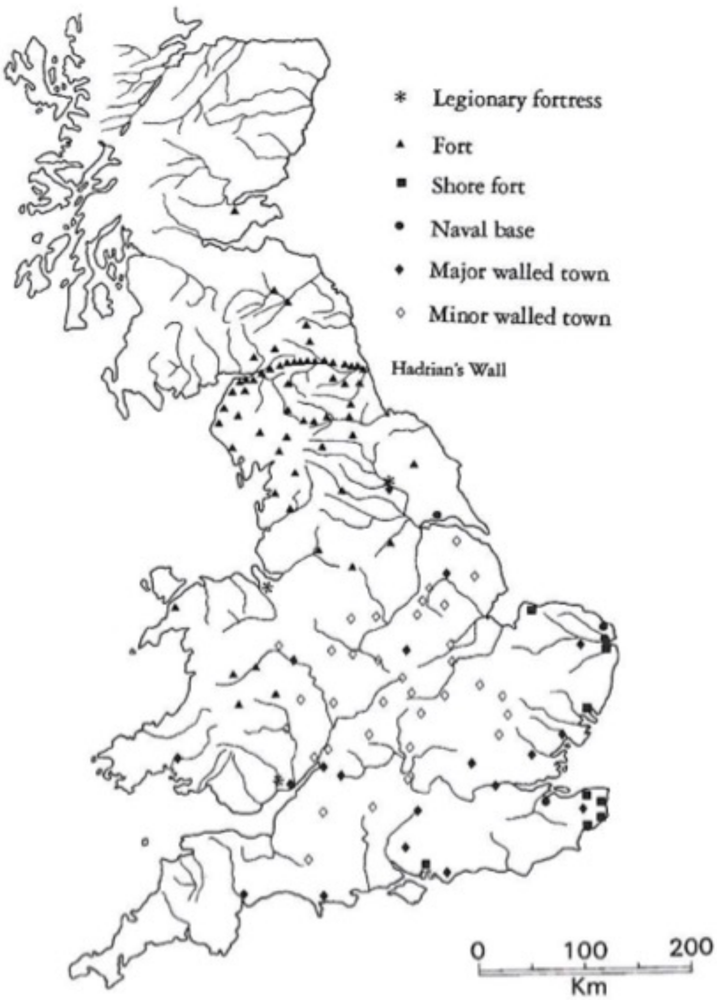


Figure 2.7 Third-century Britain

Source: (Wacher, 1998, p. 45 Fig. 27)

With the Roman invasion, the distribution of power changed from client kingdoms and oppida to Roman administration and military conquest and control. Cities were a major part of establishing administration and authority of the new political ruling class. This featured largely with the collection of taxes, but the presence of the military force was also a factor with administration managed from the cities and the military fortresses.

The use of cities and fortresses was key to the distribution of wealth and as such the associated material cultures. The military material cultures could have been associated with the army supplies and the origins of the legions. In the same way, the city material cultures could have been associated with the origins of the cities (Gardner, 1999, 2001; Greene, 2000; Pitts and Perring, 2006; Bosker, 2022). The distribution of materials can be used to suggest the trade flows from cities to rural areas. The trade flows from fortresses could also have been similar with local exchange arrangements to rural settlements. Towns as nodes in the trading networks can be defined through the material evidence and any evidence of industrial manufacturing. Analysis of the material evidence on sites could provide insights into consumption, identity, and social practices.

Greene (2000) argued that Roman agricultural techniques improved markedly under the Republic and early Empire. New farming techniques fit into the general class of increasing knowledge in the new growth theory. It is reasonable to infer from changes in farm productivity to a rise in total income. Wilson (2002) extended this argument by examining productivity change in a variety of widespread economic activities such as farming, grain milling, and mining. Farming by the Late Iron Age was already beyond subsistence level with the capacity for significant surplus (Millett, 1990, p. 98). With the invasion of Britain in 43 CE, the military forces were a consumer of agricultural products and an *annona* tax on farmers would have led to changes in how farms were managed (Wacher, 1998, pp. 109–110).

2.8 The Chronology of Vessel Glass in Roman Britain

Maritime archaeology has revealed cargoes of glass lost in Roman times on route in the Mediterranean regions to destinations unknown. This is illustrated by Silvestri's (2008) study of the *Iulia Felix*, a Roman ship that was wrecked in the Adriatic Sea dated to the first half of the 3rd century CE, with a cargo of broken glass for recycling and of glass vessels of several shapes. The glass was possibly made by at least two manufacturing centres. Other wrecks have been found with cargoes of raw glass, glass vessels and glass to be recycled dating from 60 BCE to the 3rd century CE (Fleming, 1999; Fontaine and Cibecchini, 2014; Foy, 2017). These indicate complex material distribution movements, but with the purpose and destinations not known. Leidwanger (2017) carried out a study of Graeco-Roman shipwrecks with analysis of single well-explored sites and growing databases of documented wrecks that highlighted patterns in those connections with how sea trade was conducted. This approach that combines other wrecks cargoes combined with a knowledge of glassmaking, glass-working and trading locations could indicate trading network models and possibly help to unlock the development of the glass industry in the first four centuries CE. There is, however, little information that is relevant to the maritime trade between the Continent and Roman Britain during the Roman era.

The outline Planning Policy Guidance 16: Archaeology and Planning (PPG 16) was a document produced by the UK Government to advise local planning authorities in England and Wales on the treatment of archaeology within the planning process. It was introduced in November 1990 and resulted in an expansion of the archaeological material records for sites. A consequence of this will be that new excavations data will update the basis of existing research. The following Tables 2.2, 2.3, 2.4 and 2.5 provide a summary of the characteristics of the glass vessels and the referenced vessel forms reviewed in this research with an indication of the commonality of the finds in Roman Britain. The details are based on the sources noted and are presented as guidance rather than evidence of the Romano-British material records.

The earliest glass in Roman Britain consisted mainly of glass beads with some evidence also of glass bangles (Jackson, 1992, pp. 68–69; Allen, 1998, p. 10). With the invasion in 43 CE, glass vessels reached Britain as military supplies, trade imports to civil markets and carried as personal possessions. A summary of the initial phase 43-70 CE is shown in Table 2.2 and Figure 2.8.

The glass in this phase was generally dominated by drinking vessels and tableware that was of strong colours, with occasional mosaic patterns on bowls and plates and with ornate serving jugs.

Table 2.2 The Trends in Glass Vessels for 43-70 CE

Period 43-70 CE	Characteristics	Referenced Vessel Forms
Drinking vessels, tableware	Vessels had similar designs to pottery. Patterns of colour in the glass as mosaics, with translucent and opaque strong colours and natural blue-green. Mould-blown drinking vessels often had decorations with inscriptions and makers' names.	Most common cast bowl was pillar-moulded bowl. Common drinking vessel form was blown Hofheim cup with horizontal wheel-cut grooves. Cylindrical cups also decorated with sports scenes (fairly common). Cantharus cup with stemmed base, some with two-handles (uncommon).
Containers and serving vessels	Simple ribbed serving vessels, classic shapes with glass decorations as trails and blobs. Conical bodied flasks and simple unguent bottle small containers.	Mould-blown amphorisk convex jug with two ribbon handles (not very common).

After sources: (Allen, 1998, pp. 19–27; Price and Cottam, 1998, pp. 63, 68, 71, 147) *with amendments*

The following phase of glass trends represents the continued conquest of territory north to Scotland followed by the consolidation of the occupied regions of Britain between 70-170 CE, as summarised in Table 2.3.

Table 2.3 The Trends in Glass Vessels for 70-170 CE

Period 70-170 CE	Characteristics	Referenced Vessel Forms
Drinking vessels, tableware	Increasing colourless vessels, monochrome. Common drinking vessels were blown cups and beakers, usually colourless, with cut facets.Common tableware were bowls, plates with wide everted rims, long necked jugs and globular ribbed jars.	Mould-blown conical beaker some with decorations of fruit or motifs. Globular ribbed jar and smaller jugs with spouted rims.
Containers and serving vessels	Mould-blown bottles in blue-green as tall-narrow or small-squat containers in undecorated designs with base marks. Small unguent containers were common.	Cylindrical and square bottles common. Hexagonal, rectangular bottles shapes also seen in a variety of sizes.

After sources: (Allen, 1998, pp. 28–38; Price and Cottam, 1998, pp. 75, 80, 135–145, 191–209) *with amendments*

The following glass trends (Table 2.4) represent the transition into a phase of coexistence for the period 170-300 CE.

Table 2.4 The Trends in Glass Vessels for 170-300 CE

Period 170-300 CE	Characteristics	Referenced Vessel Forms
Drinking vessels, tableware	Colourless drinking vessels, some with snake-thread glass found near Cologne suggesting manufacturing centre there. Continued evidence of vessels with engraved decorations.	Colourless cylindrical cup with fire-rounded rim. Hemispherical cup from c. 230 CE.
Containers and serving vessels	Continued glass bottles as large containers and a few varieties of unguent bottles.	Bath-flasks common until the 3rd century CE. Mercury flask frequently found on continent, rare in Britain. Blue-green square bottles still common, but large bottles now rare.

After sources: (Allen, 1998, pp. 39–47; Price and Cottam, 1998, pp. 99, 101, 115, 179, 188) *with amendments*

The use of colourless glass continued as a trend with and increasing use of engraved marks. The final phase of glass vessels details the general trends for 300-410 CE in Table 2.5.

Table 2.5 The Trends in Glass Vessels for 300-410 CE

Period 300-410 CE	Characteristics	Referenced Vessel Forms
Drinking vessels, tableware	Colourless vessel now also pale-green, yellow-green light colours. Decorations continued trailing and engraving. Rims now cracked off not fire-rounded. Cage-cups as evidence of glass-cutting expertise, probably from Cologne.	Hemispherical cups and conical beakers were common drinking vessel forms. Ovoid jugs more common in this period.
Containers and serving vessels	Continued glass bottles as large containers and small uguent bottles.	Late Roman bottle type was the mould-blown barrel-shaped Frontinus bottle, probably made in northern France.

After sources: (Allen, 1998, pp. 48–55; Price and Cottam, 1998, pp. 75, 80, 147–167, 209) *with amendments*

These phases describe the trend towards more colourless vessels, particularly drinking vessels, the introduction of glass bottles as a significant large container probably for oil or wine that continued as mould-blown blue-green containers but with a reduced variety of shapes. The following Figures 2.8, 2.9, 2.10 and 2.11 show the shapes of some of the referenced glass vessel forms for the phases described above as drinking vessels, tableware, bottles and serving vessels.

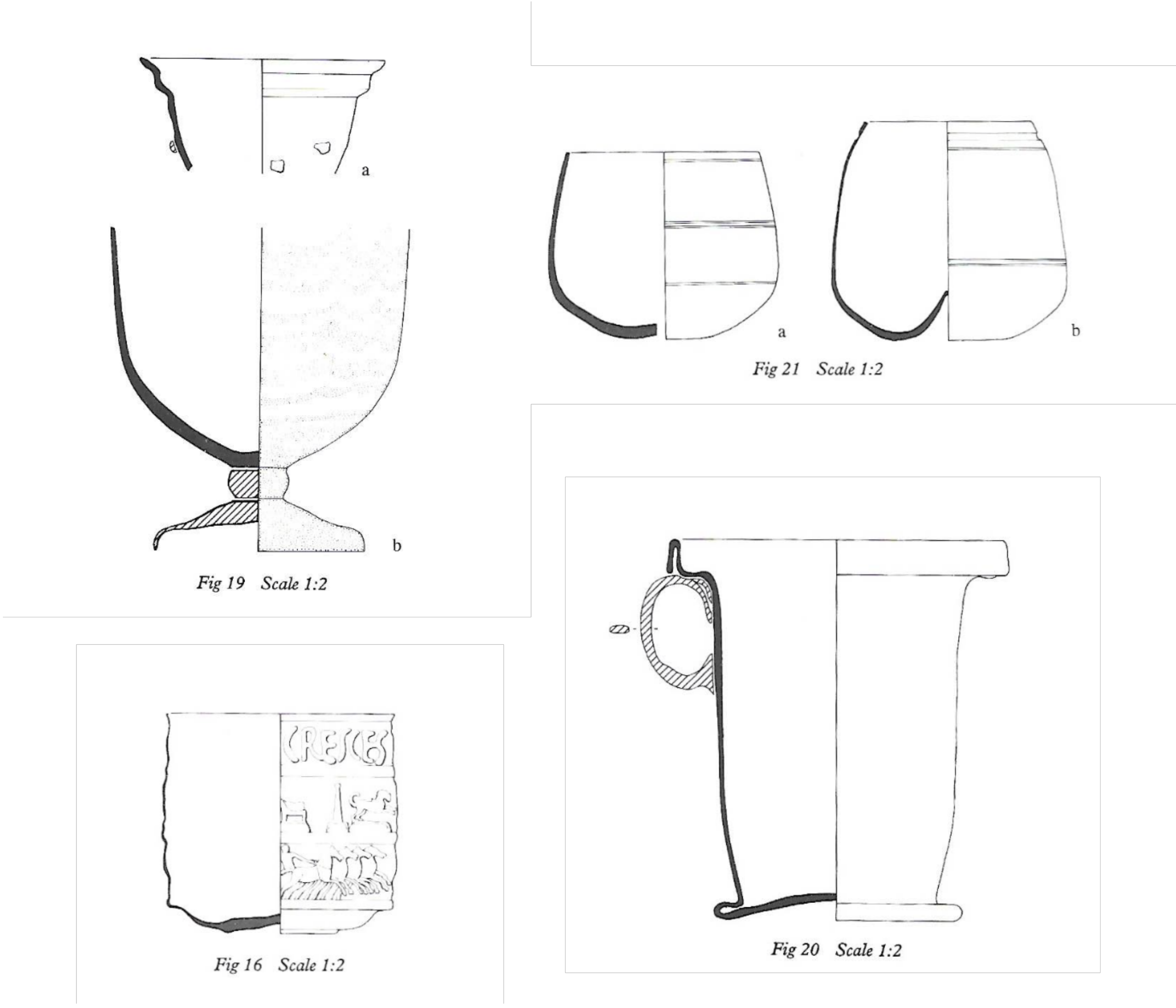


Figure 2.8 Some Cups 43-70 CE: Fig 19 Cantharus cup, Fig 21 Hofheim cup, Fig 16 Sports cup, Fig 20 Modiolus cup (drawings by Y Beadnell)

Source: (Price and Cottam, 1998, pp. 64, 69, 71, 72)

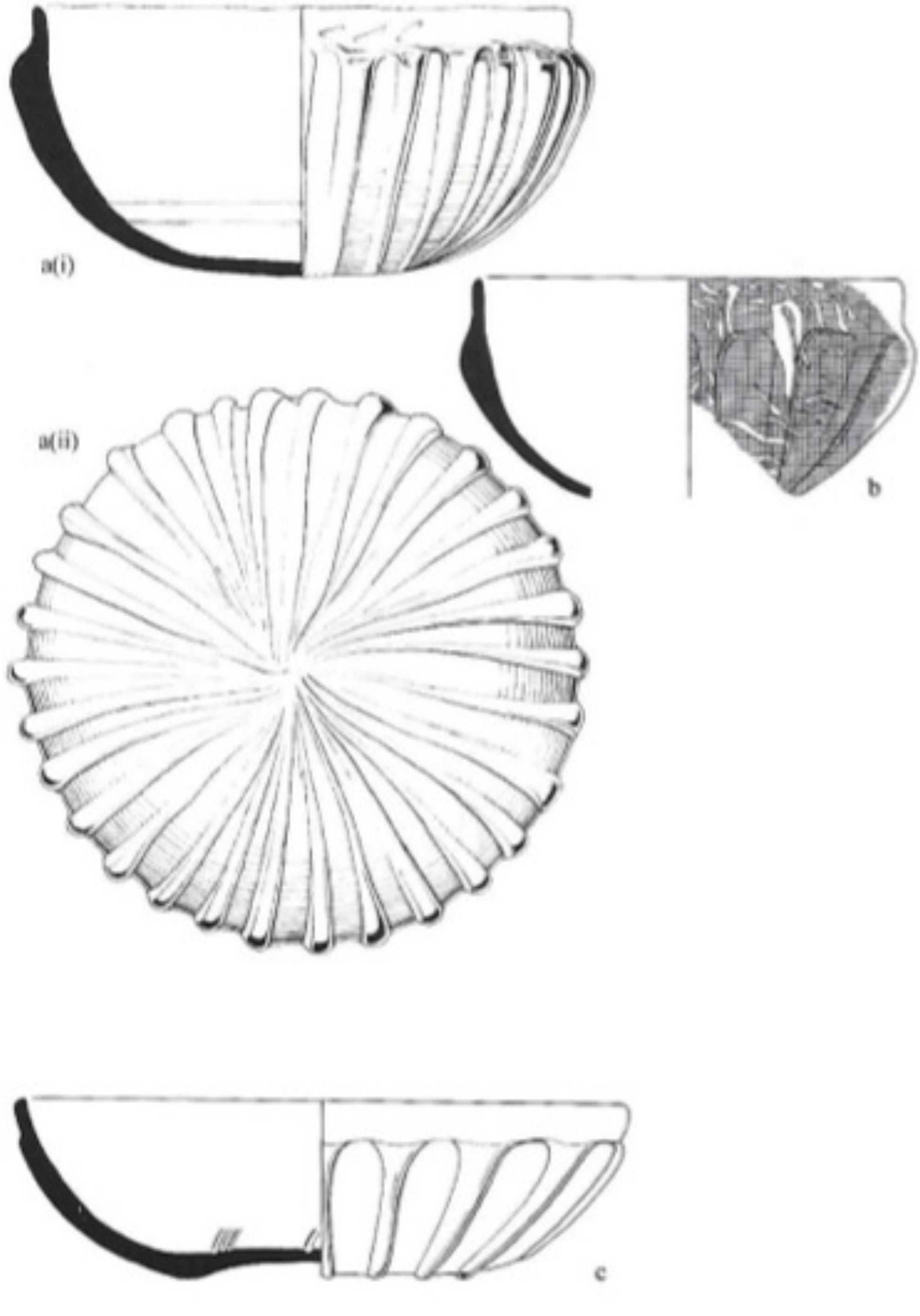


Figure 2.9 Pillar Moulded Bowl Views (drawing by Y Beadnell)

Source: (Price and Cottam, 1998, p. 45 Fig 7)

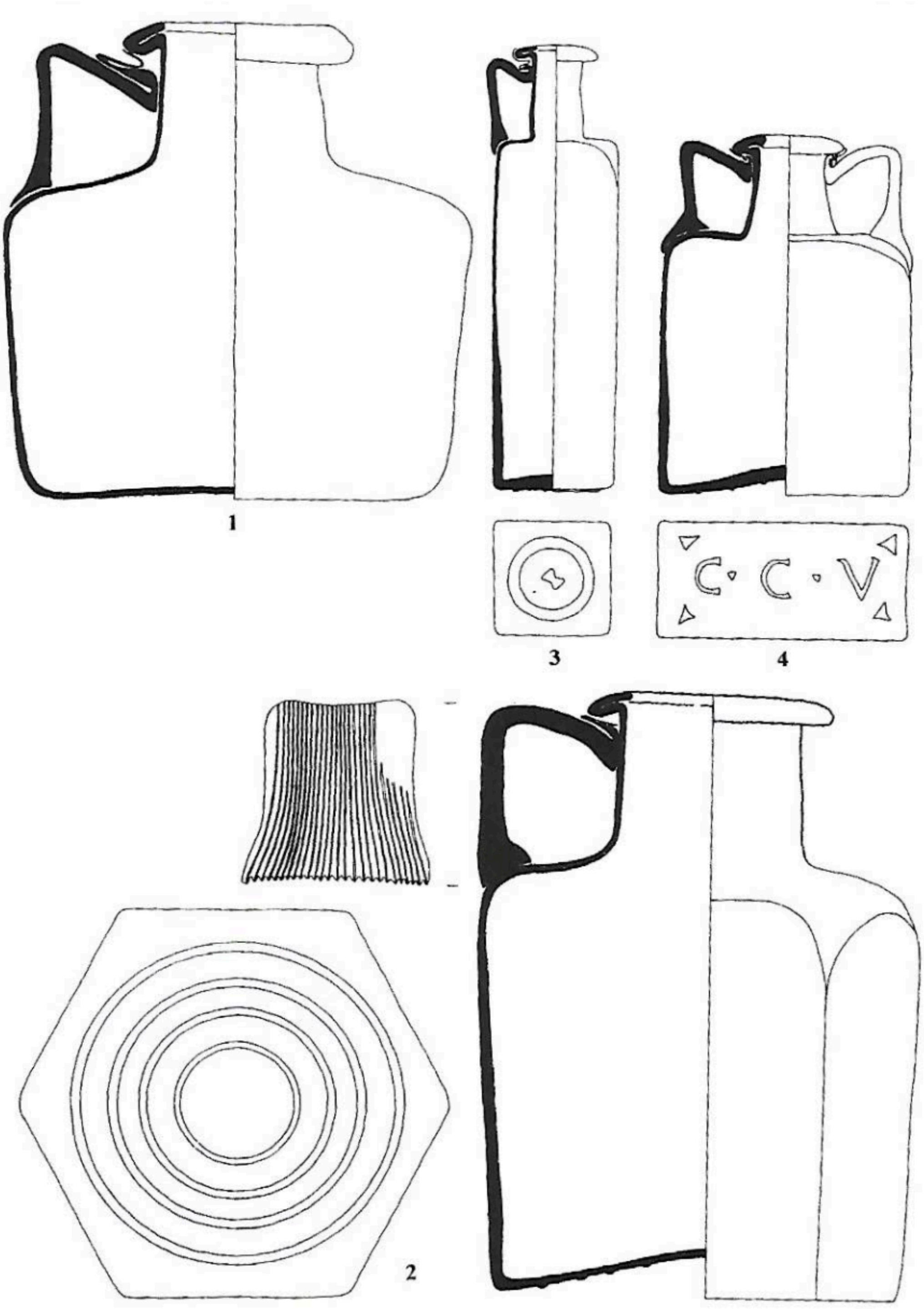


Figure 2.10 Some Bottle Shapes and Sizes 70-170 CE: 1 cylindrical (40-120 CE),2 hexagonal (70-120 CE), 3 square (40-200 CE), 4 rectangular (150-200 CE)

Source: (Allen, 1998, p. 33 Fig. 22)

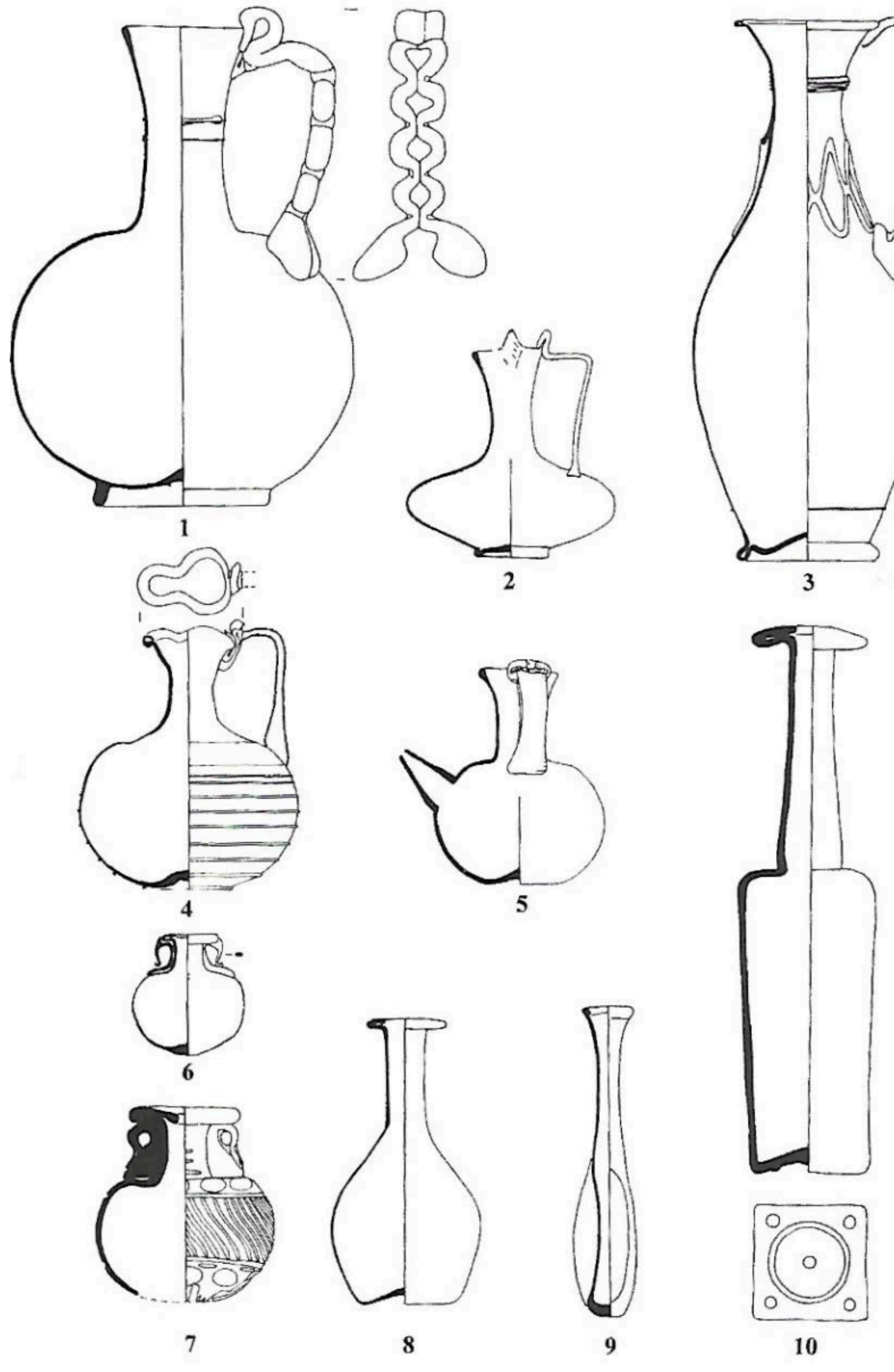


Figure 2.11 Some Serving Vessels and Containers 170-300 CE:1-5 Jugs, 6-7 Bath-flask, 8 Ovoid flask, 9 Unguent bottle, 10 Mercury bottle

Source: (Allen, 1998, p. 41 Fig. 29)

2.9 Summary

The literary review of the glass industry highlighted that the introduction of glass vessels to Britain came with the Romans and that previously there were few examples of glass in the region. Several sources indicated that the invasion generated an influx of immigrants familiar with glass from their own countries of origin, and that this expanding market of consumers coincided with the development of the glass industry that could expand the portfolio of glass products using traditional techniques and the newly introduced glass-blowing technologies.

The invasion also changed the native economy of Britain by essentially being part of a larger established trading community and a Roman model of trading networks based on large cities and elites and long distance transports for staples. The hypotheses at the core of the research study have been set out in the literary review in the areas of economics, social and material cultures, and trade. The following outlines how the research responded to the hypotheses.

The role that the large cites played in the Roman economy was important for money flows and as centres of market demand. This was assessed through analysing the glass proportional profiles of cities for patterns of glass types and making comparisons with other settlement types, civil and military. The commercial profitability of the glass industry was investigated from the analysis of the centres of distribution, the long distance and local movements of goods and the assessed prosperity of locations based on the affordability of glass.

The cultural drivers that could have influenced the consumption of glass were examined by associating the evidence of the ranges of the glass types and forms from the excavation sites with the history of the movement of peoples and their origins . The hypothesis that glass vessels could have status value was assessed from patterns of glass types and forms with marks and decoration. The material cultures of locations were assessed from combining a knowledge of the origins of the settlement communities with the site glass profiles. The site types as military or civil, city, town or rural was relevant to these assessments.

The ability of the glass industry to respond to changes in demand was assessed from the chronological changes of the site glass profiles of the large cities of Colchester and St Albans. In the period immediately following the invasion in 43 CE, they were both developed to the model of a Roman city as regional administration centres. The native Boudican revolt in 60/1 CE destroyed these settlements and that enabled the sites' glass profiles to be examined for the time frames before and after this event. This provided patterns of changes to the site profiles that reflected the supply of glass to the cities and with the changing fashions of glass characteristics over these time periods.

The questions about the sophistication of a trading network were advanced by investigating the known Roman glass production locations and probable distribution routes with the patterns of the consumption of glass types and forms across regional locations and their settlements. These provided insights into the potential role of towns as trading nodes in the Romano-British network. The distribution of identifiable glass types to settlement types was investigated for patterns of association that reveal whether some glass products could have been delivered to particular destinations. This led to the importance of glass-working centres to the supplies of glass vessels into Britain. The literature review revealed the large numbers of glass-working centres in Gaul and the Rhineland. However, other than London and a few other locations, the evidence for glass-working in Roman Britain was sparse. The scenarios of imports and in-house production were included in the analysis and assessments made of the transports of glass vessels as heavy loads by road, river, and sea to various destinations in Roman Britain. The hypothesis that military transports and the distribution routes were more than likely controlled by the military was assessed.

3 METHODOLOGY

3.1 Introduction

The methodology involves the processes and techniques used to enable the research to be carried out and underpin the validity and confidence in the analyses results. The approach included using a typology framework, recognising the taphonomy aspects of the archaeological record, collecting and compiling data that represented the presence of Roman glass vessels on settlements, and analysing the data for the information of the trading and consumption of glass in Roman Britain.

This chapter sets out the purpose and an outline of the main components of the methodology, followed by the principles and details of the data typology and taphonomy applied to this study, the design and development of the study database, and the analysis techniques used.

3.1.1 Purpose of the Methodology

The purpose of the methodology was to develop and manage a database that was used in an investigative analysis of the associations between selected datasets. This involved a structured approach to collect data from various sources that was converted into a digital data format so that it could be collated into a database developed for this study. The methodology included the means to select datasets from the database for analysis and modelling. A cornerstone of the approach was the management of the database to ensure data quality and ultimately therefore provide confidence in the research analysis.

3.1.2 Outline of the Methodology

This study was based on using the data of archaeological finds as evidence of the presence of the original glass at the place of deposition. As has been stated earlier, objectives of this research were to use the patterns of composition within sites and the distribution across regions as evidence of the consumption and trade in glass. This chapter describes the approach taken to collect and compile the source-detailed fragmentary glass assemblage data that represents the finds on the sites selected for study. The source fragmentary data were published in excavation reports as the catalogued accession line details of the fragmentary finds that also includes the archaeological context and the dating assumptions. The accession line catalogues were published in hard copy or digitally available excavation reports with the catalogues in some later reports accessible as digital datasets for download. The hard copy catalogues needed to be converted into a digital format that was manual and very time consuming given the need to quality check the outputs. The conversion process was not always complete and correct. Unfortunately, there were some archived datasets that were extremely difficult to access, and the recent increased use of the Archaeology Data Service (ADS) as an accessible download data repository is of huge value to researchers and welcomed by this author.

Defining the study data involved using a typology framework based on the data structures from characterising the archaeological fragmentary glass evidence compiled from the excavation reports. This data included the glass characteristics, the contexts of the finds and the dating assessments. The database framework was developed through applying a typology that was in a dialectical relationship with the excavated fragments. Basically, this was not a simple compare and record to a model typology process, but one in which the typology was matched to the excavated material and then the typology framework altered according to the results. The typology framework was thus developed to fit the reality of all excavation typology conventions applied to the selected corpus. The taphonomy part of the framework associated the glass characteristics data with the details of how, where and when the finds entered the archaeological record. These were factors relevant to the selection of the sites for analysis.

The data analysis section sets out the analysis principles, the rationale for quantitative proportional analysis, and taking account of the chronological implications of the finds. The analysis techniques used are described including comparative quantitative proportional analysis, correspondence analysis, and the developed site scoring system to generate information of the site compositions and regional distributions of glass types and forms.

3.2 Defining the Study Data

3.2.1 Typology

The primary sources of data were the archaeological accession line data reported from excavation sites. The data sets relevant to understanding consumer material cultures were glass vessels categorised in the classes of containers, drinking vessels, and tableware. Specialist archaeologists made judgements of the glass vessel type and form based on the inferred shape and features from the recovered fragmentary parts of the original object. A challenge in using glass data was the confidence level of the vessel identification particularly where that was based on small quantities of fragmentary glass evidence. Observations of glass shape, glass markings, decorations, descriptions of rims, bases and handles were used to identify the original vessel.

The assessment of whether glass fragments were coloured or colourless could have been difficult due to the size of the fragment and the quality of the glass. An assessment of the actual colour could have been a subjective judgement as the fragment thickness and the fragment part of the original vessel are variables that can affect the perception of colour. For this study, the colour and characteristics reported were taken as the material record.

The core attributes used in this study were whether the original form was a closed or open vessel. The original functional use of individual vessels is not known. Closed vessels such as flasks, bottles and unguentaria would have been used as containers for serving or carrying food, drink or perhaps medicines. Open vessels include cups (short), beakers (tall) and low, open vessels such as bowls and plates. Jars are used to describe closed short, constricted vessels and jugs as closed long, constricted vessels with necks and handles and some with pouring spouts; these could have been used to contain food and liquids as serving tableware. Bottles with short necks and handles would have been used as containers. There was little direct evidence available to classify vessels as tableware for eating or drinking, for serving vessels for food or drink, or simply as objects for display.

The glass types were categorised into a hierarchy of levels, with the highest-level glass classes based on the possible functional use of the glass types. The glass vessel classes included containers (e.g. bottles, phials), drinking vessels (e.g. cups, beakers), and tableware (e.g. bowls, flasks). The glass vessel hierarchy is illustrated in Table 3.1. Comparisons were made across locations at class level with the lower-level details of types and forms that are types with particular features.

Table 3.1 Glass Vessels Class Type and Form Hierarchy

	Container		Drinking	Table & Storage
Glass Classes	Container-large	Container-small	Drinking Vessels	Tableware
	container for liquids or solids that could be transported, distributed and reused	for holding and carrying small amounts of liquids or solids, e.g. cosmetics, medicine, salts, perfumes	for drinking liquids, small vessels, can be have glass on glass decor and usually engraved lines; some with handles and stemmed base	used as tableware or domestic decoration for display, possible associations with status and domestic lifestyle
Glass Types	bottle, prismatic bottle	unguent bottle, bath-flask, phial	beaker, cup, goblet	bowl, flagon, flask, jar, jug, plate, pot, urn, vase
Vessel Forms (examples)	cylindrical bottle, frontinus bottle, square bottle	tubular unguent	arcaded beaker, cantharus cup, Hofheim cup, modiolus	amphorisk, bath flask, mercury flask, conical jug, pillar moulded bowl, millefiori bowl

Source: author

The analysis was confined to glass vessels because they were common domestic, individual traded products that had pottery or metal products as alternatives for comparison. The broader range of glass products included construction materials (e.g. windows, tesserae), utensils (e.g. stirring rods) and personal items (e.g. beads, bangles, counters, inkwells). The construction materials were not particularly common finds but could be revealing given associations with lifestyle activities. The utensils were not common finds and have no significant diagnostic value. The personal items beads, bangles and counters in contrast could be very common, with the latter commonly found in soldiers' barracks and burials. These can provide context to a deposition area. Glass inkwells were very rare and again could provide supplementary detail to a location, and more than likely would have been part of the personal property of an individual perhaps carried on journeys.

The typological hierarchy was based on the glass classifications of class, types and forms detailed in catalogue guides (Isings, 1957; Price and Cottam, 1998; Foy *et al.*, 2018). These guides form a body of knowledge of a typology chronologically organised. The conventional typology vessel classes were the containers, drinking vessels and tableware classes that include the glass type (such as bottle, beaker, cup, bowl jar, jug, flask, and plate) and the characteristics (such as colour, shape of the body, rim, base). The glass forms were types with specific characteristics that can be attributed to broad chronological periods as they have been referenced in catalogues (Isings, 1957; Price and Cottam, 1998). Whether the vessel was an open or closed vessel is a feature that could be used to define the function associated with the method of fabrication using cast, mould-blown or free-blown glass techniques.

The glass fragment database included the observed physical characteristics of the glass fragments such as colour, shape, markings, decorations, and the dimensions of the fragments. The excavation reports also included specialist inferred characteristics of the original vessel parts, such as the body or rim diameters, and the original vessel heights. These details together with the excavation report details of the finds site and dating evidence were included in the database.

The approach in this research was to use as much of the reported observed glass typological characteristics, namely shape, colour, glass on glass decoration (decor), with also marks such as facets and indents, manufacturing mould and grinding marks that can be included in the excavation reports accession line detail. The reports also included inferred glass types (e.g. cup, beaker, bowl, bottle, etc.) and, if distinguishing features were present, identified glass forms (e.g. amphorisk, Hofheim cup, square bottle, etc.). This grouping of glass type into glass classes was adopted as used by Cool & Price (1995) with large containers (e.g. bottles), small containers (e.g. unguent bottles and phials), drinking vessels (e.g. cup, beaker and goblet), tableware (e.g. bowls, flasks, jars, jugs) and also construction materials (e.g. window and tesserae), individual used objects (e.g. jewellery beads, bangles, pins, etc.) and utensils (e.g. lids, ladles, etc.). There was a no-class category for fragments that were diagnostically confirmed as vessel types, but inconclusively confirmed as a single type or class (e.g. cup or bowl). The conventions used in this study are summarised in Table 3.2 for the glass vessel class, type, and form designations of the drinking vessel, tableware and container classes.

Table 3.2 Common Glass Catalogue Forms Functional Uses

Glass Class	Glass Type	Features Open / Closed	Assumed Functional Use	Related Forms
container-large	bottle	closed-short neck & handles	containing & carrying liquids / solids	amphora, cylindrical-bottle, square-bottle, frontinus-bottle
container-small	unguent	closed-small tubular	containing & carrying liquids / solids	
drinking	beaker	open-tall	drinking liquids	almond-knob-beaker, arcaded-beaker, catharos, cup-base-ring, cylindrical-cup-fire-rim, hofheim-cup, indented-beaker, modiolus, ribbed-cup, skyphos, sports-cup
	cup	open-short	drinking liquids	
	goblet	open	drinking liquids	
tableware	bowl	open-low	serving food or drinking liquids	amphorisk, bath-flask, bulbous-jug, conical-jug, cylindrical-bowl, mercury-flask, pillar-moulded bowl, ribbed-bowl, tubular-rimmed-bowl,
	flagon	closed	table serving liquids	
	flask	closed	table serving liquids; bath flask to carry scents and salts and not a table serving vessel	
	jar	closed-long constricted neck & handles	storing food or liquids	
	jug	closed-short constricted neck	storing and serving food or liquids	
	plate	open-low	serving food	
	pot or urn	closed	storing and serving food or liquids; also primary or secondary used for burial of ashes	

Sources: (Isings, 1957; Cool and Price, 1995; Price and Cottam, 1998; Foy *et al.*, 2018)

The descriptions of the related forms are set out in Tables 3.3, 3.4, 3.5 with the sources noted. These were forms of glass types identifiable from features of body, base, rim or handle shapes and had been catalogued with descriptions from known examples of dimensions, date ranges and locations.

Table 3.3 The Glass Drinking Vessel Forms Descriptions

Drinking Vessel Glass Form	Description and Reference
Arcaded beaker	A beaker with applied decoration (Isings, 1957, p.33; Price and Cottam, 1998, p.83)
Cantharus cup (sometimes called cantharos)	A cup with a stepped rim and stemmed base; not common in Britain and dated to the 1st century CE (Price and Cottam, 1998, p.68)
Cup on base ring	Cup on base ring (Isings, 1957, p.85)
Cylindrical cup with a fire-rounded rim	Cylindrical cup with fire-rounded rim & trailed decoration (Isings, 1957, p.85; Price and Cottam, 1998, p.101)
Hofheim cup	A convex cup with wheel-cut lines that was very common on sites in southern Britain with date range 43-c 75 CE (Price and Cottam, 1998, p.72)
Indented beaker	The indented beaker with concave base has a vertical or out-turned rim, edge cracked off ground smooth, indented body, concave base. This form was common 1st - 4th century CE (Isings, 1957, p.32; Price and Cottam, 1998, p.85)
Ribbed cup	Ribbed cup (zarte Rippenschale) has trails, a curved rim and a convex body (Price and Cottam, 1998, p.67)
Sports cup	A mould-blown sports cup that displays, in zones of decoration, scenes from the circus or arena and was a fairly common find on sites in southern Britain in the 1st century CE (Price and Cottam, 1998, p.63)

Table 3.4 The Glass Tableware Vessel Forms Descriptions

Tableware Glass Form	Description and Reference
Amphorisk jug	Amphorisk jug with pointed base (IS60) ; Convex jug with two handles (amphorisk Price and Cottam, 1998, p.147)
Bath flask	Small globular flasks with two looped handles that were very common particularly in the 2nd and 3rd centuries (Price and Cottam, 1998, p.188)
Conical jug	Conical jug (Price and Cottam, 1998, p.152) with long neck, angular ribbon handle, and concase base (IS55a) also with open base ring (long neck, concave base) (IS55b)
Cylindrical bowl	Cylindrical bowl was a cylindrical dish with outsplayed sides (Isings, 1957, pp.22-23; Price and Cottam, 1998, p.50)
Pillar-moulded bowl	A cast glass bowl seen in monochrome in usually blue-green or in polychrome with many colours represented and complex floral or spiral patterns achieved from rods and millefiori arranged on a plate that was slumped into a mould at a high temperature (Price and Cottam, 1998, p.44)
Ribbed bowl	A trailed ribbed cup, relatively uncommon and found in the mid 1st century in southern England (Price and Cottam, 1998, p.67)
Tubular rimmed bowl	Not common but found on some sites in southern Britain with a date range of 43-65 CE (Price and Cottam, 1998, p.77)

Table 3.5 The Glass Container Forms Descriptions

Container Glass Form	Description and Reference
Cylindrical bottle	Very common in the 1st century and were made with ranges of heights (c. 150 – 400 mm) and body widths (c. 80 – 250 mm) (Price and Cottam, 1998, p.191)
Frontinus bottle	Frontinus bottle; known as barrel jug (IS89); cylindrical bottle with corrugated body as frontinus bottle (Price and Cottam, 1998, p.209)
Square bottle	Commonly seen on all 1st century CE settlements and lasting longer than the cylindrical bottle glass form continuing towards the end of the 2nd century CE (Price and Cottam, 1998, p.194)

The evidence of types and forms related to sites are described in Chapter 4 'The Presentation and Assessment of Data for Analysis'.

3.2.2 Selection of Sites

A selection of sites was made that represented a diversity of locations across Roman Britain. The selected sites were included in the bibliography as archaeological references. Sites were selected that represented the site types and had sufficient samples of glass data. Site types were identified based on the classification used by Perring and Pitts (2013). These included:

1) large cities recognised in Roman times as regional administration centres
2) towns that could include industrial work centres for iron and pottery working
3) rural settlements as low-status farms and high-status villas
4) military occupied sites, some with civilian settlements (*vicus)*
5) shrines and burial sites

The sites in Roman Britain are detailed in Table 3.6.

Table 3.6 Sites Analysed in this Thesis

Site Types	Sites	Site Types	Sites
Military Sites	Birdoswald	Urban - Large Cities	Colchester
	Caerleon		Silchester
	Carlisle		St Albans
	Castleford		Wroxeter
	Corbridge	Town - Industrial Settlements	Catterick
	Elginhaugh		Scotch Corner
	Inchtuthil		Walton le Dale
	London		Wilderspool
	Piercebridge	Rural Settlements	Barton Court Farm
	Ravenglass		Frocester Villa
	Ribchester		Gorhambury Villa
	Strageath		Piercebridge Villa
	Usk		Graeanog Ridge Farm
	Watercrook	Shrines & Burial Sites	Gloucester
	Wroxeter		Stanway
	York		Uley
			Skeleton Green

The site types are categories based on the dominant role of the settlement in the region across the periods of time. The military sites are categorised as such as they had military structures for significant periods of the occupation of the site. This can oversimplify the lifecycle of the sites as there are examples where the military role was secondary to that of a trading or supply centre, as for example for London as a fortified town and Piercebridge as a garrison town. The origin of Colchester as a fortress for a short period was overshadowed by the development into a major large administration city and hence it is categorised as such. In contrast, the origin of the large city at Wroxeter was a fortress for several decades and so the fortress and the city are separately listed. These are nuances that will be revealed through the details of the chronology, origins and occupation of the sites in Chapter 4. The selected sites are shown geographically in Figure 3.1 with the main road networks and tribal areas of Roman Britain shown in Figure 3.2.

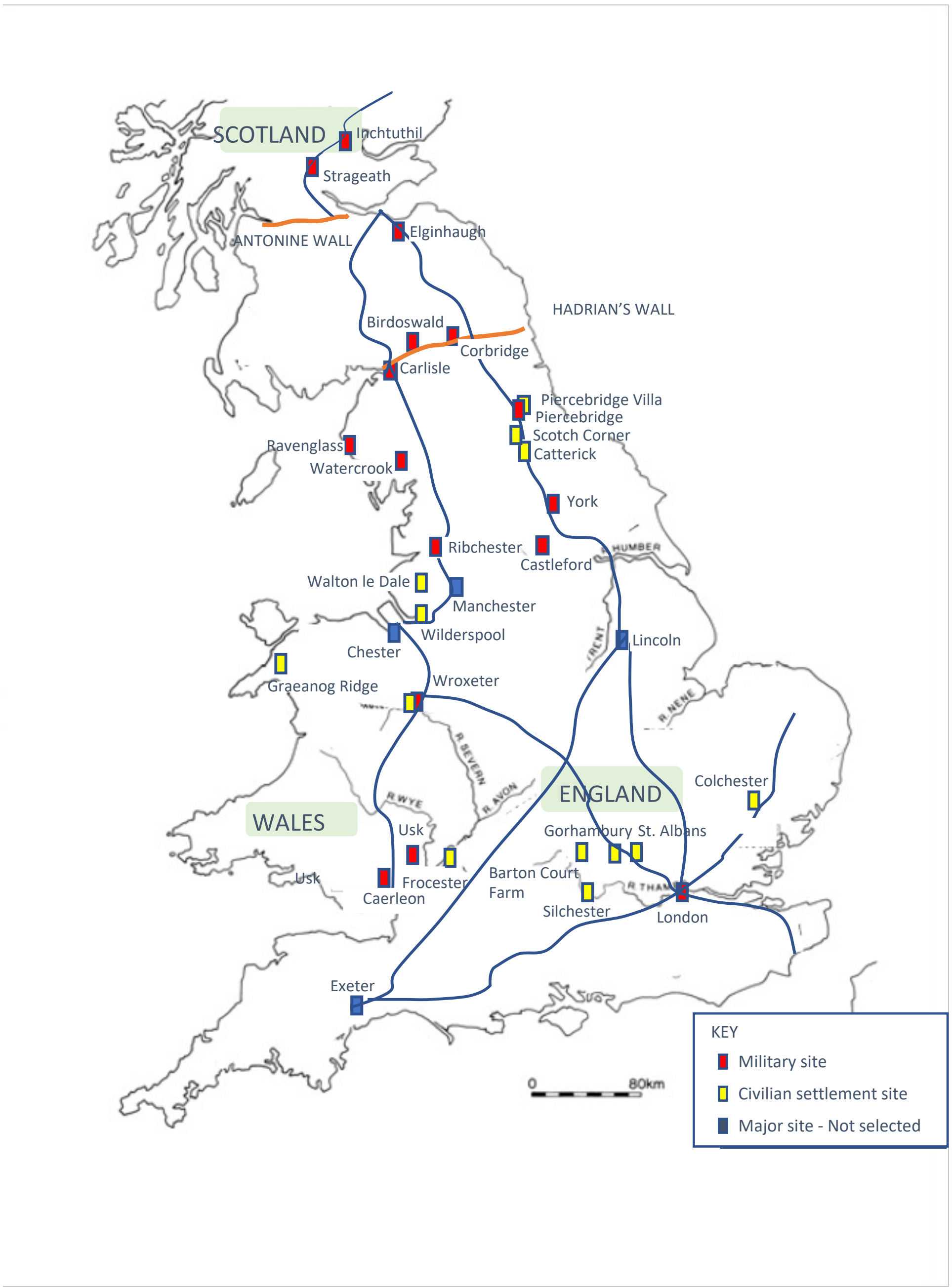


Figure 3.1 The Selected Sites in Roman Britain

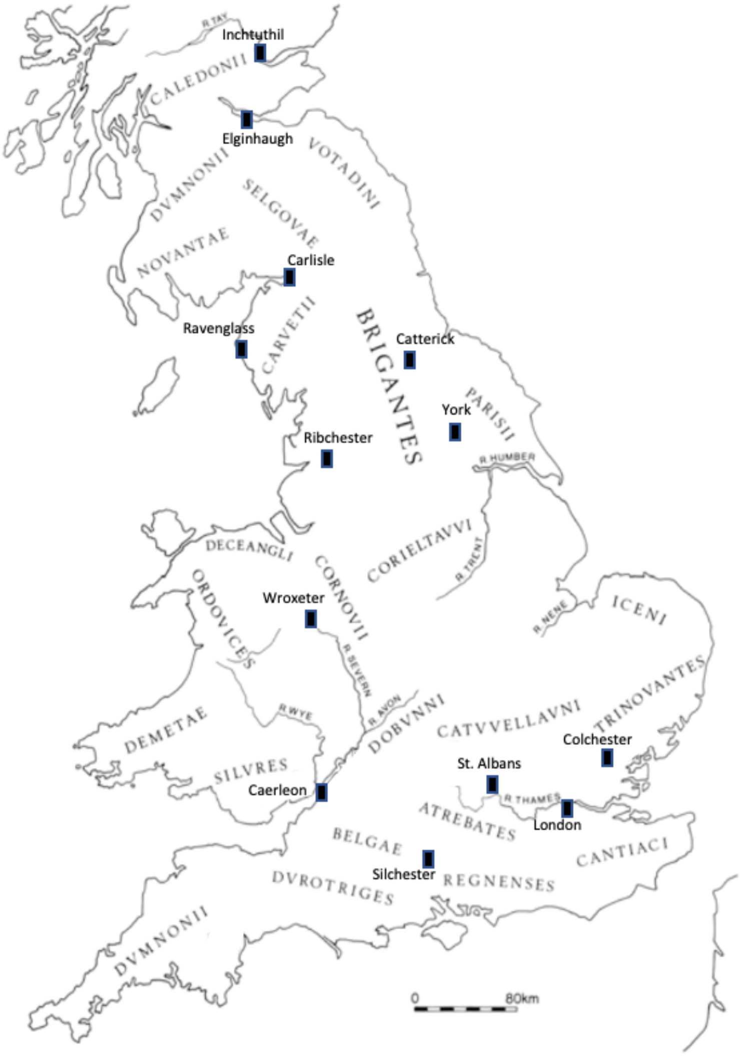


Figure 3.2 Britain in the First Century CE

Source: (Webster and Chadderton, 2002)

These figures show the geographical and political landscapes relevant to understanding the contexts of sites. As the taphonomy of the glass is designed to recognise the different types and forms of the original complete glass vessels, the lifecycle of the original complete glass vessels can widely differ particularly in the final phases of disposal and deposition prior to recovery. The next section outlines the approach for this study to compensate for this.

3.2.3 Taphonomy

Archaeological finds are generally not discovered as complete objects, but as fragments representing parts of the original forms. As discussed previously, the form-fabric typologies can guide the identification of the original vessels. The diagnosis should take account of the reported evidence and the variability of the data itself (Baxter *et al.*, 1995; Baxter, Cool and Jackson, 2005). This applies to organic materials, animal or plant, with the implications of the journey from deposition into the excavated material record and is relevant to inorganic materials. The taphonomy of glass assemblages included the considerations of how material entered the archaeological material record with any potential biases in the data.

The causes of bias that can influence the material record are that the:

- Disposal methods, accidental or deliberate, could determine where the remains of the object were left and can influence the quality of the samples, the dating and context
- Fragility of the object could have influenced the quantity of the fragments left in the ground
- Size of the excavation site and recovery methods could influence the categorisation, identification, and reporting of the archaeological material record and the sample size
- Occupancy duration of the settlement could influence the quantity of the recovered finds

These sources of bias were considered for each site and are set out in the next section.

3.3 Data Analysis

3.3.1 Quantitative and Qualitative Data Analysis

The need for quantitative data is a core requirement for any comparative analysis. The base archaeology excavation data consisted of accession lines that each included the details of the reported fragmentary glass assemblages with the details of the physical evidence including the number of fragments, the observed and inferred characteristics, and the identification of the original vessel type and form if there was sufficient evidence to make that possible.

Orton and Hughes (2013) outlined the main approaches to quantify the number of vessels by fragment, by the number of vessels and concluded that only vessel-equivalents and weights can be used reliably to calculate the proportionality of assemblages. The vessel equivalent assessments try to calculate the number of the original vessels using various methodologies that utilise the numbers of fragments in assemblages. These include the estimated vessel quantity (EVQ), the estimated vessel equivalents (EVE) and the minimum number of vessels (MNV) approaches. There are issues with all these approaches with potential sources of error and bias from the collected and reported archaeological fragmentary evidence (Orton and Hughes, 2013). However, they have been used in research studies as accepted ways to arrive at the number of vessels in an assemblage and that number can then be used in quantitative analyses (Cool and Price, 1995; Perring and Pitts, 2013).

The quantification of vessels is an area of challenge for glass given that the quantity of fragments generally is less in comparison with pottery possibly due to the ability to recycle and re-melt glass (Cool and Price, 1995; Willis, 1998). The quantification of pottery vessels is based on the much larger quantity of pottery fragments, the well-defined vessel types and in particular the fact that with this evidence the number of vessels can be based on handles (Cool and Price, 1995; Willis, 1996; Perring and Pitts, 2013). The methodology for ceramics has some possibilities, but without glass fragment weights recorded, this has limited application for glass. Using the sites' percentage proportional profiles of glass types for cross site comparisons has the benefit that the scale of all the data used is the same, which satisfies the particular data constraints for correspondence analysis. As with all data sets, any potential issues with the proportionality of the data can be assessed by investigating the archaeology for the deposition or excavation scope to better understand and make appropriate adjustments as necessary.

The approach taken in this study was to use the accession lines themselves as the base data and modify these quantities to percentage proportional counts of the combined accession lines for a particular site for defined periods. Each accession line represented the number of fragments found in a deposition site context. The research of Perring and Pitts included a comparison between using MNV and percentage proportional accession line counts for sites and concluded that while the base data was different, the modified data from both approaches was very similar (Perring and Pitts, 2013, p. 214). A comparison was made in this study using EVE data from Colchester with study accession line counts data from the same site and in both cases the percentage profiles were similar (Cool, 2006, p. 178). The calculation is shown in Appendix 1. The similarity of the percentage counts from this study with the EVE percentages validated this approach.

The main point of principle was that the percentage counts of a accession line site assemblage represented the presence of an original vessel deposited at the location in Roman times. Proportional representations of the presence of glass on a site or across regions were used as quantification measures of the original population of the glass. The presence of identified glass types and forms proved to be useful indicators of the distribution patterns across sites and periods of time.

3.3.2 Comparative Proportional Analysis

Comparative proportional analysis was used to investigate the relationships between types, forms, particular colours, recognisable decoration types and settlement types based on the sites data. Comparative proportional analysis is an approach that can use qualitative variables in a quantitative way to determine which inferences can be empirically supported by a data set. The data sets were extracted from the study database of accession lines where each row is based on an individual free-text description for each find together with the unique find identification number, an assessment of the period date and with details of the site find deposition context. These accession line free-text descriptions were supplemented with additional relevant data from the narratives in the reports that discussed the finds. The free-text descriptors provided the detail of the fragment(s) as a part of the original vessel with characteristics such as colour, body marks and glass on glass decorations. All these descriptors were compiled into accession line characteristics as data fields in columns. These accession line categorical sets of data were the basis for the qualitative analysis carried out in a quantitative way. The application of quantitative methods to essentially qualitative categorical data, such as the characteristics of a glass artefact and its vessel type, colour, shape, marks, and decoration was based on the fragmentary evidence of an original vessel, represented by the accession line detail. These accession line counts of occurrence across a data set were used to describe the dataset using tables, summaries, and graphs, as descriptive analyses modified through proportional site representation to minimise the effects of bias across sites.

However, they were not used to reflect any inferences of quantity of the original glass vessels population as the accession lines do not represent estimates of vessel numbers - there are too many uncertainties associated with the fragment evidence being associated with individual vessels and the sites bias uncertainties. In any case, that projection while possibly of some interest was not of value to this study. Given all the uncertainties for glass, this study has not relied on a method to try to calculate the numbers of vessels in an assemblage.

Sample size, using selected data sets, was very important as this could have influenced the proportionality of the accession line counts, and therefore have impacted comparisons between groups. The approach included using statistical techniques that minimised bias from the site's assemblages' sizes, with correspondence analysis of the data for comparative purposes (Baxter *et al.*, 1995; Baxter, Cool and Jackson, 2005; Baxter and Cool, 2016).

There was no simple way of estimating the minimum viable sample size (Orton and Hughes, 2013). The evidence of the container, drinking vessel and tableware classes was assessed on a case-by-case basis. A maximum sample size was not set. What was more relevant was the consideration of the archaeology of the site and the places of deposition. These were important when assessing the analyses for bias and critical to any comparisons between sites using comparative proportional analysis. These details will be assessed in the Chapter 4 'Presentation and Assessment of Data for Analysis' for the sites.

Glass vessels break in different ways. For example, bottles were made for heavy handling as thick-walled glass containers. Drinking vessels were usually thin-walled glass with shaped rims, body and bases that were more likely to suffer breakage loss and with more fragments than from bottles. Thick-wall glass fragments were more likely to be collected for recycling and so would not have entered the material record. The assumption made for this study was that basing the analyses on the accession line assemblages rather than the fragments themselves, reduced the bias from the varying levels of fragility of the original individual vessels.

3.3.3 Correspondence Analysis

Correspondence analysis is widely used in archaeology research (Baxter and Cool, 2016; Carlson, 2017). The technique applies a statistical process that modifies a dataset and then plots the rows and columns in two overlapping plots. The associations between the row and column components can be shown in the same corresponding quadrant, hence the name. The modification of the data basically results in each cell changed to be the average of the rows and columns that pass through that cell. Using that modified data, an expected value of each cell is then calculated using a chi-squared equation. The difference between the modified average and the expected value then forms the correspondence dataset, for which the row and column factors are plotted as differences from zero, either positive or negative values apply. These values are plotted in the row and column quadrants that are the row–column differences.

There are some rules in assuming associations based on the row – column differences. The same quadrant plots can be associated, with the closer the lines between the zero, or origin, and the row – column factors the larger is the association. The further out a factor is from the origin, the larger is the difference between the value and the expected value.

Correspondence analysis is dependent on a valid representation of the data with a normal probability distribution. For archaeology excavations, the sampling process may not result in data following such normal probability distribution. This means that if there is data that could be skewed because of dating, discovery, measuring or reporting errors or bias, then the data set may need to be adjusted accordingly. This reinforced the need to examine the glass data with an interpretation of the location site context and the time period as discussed in the next section.

3.4 The Database

3.4.1 The Data Model

An objective of the research study was to investigate the associations between the glass assemblage, location, chronology and an inferred population identity based on the archaeology. This is illustrated in the conceptual data structure in Figure 3.3.

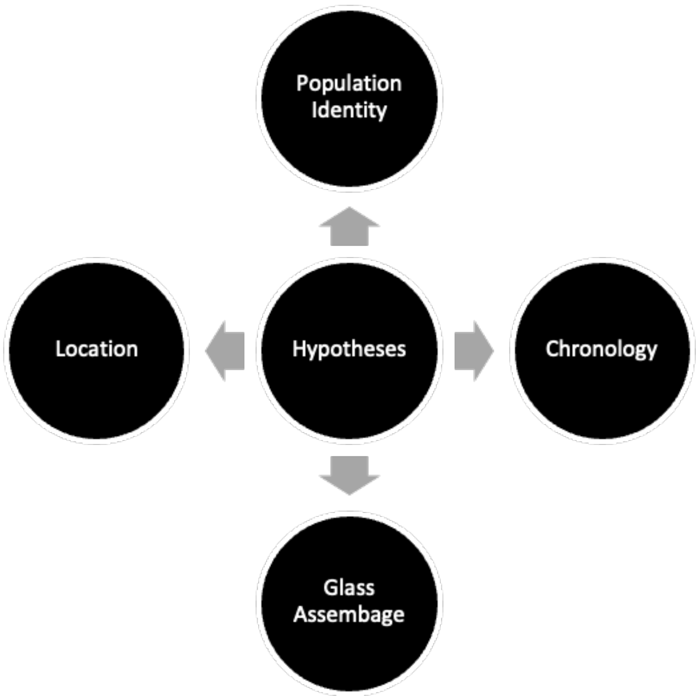


Figure 3.3 Methodology Data Model

(Source: author)

As discussed earlier, the glass fragmentary recorded evidence was subject to the recovery, identification and recording of the observed and inferred characteristics. The dating frameworks could have been different for each site based on the sample deposition area and context. The challenge was to translate the variabilities of the characteristics of the glass fragmentary assemblages and the complexities of each of the individual sites into a database. The database design was defined by categorising all these individual glass features together with the contextual data of geography and chronology. The data collected from each excavation site was the individual unique accession lines data of the fragmentary evidence in an unstructured text format. The logical step was to create a unified database that could accommodate all the accession line data from all of the selected sites.

3.4.2 Database Design

The design of the database was based on categorising the glass, location and period phase data into variables represented as columns in the data-frame and the fragmentary accession lines as rows that represent the sites. The glass data design used the characteristics typology as headers to validate each data entry into the database to match a header value. The database design was accordingly defined by all of these features together with location and period phases represented as data entities as illustrated in Figure 3.4 below.

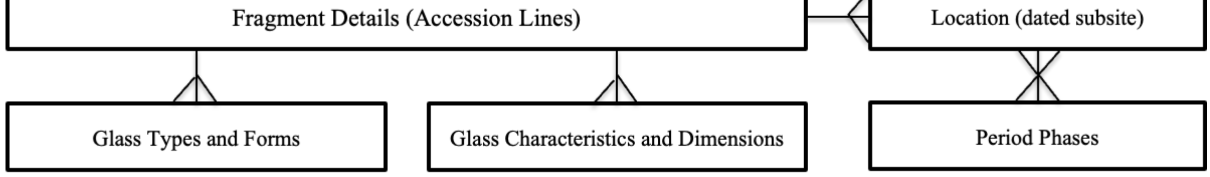


Figure 3.4 The Data Entities Representing Accession Lines

This figure shows the interconnectivity between the data entities. The following database design principles were defined:

- The fragmentary data evidence would be defined by the rows of the database as accession lines representing the 'presence' of material with characteristics
- The 'presence' of material characteristics, and the type and form in each accession line was the base unit of quantitative measurement
- Glass forms were defined by the excavation report details as a basic glass type (e.g. bowl, beaker, cup, bottle, etc.) together with colour and additional features of shape, marks, decoration and dimensions (e.g. tubular base ring, rim bent out, cylindrical body, etc.)
- The recorded accession line observed characteristics and inferred typological categories with the settlement type, deposition place type and dating data of the glass and site meant that all the reported data was used
- The dating data of accession lines was based on the range of the deposition estimated dates. These are used in the selection of datasets for particular chronological ranges. Accession lines with unstratified data were included in the database but not used for analysis
- The database was used to select datasets of accession line features at an appropriate level of detail to compare patterns of glass finds across sites, locations and regions and time

These principles were the basis of the data design, the design of the database and the use of technology for data management and subsequent data analysis. The use of bespoke technology systems for relational database management was considered for the management and selection of the data for multi-variate component analysis, comparing each component with each other to highlight the most relevant relationships. For this research, a SQL database technology was in development (work in progress) to provide a relational database to upload and import datafiles into the database structure with validation checks on data quality made after the import. The database technology design would have enabled the selection and extraction of datasets, specific sets of data as cells from the rows and columns, to use for multi-component analysis using analysis applications either from the SQL database or exported to another accredited database. The challenge was that the dialectic process to define the typology extended the development time of the SQL database and this work was paused to be picked up as a later stage. The database technology used was Microsoft Excel that was configured to closely represent a relational database structure using dataset sheets for analysis linked to site templates (refer to Appendix 5). Correspondence analysis was provided by using selected datasets from the database in an archaeology package in the R technology.

3.4.3 Managing the Database

It was critical that the data in this master database accurately recorded the reference source report data and that all the compiled fields have been checked as complete and correct. The management of glass archaeological data was based on the following principles:

- Data quality can be maintained with the data correct, complete and any changes controlled to reflect the original reported content
- Accession lines of the reported fragmentary finds can provide observable and inferred details of the original glass

- Data can be transformed as quantified components of the original glass forms, shapes, dimensions and characteristics for each accession line
- Statistical methods will be applied to reduce the impacts of finds' biases

Comparative analyses of the data were based on the lowest level detailed fragmentary glass evidence that revealed patterns of associations between fragment accession lines and locations as sites. The analyses were applied to the site vessel composition data and the regional distribution of vessel data described in the following sections.

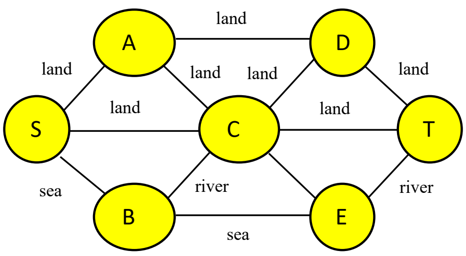
3.4.4 Site Profile and Site Scoring Model

A site profile was defined by the range and proportions of the vessel types as percentage accession line counts, and with the associations of the site with vessel types using correspondence analysis. A further qualitative system was developed based on the presence of glass types and forms that provides a ranking score for a site. The scoring system was compatible with the site type profile as a qualitative measure of the range of the glass types and forms. The scoring system was based on allocating a score of one for each glass type and form that is recorded as present on a site in the archaeological material record. The sum of the scores was then used as a site ranking that as a single figure can be used to supplement the site profile. This is further described in Section 5.3.

3.4.5 Distribution Model

The distribution model is based on defining the network points by the sites' distribution of glass vessels. The sites can be viewed as the nodes of a transport network. The purpose of the distribution model was to provide assessments of the means of transport from the producers to the consumers and the potential distribution routes to move glass products. A distribution model was developed based on using an algorithm solver in Excel to find the shortest path from one node to another node in an undirected network. The locations of the sites in the Roman Britain network were called nodes (S, A, B, C, D, E and T) and the routes in a network were called arcs (SA, SB, SC, AC, etc) as shown in Figure 3.5, detailed in Table 3.7. The full details of the calculations in Appendix 2.

Node	Location
S	London
A	Wroxeter
B	York-coast
C	York
D	Carlisle
E	Elginhaugh-coast
T	Elginhaugh



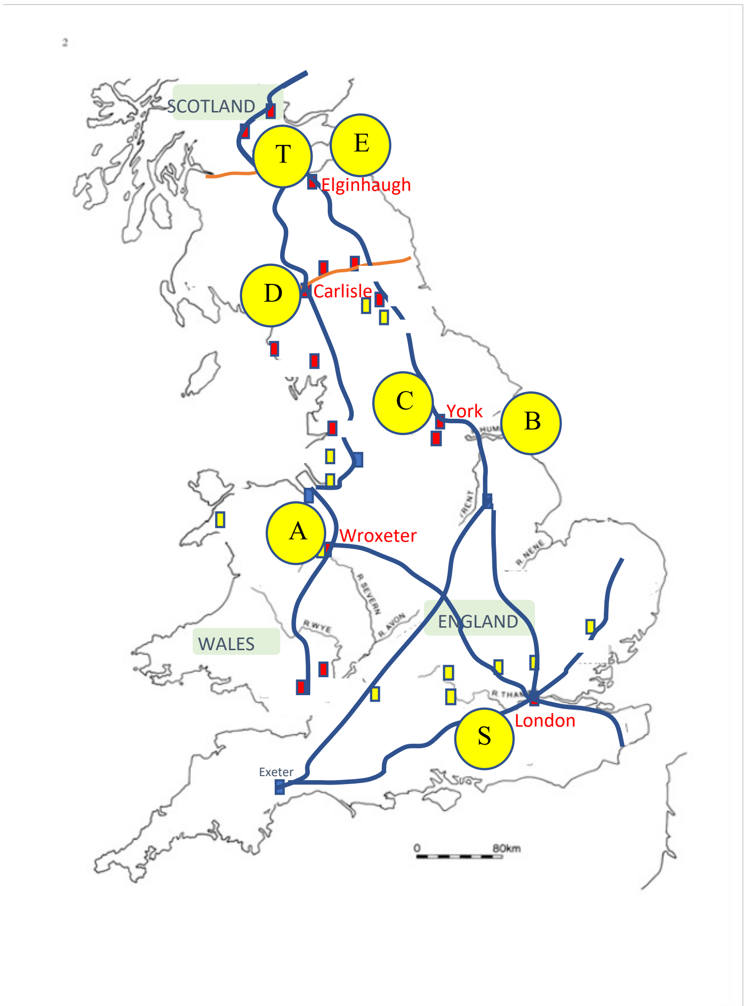


Figure 3.5 Distribution Model Showing Nodes-Locations in Britain

Table 3.7 Network Routes and Dimensions

(Cost factors based on Greene 1986, p. 40)

Arc	Route map	Road	Roman Route	Miles	Cost factor	Distance x Cost
S-->A	London-Wroxeter	1d,1e,1f,1g,1h	Watling Street	145	28.0	4053
S-->B	London-York-port		sea	300	1.0	9000
S-->C	London-York	2a,2b,2c,28a,28b,28c	Ermine Street	199	28.0	11116
A-->C	Wroxeter-York		via Chester-Manchester	167	28.0	4676
A-->D	Wroxeter-Carlisle	6a,701,70b,70c,70d,7c,7d,7e	Western Way North	187	28.0	5243
B-->C	York-coast - York		local river road	10	4.9	49
B-->E	York-coast - Elginhaugh-coast		sea	300	1.0	9000
C-->A	York - Wroxeter	6a,7a,7b,72a,72b,28c	via Chester-Manchester	167	28.0	4676
C-->B	York - York-coast		local river road	10	4.9	49
C-->D	York - Carlisle	8a,8b,8c,8d,85a,85b	via Stanegate	126	28.0	3521
C-->E	York - Elginhaugh-coast		river to coast and sea	300	1.0	9000
C-->T	York - Elginhaugh	8a,8b,8c,8d,8e,8f,8g,8x	Eastern Way North	187	28.0	5236
D-->A	Carlisle - Wroxeter		Western Way North	187	28.0	5243
D-->C	Carlisle - York		via Stanegate	126	28.0	3521
D-->T	Carlisle - Elginhaugh	7f,7g	Western Way North	100	28.0	2786
E-->B	Elginhaugh-coast - York-coast		sea	300	1.0	9000
E-->C	Elginhaugh-coast - York		via York-port	300	1.0	9000
E-->T	Elginhaugh-coast - Elginhaugh		local river road	10	4.9	49

This table shows all the arcs between S (the source that is London) and T (the terminus, in this case Elginhaugh). The road routes with the road number and distance in miles was taken from Margary (1973). A cost factor is applied based on whether the route is by road, river or sea. This is based on the differences in cost of transporting goods in Roman times by road relative to river and sea transports (Greene, 1986).

The Excel Solver was used to find the optimal solution for a particular scenarios of moving goods from London to Elginhaugh on the northern frontier in the 1st century. The details of the calculation assumptions and scenario calculations are shown in the Appendix 2.

The model was used to assess the optimised route for any transport route scenario as the shortest 'distance-cost' from the starting point (S) to the terminus (T). The possibility that military transports were used for civil goods movements would have had cost implications that are not specifically considered, although the 'distance-cost' factor would represent time that would have also been in proportion to the cost. The model was also not used to simulate the differences in load carrying capacity with a standard load of 1te assumed for each journey. It was used to test various scenarios by weighting particular routes and changing the distance for particular arcs. For example, if the route between Wroxeter and York was considered to be 'impassable' then the distance would be weighted to reflect that scenario.

3.5 Summary

The key purpose of the methodology was to be able to analyse glass assemblage fragmentary data of glass vessels across sites and regions to respond to the research questions. This required the reported archaeological glass accession line data to contain the observed features with dimensions of the fragmentary glass, the associated disposal type and the reported dating information, all categorised to a typological framework. The details of the reference reports reviewed for data for this research are provided in the bibliography. The main implication for this research is that there was huge value from the archaeological investment in compiling and reporting all the revealed evidence from excavations.

4 PRESENTATION AND ASSESSMENT OF DATA FOR ANALYSIS

4.1 Introduction

This chapter presents the data from the selected sites and provides an assessment of the quality and quantity of the data for analysis with an understanding of any potential sources of data bias. This will include an assessment of the features that could reveal patterns of similarity or difference that will be picked up in the later analysis chapters. The selected sites glass assemblages and vessels counts are shown in Table 4.1. This shows for each of the sites the number of reported accession lines of the glass fragmentary assemblages, including construction materials, utensils, personal objects, and vessels. The study scope of vessels is described in Tables 4.2 and 4.3 for the civil and military sites. Figure 4.1 shows the vessel percentage proportions of the site type groups and it is interesting that the large city group is in fact the largest of the corpus. This is due to Colchester that is nearly 1/3rd of the corpus.

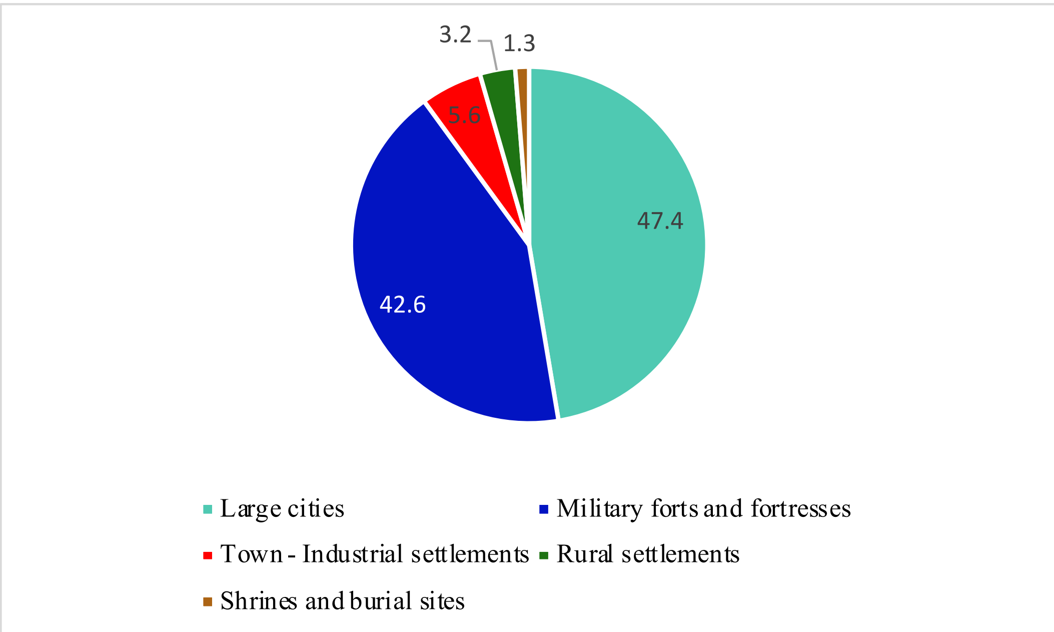


Figure 4.1 Site Types as a Percentage of the Corpus

Table 4.1 Accession Line Counts and Vessel Percentages for the Selected Sites

Site Types	Sites	No. accession lines (fragment assemblages)	Vessel accession lines	Vessel accession lines as % of the Corpus
Military Sites	Birdoswald	79	71	1.3
	Caerleon	147	131	2.5
	Carlisle	378	233	4.4
	Castleford	561	270	5.1
	Corbridge	93	45	0.8
	Elginhaugh	144	118	2.2
	Inchtuthil	22	20	0.4
	London	227	204	3.8
	Piercebridge	566	418	7.8
	Ravenglass	32	19	0.4
	Ribchester	262	205	3.8
	Strageath	81	23	0.4
	Usk	114	114	2.1
	Watercrook	42	24	0.5
	Wroxeter	186	159	3.0
	York	242	215	4.0
	Total	3176	2269	42.6
Urban - Large Cities	Colchester	1570	1552	29.1
	Silchester	317	300	5.6
	St Albans	484	386	7.2
	Wroxeter	284	284	5.3
	Total	2655	2522	47.4
Town - Industrial Settlements	Catterick	202	196	3.7
	Scotch Corner	62	61	1.1
	Walton le Dale	51	25	0.5
	Wilderspool	20	15	0.3
	Total	335	297	5.6
Rural Settlements	Barton Court Farm	13	13	0.2
	Frocester Villa	75	51	1.0
	Gorhambury Villa	115	92	1.7
	Piercebridge Villa	32	14	0.3
	Graeanog Ridge Farm	10	1	0.0
	Total	245	171	3.2
Shrines & Burial Sites	Gloucester	6	5	0.1
	Stanway	34	18	0.3
	Uley	42	23	0.4
	Skeleton Green	21	21	0.4
	Total	103	67	1.3
	TOTAL	6514	5326	100.0

Table 4.2 Civil Sites Vessel Class Accession Line Counts

Civil Sites Counts	container-large	container-small	drinking	tableware	vessel no-class	Totals
			Large Cities			
Colchester	337	45	254	864	52	1552
Silchester	143	8	29	101	19	300
St Albans	56	10	61	250	9	386
Wroxeter	90	9	58	121	6	284
			Town - Industrial Settlements			
Catterick	87	2	30	74	3	196
Scotch Corner	16	-	14	29	2	61
Walton le Dale	4	2	6	11	2	25
Wilderspool	11	-	-	3	1	15
			Rural Settlements			
Barton Court Farm	2	-	1	7	3	13
Frocester	11	-	8	23	9	51
Gorhambury	8	1	18	65	-	92
Piercebridge Villa	3	-	11	-	-	14
Graeanog Ridge	-	-	-	1	-	1
			Shrines & Burial Sites			
Gloucester	-	5	-	-	-	5
Stanway	-	10	1	5	2	18
Uley	4	-	6	10	3	23
Skeleton Green	2	-	3	11	5	21

Table 4.3 Military Sites Vessel Class Accession Line Counts

Sites Counts	container-large	container-small	drinking	tableware	vessel no-class	Totals
Fortresses & Forts						
Birdoswald	33	-	11	21	6	71
Caerleon	36	9	8	54	24	131
Carlisle	193	-	9	30	1	233
Castleford	52	7	93	102	16	270
Corbridge	7	2	14	19	3	45
Elginhaugh	85	2	8	23	-	118
Inchtuthil	9	-	-	8	3	20
London	21	4	37	116	26	204
Piercebridge	215	11	130	57	5	418
Ravenglass	12	1	2	3	1	19
Ribchester	141	3	9	48	4	205
Strageath	7	-	5	9	2	23
Usk	15	9	18	60	12	114
Watercrook	16	1	-	4	3	24
Wroxeter	17	8	49	78	7	159
York	45	7	58	56	49	215
Military Sites	904	64	451	688	162	2269
Civil Sites	774	92	500	1575	116	3057
Overall Total	1678	156	951	2263	278	5326

Each of the vessel accession lines in the database includes the reported features of the assemblages as shape, type, form, colour, marks, decoration, and dimensions. Not all of the fragment evidence reveals marking, decoration or even an attribution of colour. A no-class category column is used for confirmed vessels but without a precise vessel type identified.
The study assumption is that the sample evidence represents the original population of glass vessels. As I have already discussed, this assumption is dependent on many variables including the extent of the excavation, the quantity and quality of the assemblage details that includes the identification and features of the glass. Accordingly, the data for each site was assessed against the archaeological context for relevance to the analyses in Chapters 5 and 6.

This chapter includes the investigation of the assemblage data sets of the military sites in the regions of Roman Britain. The regions are London, Wales and the Marches, Lancashire and Yorkshire, Cumbria and Northumberland, Hadrian's Wall in the North of England, and Scotland. The selected military sites represent the movement of the Roman army occupying Britain in defined chronological periods. The military sites are followed by the civil sites as industrial centres, rural farms and villa farmsteads that were all associated with trade of goods or agricultural products, and the large city sites that were centres of Roman administration. The data from selected shrines in the south of England will complete the sites' vessel type and form fragmentary evidence.

The final sections of the chapter include the reviews of the glass colour, marking, decoration and dimensional characteristics of all the sites that are considered together for any patterns of association with the assemblage data across the regions. The sites data is considered as a complete proportional data set for the sites analysis in Chapter 5, and as a complete corpus data set that will be analysed for distribution patterns in Chapter 6.

All the data is presented without any chronological breakdown for the period of Roman occupation and post-occupation in Britain from 43-500 CE. No attempt was made to analyse the data for phases, except that the order of the reviews of the military sites naturally follows the progress with the invasion. The detail for each site includes the occupation period of the settlement, the post-occupation history and character of the site together with location and relevance of the settlement to life in Roman Britain.

4.2 Sites' Assemblages

The presentations of the assemblage types, forms and characteristics data for each of the sites is summarised collectively as follows for the civil and military sites. The sites' class profiles show the proportions for each of the site groups, based on the data for the individual sites that has been detailed earlier and shown in Tables 4.4, 4.5 and Figures 4.2, 4.3.

Table 4.4 Civil Sites Class Percentage Counts Profiles

Sites % Counts	**container-large**	**container-small**	**drinking**	**tableware**	**vessel no-class**	**Totals**
			Large Cities			
Colchester	21.7	2.9	16.4	55.7	3.4	100.0
Silchester	47.7	2.7	9.7	33.7	6.3	100.0
St Albans	14.5	2.6	15.8	64.8	2.3	100.0
Wroxeter	31.7	3.2	20.4	42.6	2.1	100.0
			Town - Industrial Settlements			
Catterick	44.4	1.0	15.3	37.8	1.5	100.0
Scotch Corner	26.2	-	23.0	47.5	3.3	100.0
Walton le Dale	16.0	8.0	24.0	44.0	8.0	100.0
Wilderspool	73.3	-	-	20.0	6.7	100.0
			Rural Settlements			
Barton Court Farm	15.4	-	7.7	53.8	23.1	100.0
Frocester	21.6	-	15.7	45.1	17.6	100.0
Gorhambury	8.7	1.1	19.6	70.7	-	100.0
Piercebridge Villa	21.4	-	78.6	-	-	100.0
Graeanog Ridge	-	-	-	100.0	-	100.0
			Shrines and Burial Sites			
Gloucester	-	100.0	-	-	-	100.0
Stanway	-	55.6	5.6	27.8	11.1	100.0
Uley	17.4	0.0	26.1	43.5	13.0	100.0
Skeleton Green	9.5	0.0	14.3	52.4	23.8	100.0

Table 4.5 Military Sites Class Percentage Counts Profiles

Sites % Counts	container-large	container-small	drinking	tableware	vessel no-class	Totals
			Fortresses & Forts			
Birdoswald	46.5	-	15.5	29.6	8.5	100.0
Caerleon	27.5	6.9	6.1	41.2	18.3	100.0
Carlisle	82.8	-	3.9	12.9	0.4	100.0
Castleford	19.3	2.6	34.4	37.8	5.9	100.0
Corbridge	15.6	4.4	31.1	42.2	6.7	100.0
Elginhaugh	72.0	1.7	6.8	19.5	-	100.0
Inchtuthil	45.0	-	-	40.0	15.0	100.0
London	10.3	2.0	18.1	56.9	12.7	100.0
Piercebridge	51.4	2.6	31.1	13.6	1.2	100.0
Ravenglass	63.2	5.3	10.5	15.8	5.3	100.0
Ribchester	68.8	1.5	4.4	23.4	2.0	100.0
Strageath	30.4	-	21.7	39.1	8.7	100.0
Usk	13.2	7.9	15.8	52.6	10.5	100.0
Watercrook	66.7	4.2	-	16.7	12.5	100.0
Wroxeter	10.7	5.0	30.8	49.1	4.4	100.0
York	20.9	3.3	27.0	26.0	22.8	100.0

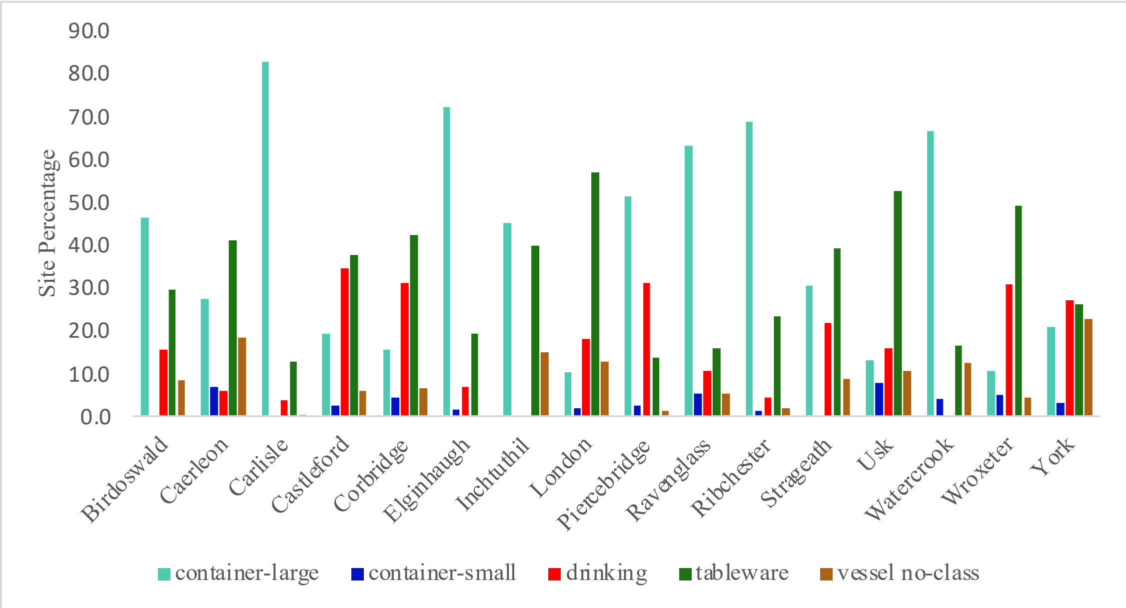


Figure 4.2 Military Sites Vessel Class Sites' Percentage Counts

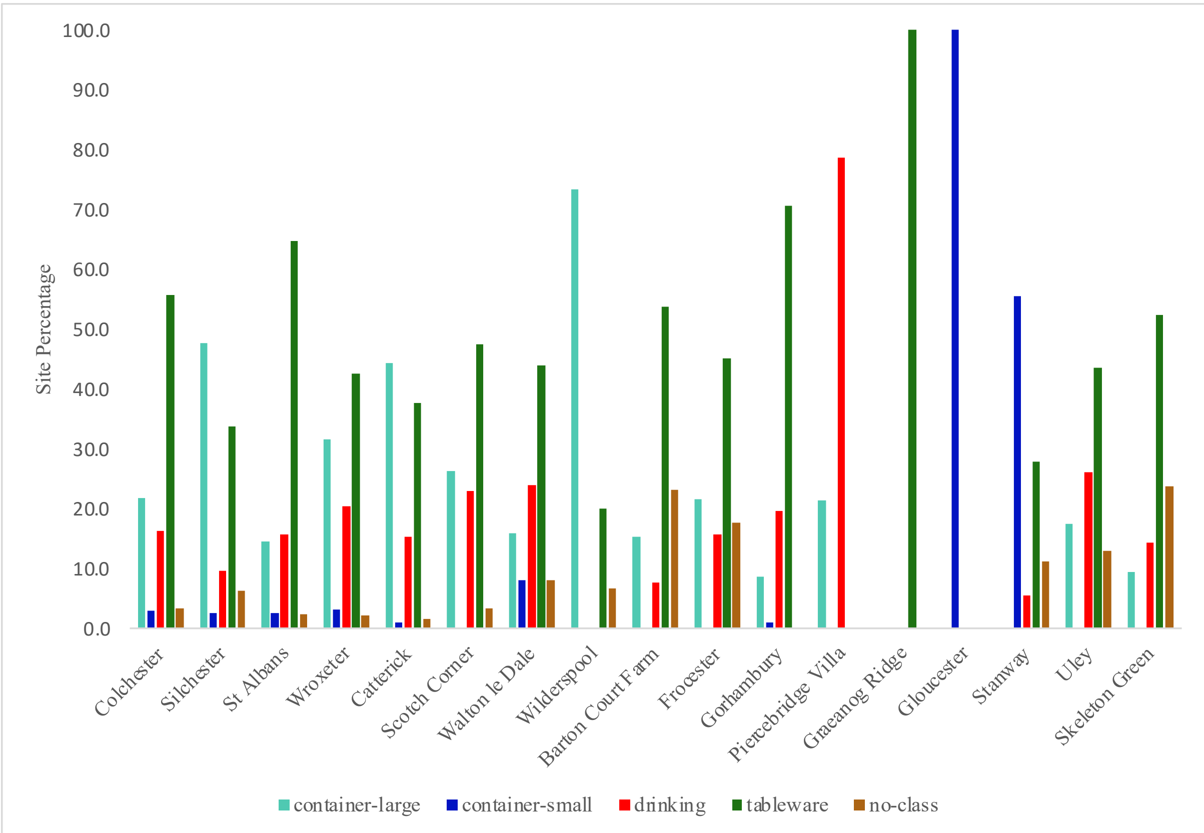


Figure 4.3 Civil Sites Vessel Class Sites' Percentage Counts

These illustrate the dominance of the large container bottles on the majority of the forts and the s. The high bottle counts on the military sites of Carlisle, Elginhaugh, Inchtuthil, Watercrook, Ravenglass and Ribchester are prominent.

The individual site vessel type percentage counts reveal more details as shown in Tables 4.6 and 4.7 for the military sites, and Tables 4.8 and 4.9 for the civil sites.

Table 4.6 Military Sites Type Percentage Counts to 500 CE (1)

Glass Type	Birdoswald	Caerleon	Carlisle	Castleford	Corbridge	Elginhaugh	Inchtuthil	London
bottle	46.5	27.5	82.8	19.3	15.6	72.0	45.0	10.3
unguent	-	6.9	-	2.6	4.4	1.7	-	2.0
beaker	1.4	2.3	-	8.5	22.2	3.4	-	5.9
cup	12.7	2.3	3.9	25.2	8.9	1.7	-	11.8
bowl	12.7	6.9	5.2	14.4	11.1	10.2	5.0	19.6
flagon	-	-	6.0	-	-	-	-	0.5
flask	4.2	23.7	-	2.2	6.7	-	-	7.8
jar	2.8	0.8	0.9	2.6	4.4	1.7	-	11.3
jug	4.2	3.1	-	9.6	4.4	4.2	35.0	13.2
plate	-	4.6	-	0.4	-	-	-	0.5
drinking-var	1.4	1.5	-	0.7	-	1.7	-	0.5
tableware-var	5.6	2.3	0.9	8.5	15.6	3.4	-	3.9
vessel no-class	8.5	18.3	0.4	5.9	6.7	-	15.0	12.7
Total Vessel Counts	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4.7 Military Sites Type Percentage Counts to 500 CE (2)

Glass Type	Piercebridge	Ravenglass	Ribchester	Strageath	Usk	Watercrook	Wroxeter	York
bottle	51.4	63.2	68.8	30.4	13.2	66.7	10.7	20.9
unguent	2.6	5.3	1.5	-	7.9	4.2	5.0	3.3
beaker	3.1	10.5	2.9	-	4.4	-	20.1	13.5
cup	25.1	-	1.5	21.7	8.8	-	9.4	7.4
bowl	3.3	-	3.4	4.3	24.6	4.2	31.4	12.1
flagon	-	10.5	-	-	-	8.3	-	-
flask	3.1	-	-	4.3	1.8	-	3.1	1.9
jar	0.2	-	1.0	4.3	6.1	4.2	-	4.2
jug	4.3	-	13.7	13.0	13.2	-	10.1	3.3
plate	0.5	5.3	-	-	0.9	-	-	0.5
drinking-var	2.9	-	-	-	2.6	-	1.3	6.0
tableware-var	2.2	-	5.4	13.0	6.1	-	4.4	4.2
vessel no-class	1.2	5.3	2.0	8.7	10.5	12.5	4.4	22.8
Total Vessel Counts	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4.8 Civil Sites Type Percentage Counts to 500 CE (1)

Glass Type	**Colchester**	**Silchester**	**St Albans**	**Wroxeter**	**Catterick**	**Scotch Corner**	**Walton le Dale**	**Wilderspool**
bottle	21.7	47.7	14.5	31.7	44.4	26.2	16.0	73.3
unguent	2.9	2.7	2.6	3.2	1.0	0.0	8.0	-
beaker	5.9	3.0	15.8	9.2	3.6	1.6	12.0	-
cup	7.3	6.3	-	8.5	11.2	21.3	12.0	-
bowl	17.0	11.3	31.1	8.8	10.2	31.1	16.0	-
flagon	-	-	13.5	-	-	-	8.0	-
flask	2.1	1.0	4.9	7.0	4.6	-	-	13.3
jar	6.7	1.3	10.1	4.9	3.6	-	4.0	6.7
jug	13.5	10.3	3.1	15.5	11.2	9.8	4.0	-
plate	0.3	0.7	-	-	-	-	8.0	-
drinking-var	3.2	0.3	-	2.8	0.5	-	-	-
tableware-var	16.1	9.0	2.1	6.3	8.2	6.6	4.0	-
vessel no-class	3.4	6.3	2.3	2.1	1.5	3.3	8.0	6.7
Total Vessel Counts	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4.9 Civil Sites Type Percentage Counts to 500 CE (2)

Glass Type	Barton Court Farm	Frocester	Gorhambury	Piercebridge Villa	Graeanog Ridge	Gloucester	Stanway	Uley	Skeleton Green
bottle	15.4	21.6	8.7	21.4	-	-	-	17.4	9.5
unguent	-	-	1.1	-	-	100.0	55.6	-	-
beaker	-	9.8	12.0	28.6	-	-	-	-	14.3
cup	7.7	5.9	5.4	50.0	-	-	-	26.1	-
bowl	38.5	27.5	29.3	-	100.0	-	5.6	-	-
flagon	-	-	-	-	-	-	27.8	21.7	28.6
flask	-	2.0	-	-	-	-	-	-	4.8
jar	-	-	19.6	-	-	-	-	4.3	9.5
jug	15.4	11.8	17.4	-	-	-	-	-	-
plate	-	-	-	-	-	-	-	13.0	4.8
drinking-var	-	-	2.2	-	-	-	-	-	-
tableware-var	-	3.9	4.3	-	-	-	-	4.3	4.8
vessel no-class	23.1	17.6	-	-	-	-	11.1	13.0	23.8
Total Vessel Counts	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

These details are visually represented in the Figures 4.4 and 4.5 for the military and civil sites respectively.

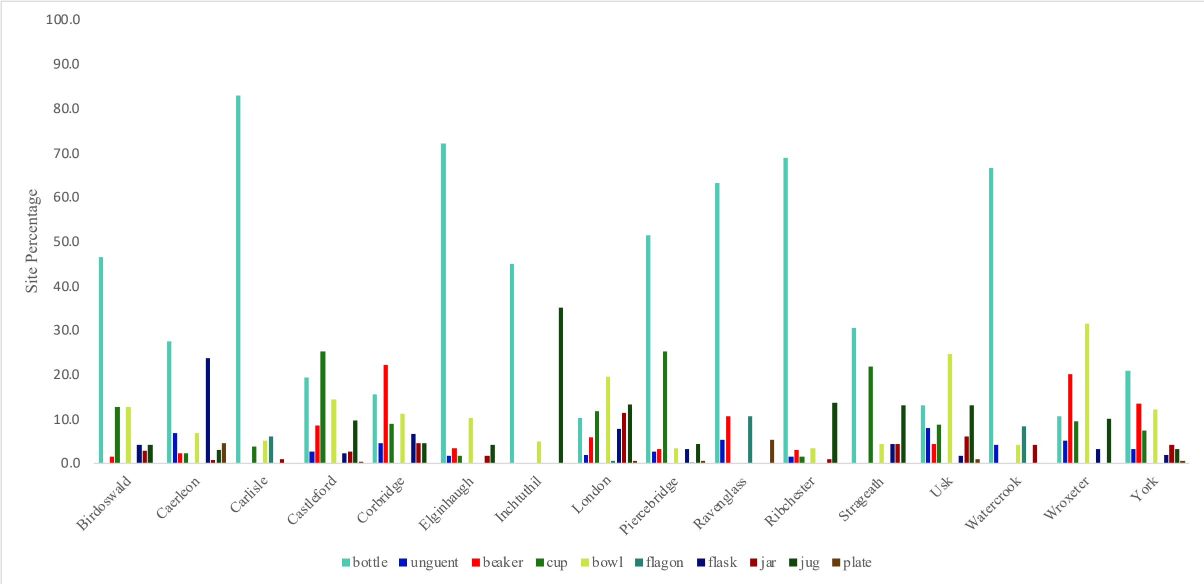


Figure 4.4 Military Sites Vessel Types Sites' Percentage Counts

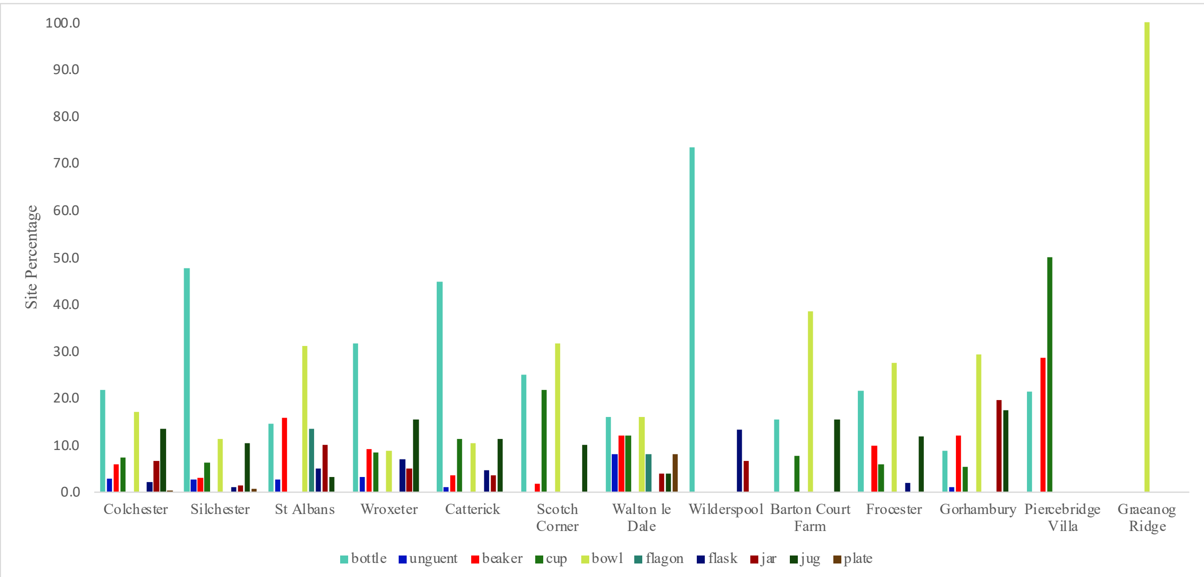


Figure 4.5 Civil Sites Vessel Types Sites' Percentage Counts

Colchester is the largest selected study site and with 1552 counts is 29% of the study corpus. Colchester included four inner city sites that are 94% of the overall site. Colchester and the individual sites will be analysed in a later Section (5.2.1). The individual sites glass types show the dominance of bottles and bowls on most sites. There is a lower common level of glass drinking vessels seen across all the sites with the beaker and cup visible on most with the exception of St Albans. The broad similarity of the fortress sites with the large city sites' vessel types is also noted. Although bottles feature on all the sites, there is significant variation in the military site profiles. The military sites with significant vessel ranges are the Caerleon, Usk, Wroxeter and York fortresses and the Castleford, Piercebridge, London and Ribchester forts. These points will be picked up for analyses in Chapter 5.

Finally, the tableware, drinking vessel and bottle forms percentage counts for the civil sites are shown in Tables 4.10, 4.11, 4.12 and for the military sites in Tables 4.13, 4.14, 4.15.

Table 4.10 Military Sites Tableware Forms Percentage Counts

Site	amphorisk	bath-flask	bulbous-jug	conical-jug	cylindrical-bowl	mercury-flask	pillar-moulded bowl	ribbed-bowl	tubular-rimed-bowl
Birdoswald	-	1.4	-	-	1.4	-	-	-	-
Caerleon	-	15.3	-	-	-	-	2.3	-	-
Carlisle	-	-	-	-	-	-	4.3	-	0.9
Castleford	-	0.4	-	3.3	-	-	5.9	1.1	-
Corbridge	2.2	-	-	-	-	-	2.2	-	-
Elginhaugh	-	-	-	2.5	-	-	7.6	-	1.7
Inchtuthil	-	-	-	15.0	-	-	5.0	-	-
London	-	1.0	1.0	-	-	-	2.5	0.5	2.0
Piercebridge	-	-	-	-	-	0.2	-	-	0.7
Ravenglass	-	-	-	-	-	-	-	-	-
Ribchester	-	-	-	3.4	-	-	2.9	-	-
Strageath	-	-	-	4.3	-	-	4.3	-	-
Usk	0.9	-	-	6.1	0.9	-	15.8	-	-
Watercrook	-	-	-	-	-	-	-	-	-
Wroxeter	0.6	-	-	-	-	-	20.1	5.7	-
York	0.5	-	-	0.9	-	-	12.1	-	-

Table 4.11 Military Sites Drinking Vessel Forms Percentage Counts

Site	almond-knob-beaker	arcaded-beaker	cantharos	cup-base-ring	cylindrical-cup-fire-rim	hofheim-cup	indented-beaker	modiolus	ribbed-cup	skyphos	sports-cup
Birdoswald	-	-	-	-	-	-	-	-	-	-	-
Caerleon	-	-	-	-	-	-	-	-	-	-	-
Carlisle	-	-	-	-	-	-	-	-	-	-	-
Castleford	0.4	-	-	5.2	2.2	0.4	-	-	-	-	-
Corbridge	-	-	-	4.4	4.4	-	-	-	-	-	-
Elginhaugh	-	0.8	0.8	-	-	-	-	0.8	-	-	-
Inchtuthil	-	-	-	-	-	-	-	-	-	-	-
London	-	0.5	1.0	0.5	0.5	2.0	-	-	-	0.5	0.5
Piercebridge	-	-	-	4.1	11.2	-	-	-	1.0	-	-
Ravenglass	-	-	-	-	-	-	-	-	-	-	-
Ribchester	-	-	-	-	-	-	-	-	-	-	-
Strageath	-	-	-	-	-	-	-	-	-	-	-
Usk	-	-	-	-	0.9	-	0.9	-	-	-	-
Watercrook	-	-	-	-	-	-	-	-	-	-	-
Wroxeter	1.9	0.6	-	-	-	-	1.9	-	-	-	-
York	-	0.5	-	-	1.9	-	1.4	-	-	-	-

Table 4.12 Military Sites Bottle Vessel Forms Percentage Counts

Site	amphora	cylindrical-bottle	frontinus-bottle	square-bottle
Birdoswald	-	1.4	-	4.2
Caerleon	-	3.8	-	5.3
Carlisle	-	6.4	-	76.0
Castleford	-	3.0	-	5.6
Corbridge	-	0.0	-	8.9
Elginhaugh	-	45.8	-	0.8
Inchtuthil	-	35.0	-	5.0
London	-	0.5	-	2.0
Piercebridge	-	2.9	0.2	6.9
Ravenglass	-	-	-	5.3
Ribchester	-	9.8	-	1.5
Strageath	-	4.3	-	4.3
Usk	-	-	-	6.1
Watercrook	-	25.0	-	37.5
Wroxeter	-	0.6	-	1.3
York	-	2.8	-	0.9

Table 4.13 Civil Sites Tableware Vessel Forms Percentage Counts

Site	amphorisk	bath-flask	bulbous-jug	conical-jug	cylindrical-bowl	mercury-flask	pillar-moulded bowl	ribbed-bowl	tubular-rimed-bowl
Colchester	0.3	0.7	-	1.3	0.5	0.1	10.1	0.3	2.0
Silchester	1.0	-	-	1.3	0.7	0.3	5.3	0.7	0.3
St Albans	-	0.3	-	-	3.6	-	4.1	3.1	8.3
Wroxeter	-	2.5	-	1.8	-	-	4.9	0.7	2.5
Catterick	-	2.6	-	2.0	4.1	-	0.5	-	0.5
Scotch Corner	-	-	-	3.3	1.6	-	26.2	-	1.6
Walton le Dale	-	-	-	-	-	-	4.0	-	4.0
Wilderspool	-	-	-	-	-	-	-	-	0.0
Barton Court Farm	-	-	-	-	-	-	-	-	15.4
Frocester	-	-	-	-	-	-	3.9	-	-
Gorhambury	-	-	-	1.1	-	-	1.1	-	5.4
Piercebridge Villa	-	-	-	-	-	-	-	-	-
Graeanog Ridge	-	-	-	-	-	-	-	-	-

Table 4.14 Civil Sites Drinking Vessel Forms Percentage Counts

Site	almond-knob-beaker	arcaded-beaker	cantharos	cup-base-ring	cylindrical-cup-fire-rounded-rim	hofheim-cup	indented-beaker	modiolus	ribbed-cup	skyphos	sports-cup
Colchester	-	0.1	0.2	0.9	0.3	2.9	0.6	-	0.0	-	0.4
Silchester	-	-	-	1.0	0.3	0.3	0.7	-	0.7	-	-
St Albans	-	-	-	-	-	-	0.8	-	-	-	-
Wroxeter	-	-	-	2.8	1.1	3.5	0.4	-	-	-	-
Catterick	-	-	-	2.0	6.1	-	-	-	-	-	-
Scotch Corner	-	-	-	-	-	-	-	-	6.6	-	-
Walton le Dale	-	-	-	-	-	-	-	-	-	-	-
Wilderspool	-	-	-	-	-	-	-	-	-	-	-
Barton Court Farm	-	-	-	-	-	-	-	-	-	-	-
Frocester	-	-	-	2.0	-	-	-	-	-	-	-
Gorhambury	-	2.2	-	-	-	-	-	-	-	-	-
Piercebridge Villa	-	-	-	-	14.3	-	-	-	-	-	-
Graeanog Ridge	-	-	-	-	-	-	-	-	-	-	-

Table 4.15 Civil Sites Bottle Forms Percentage Counts

Site	amphora	cylindrical-bottle	frontinus-bottle	square-bottle
Colchester	-	1.8	0.3	2.3
Silchester	-	7.3	-	12.0
St Albans	0.3	0.8	-	9.3
Wroxeter	-	5.3	1.1	5.3
Catterick	-	3.1	0.5	3.6
Scotch Corner	-	8.2	-	1.6
Walton le Dale	-	-	-	4.0
Wilderspool	-	6.7	-	26.7
Barton Court Farm	-	7.7	-	-
Frocester	-	-	-	-
Gorhambury	-	5.4	3.3	2.2
Piercebridge Villa	-	-	-	7.1
Graeanog Ridge	-	-	-	-

The presence of the vessel forms in several cases was used to corroborate the ranges of vessel types on sites. They could be used in association with types and dates to enrich the insights of status and material cultures on sites as the forms defined characteristics can more indicate the functional use and value rather than the more general vessel type categories. The bottle forms are common to the majority of the sites with the difference from the other vessel forms in that they could have been traded for the oil or wine contents and indicate patterns of lifestyle for the sites.

The data tables presented above provide the summary of glass vessel class, type and form based on the glass accession line details that together with deposition and period data in the database can add the context of the finds for analysis. The sites' archaeology is then compared to this glass vessel data and is presented as comparisons between the sites as site percentage profiles in the following evaluation.

4.3 Military Sites Evaluation

The military sites include the legionary fortresses of Usk, Caerleon, Wroxeter and York, together with a selection of forts across the regions of England, Wales, and Scotland. Legionary fortresses would have been prioritised by the military for supplies of goods and materials during their occupancy periods given their strategic military roles to control regions (Wacher, 1998, pp. 161–163). Most of the military sites include civil settlements that were close to but outside the fortifications (commonly known as *vici*). The site outlines follow a geographical and chronological tour going from London to Wales, England and Scotland.

4.3.1 London - *Londinium*

The historical and geographical context for London was described earlier in Chapter 2 (2.7) with the importance of the forts and town as a trading centre and as a location for glass-working sites. London was an early trading centre in southern Britain that took advantage of the River Thames with access to the Continent. London was unique in that the town was established as a town trading settlement before the first fort. The context for London will reflect the military and civil aspects of the communities.

The summaries of the context of the London Roman forts and town are described in Tables 4.16, and 4.17. As has been described previously, the early development of London was more associated as a riverside port for the importation of goods and as a merchants trading centre (Hingley, 2018, pp. 27–28). There is evidence of waterfronts and a bridge across the River Thames.

Table 4.16 Historical context for the London Plantation Hill and Cripplegate Forts

Context	**Plantation Place Fort** (1)	**Cripplegate Fort** (2) and (3)
Site occupation period	Fort constructed c. 60/1 - 70-5 CE, probably c. 63 CE. Short lived with signs of deterioration after c. 70CE. Defences cleared after c. 85 CE	Masonry fort established in the 120s CE and in use until the end of the 2nd century CE
The character of the site	Size of the fort was to garrison one cohort, 500 infantry	Suggestion that the fort housed the bodyguard of the provincial governor (1000 soldiers), but evidence is that it was larger
Later history	Site cleared after phase of urban reconstruction and large townhouse built after c. 150 CE that survived until the 4th century CE	Fort was out of use early in the 3rd century CE. Abandoned between 4th-11th centuries CE
Site location	Located near the north bank of the River Thames at Cornhill	Located to the west of the Roman town, closely associated with the urban development; could have been important regarding the main supply bases in the south-east of Britain

Sources: (1) (Dunwoodie *et al*., 2015)*; (2)* (Howe and Lakin, 2004)*; (3)* (Shepherd, 2012)

Table 4.17 Historical context for the London Town Guildhall and Basinghall Street

Context	**Guildhall** (1)	**Basinghall Street** (2) and (3)
Site occupation period	During the early period of Roman occupation, there is evidence of timber wharfs, jetties, a bridge and main roads constructed by the mid 50s CE	Several phases of industrial development from the late 1st century into the 2nd century CE
The character of the site	The building of the forum, amphitheatre and bathhouse to the west of the Plantation Place fort were part of a plan for the new town and the Cripplegate fort. In the mid 1st century CE, the Walbrook valley was developed with buildings	Glass workers arrived early in 2nd century with sites also at Moorgate that included industrial activity such as pottery kilns, leather-working and glass-working. Several phases of kiln working followed until the mid 3rd century when the area was occupied with buildings and pits
Later history	Scattered buildings and dumps in the 3rd centuryCE. No significant evidence for occupation from the 5th until the 9th century CE	Scattered buildings and dumps in the 3rd centuryCE. No significant evidence for occupation from the 5th until the 9th century CE
Site location	Located near the north bank of the River Thames at Cornhill	Located near the north bank of the River Thames at Cornhill

Sources: (1) (Bateman *et al*., 2008) *; (2)* (Wardle, 2015a)*; (3)* (Seeley and Drummond-Murray, 2005)

London is relevant to this study in that it was an early Roman occupied location comprising both forts and industrial centres from 43 CE until the mid 3rd century. The data for the London fort although it is presented as a military site, the origins were more complex and following the Roman occupation in 43 CE, it developed into what can be described as a fortified town (Hingley, 2018, pp. 23–27). By the end of the 1st century CE, London had become a provincial administration capital and a major port (Wacher, 1998, pp. 46, 165–168).The data and analysis are shown for London and separately for the forts and the town as tables and figures reflecting military and civil assemblages. The glass class accession line counts and percentage counts are shown in Table 4.18 and the proportions in Figure 4.6 for the London forts, town and London with the comparison with Roman Britain that is the mean for the selected sites.

Table 4.18 London Glass Class Accession Line Counts and Percentage Counts

Glass Class	London Forts Counts	London Forts %	London Town Counts	London Town %	London Counts	London %	Roman Britain %
container-large	10	13.5	11	8.5	21	10.3	31.5
container-small	1	1.4	3	2.3	4	2.0	2.9
drinking	16	21.6	21	16.2	37	18.1	17.9
tableware	43	58.1	73	56.2	116	56.9	42.5
no-class	4	5.4	22	16.9	26	12.7	5.2
Total	74	100.0	130	100.0	204	100.0	100.0

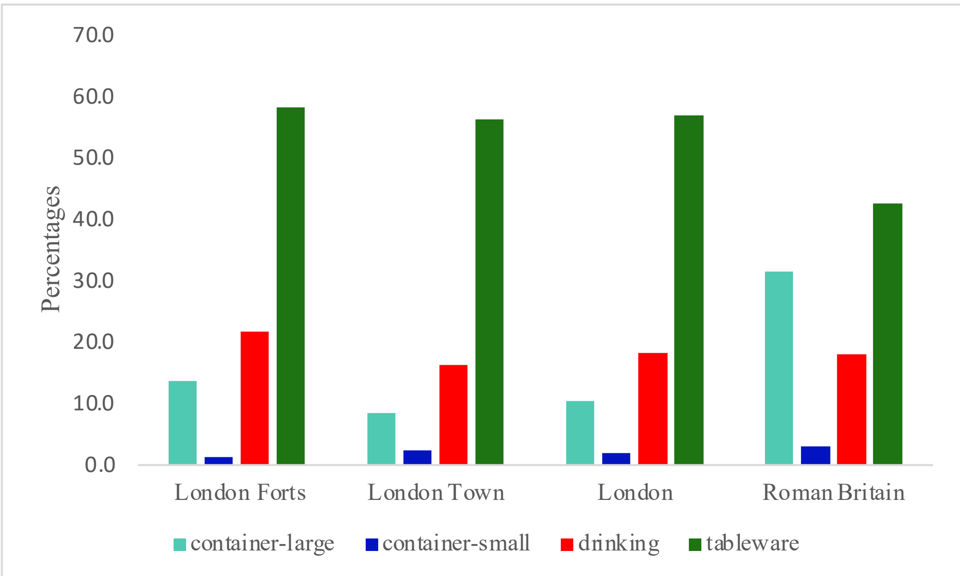


Figure 4.6 Vessel Class Percentage Profiles for the London Forts and Town (43-500 CE)

The accession line percentage counts for the glass classes shows a profile broadly like the entire selected corpus for Roman Britain for both the forts and town. This provides some confidence that the percentage counts for vessel types and colours are not skewed by sample size, and also suggests that the civil and military communities have similar material cultures, sharing the same

London space. In both cases the dominant glass types were tableware followed by drinking vessels and combined at *c.* 80% of the sites' samples totals. The no-class vessels were within the corpus error band that reinforces the confidence in the data. The glass type accession line counts and percentage profiles are shown in Table 4.19 and Figure 4.7 for the London forts and town.

Table 4.19 London Vessel Type Percentage Counts

Glass Type	London Forts	London Town	London	Roman Britain
bottle	13.5	8.5	10.3	31.5
unguent	1.4	2.3	2.0	2.9
beaker	8.1	4.6	5.9	6.8
cup	13.5	10.8	11.8	9.2
goblet	-	-	-	-
bowl	25.7	16.2	19.6	15.1
flagon	1.4	-	0.5	1.4
flask	9.5	6.9	7.8	3.2
jar	9.5	12.3	11.3	4.7
jug	9.5	15.4	13.2	9.7
plate	-	0.8	0.5	0.4
drinking-misc	-	0.8	0.5	1.9
tableware-misc	2.7	4.6	3.9	8.1
vessel-no-class	5.4	16.9	12.7	5.2
Total	100.0	100.0	100.0	100.0

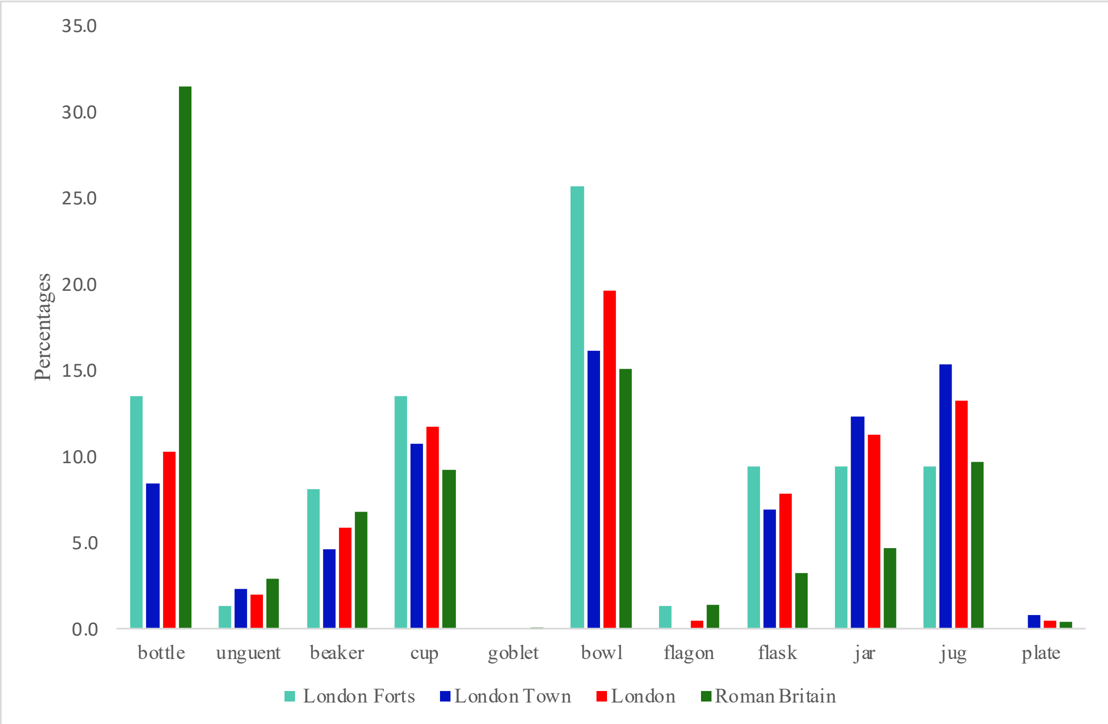


Figure 4.7 Vessel Type Percentage Profiles for the London Forts and Town

The drinking vessel and tableware types proportions for the forts and the town are broadly similar and to the corpus type profile. The proportion of the forts' bowls is higher than for the corpus and town which could be due to the lower vessel no-class percentage.

The glass forms as a percentage of the site vessels are set out in Table 4.20 and Figures 4.8, 4.9 for the forts and town with the corpus proportions as a comparison. The higher proportion of bowls for the forts are not reflected in the bowl forms; the town had more bowl forms and with higher proportions than for the forts. The absence of bottle forms for the town is possibly due to fragment size and identification as the bottle proportions are similar for both the forts and town. The presence of the bath-flask form in the Basinghall town site is relevant as baths were located in the town at Cheapside (Marsden, 1976; Wallace, 2014). The single cup form for the town includes the common cylindrical cup in the 2nd-3rd century CE (Price and Cottam, 1998, p. 101). There are more cup forms from the forts that are described in Table 2-3 and later in this chapter for settlements. The single fragment of the sports cup is worthy of mention. This form is a 1st century mould-blown cylindrical cup with zones of decoration showing circus scenes of chariot races or gladiators and was fairly common on early sites in southern Britain and represented in this study by finds in Colchester and London (Price and Cottam, 1998, p. 63). This find represents the social culture of communities with an amphitheatre during the 1st-2nd centuries CE (Hingley, 2018, pp. 76–80). The counts of the vessel forms data are low relative to the sites sample sizes representing the total vessel types. It was not always possible to identify a particular form of a vessel type (e.g. sports cup) from the fragmentary assemblages.

Table 4.20 London Glass Forms Site Counts and Percentage Counts

Glass Form	Forts Counts	% of Forts Vessels	Town Counts	% of Town Vessels	Roman Britain %
cylindrical bottle	1	1.4	-	-	3.4
square-bottle	4	5.4	-	-	3.5
arcaded-beaker	1	1.4	-	-	0.1
cantharos cup	2	2.7	-	-	0.1
cup-base-ring	1	1.4	-	-	1.0
cylindrical-cup	-	-	1	0.8	1.3
hofheim-cup	4	5.4	-	-	0.9
sports-cup	1	1.4	-	-	0.1
bath-flask	-	-	2	1.5	0.7
pillar-moulded-bowl	1	1.4	4	3.1	5.4
ribbed-bowl	-	-	1	0.8	0.5
tubular-rimed-bowl	-	-	4	3.1	1.4

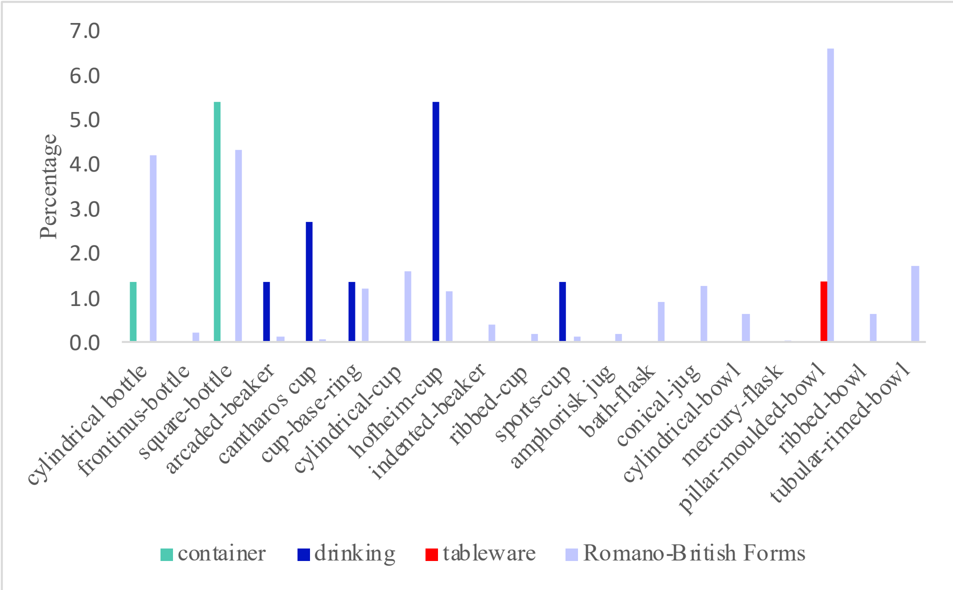


Figure 4.8 Glass Form Percentage Counts of the Total Vessel Type Counts for London Forts

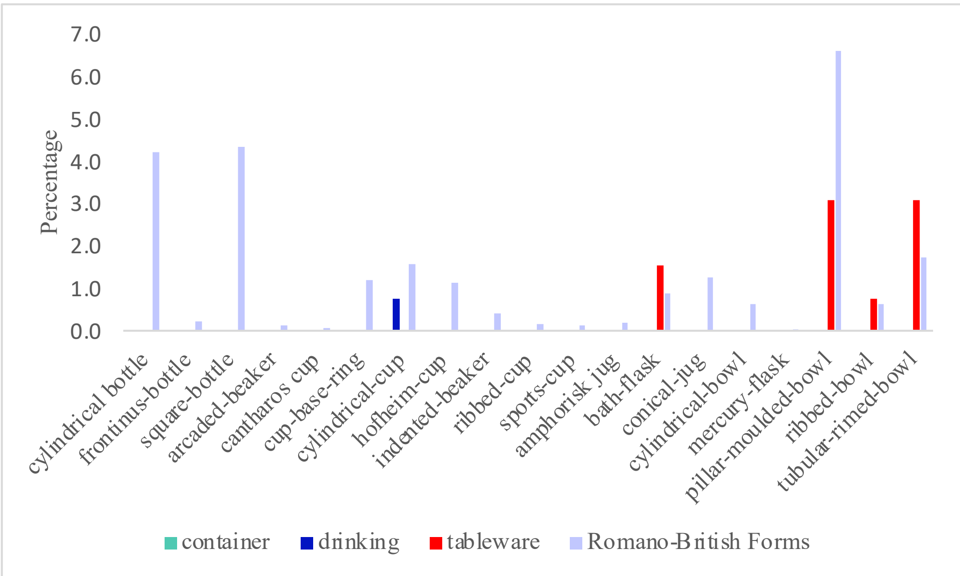


Figure 4.9 Glass Form Percentage Counts of the Total Vessel Type Counts for London Town

The following glass objects are noted as they represent the industry and buildings. Of the 15 counts of construction materials, 14 were glass residues found at Plantation Place possibly from glass-working as some were associated with furnace materials (Dunwoodie *et al*., 2015). There were buildings on the site before the construction of the Cripplegate fort with industrial activities that included evidence of glass kilns and glass fragments dated 70 – 120 CE. The archaeological evidence suggests that these buildings were demolished, and the site cleared early in the 2nd century CE in preparation for the development of the Cripplegate fort (Howe and Lakin, 2004, p. 25). Glass vessel records will also include some residual material. In this case the possibility is high given buildings were demolished and cleared.

In summary, the archaeological evidence and the glass assemblage data aligns with the history of London that developed from the mid 1st century as a town and forts. The data is considered a reliable indication of the glass deposited during the Roman period to be used for site and regional analyses with the provisos raised.

4.3.2 Wales and the Marches

The region of Wales and the Marches includes the Caerleon, Usk and Wroxeter fortresses. Table 4.21 is a summary of the context of the Roman fortresses at Usk, Wroxeter and Caerleon.

Table 4.21 Historical context for the Fortresses at Usk, Wroxeter and Caerleon

Context	**Usk Fortress** (1)	**Wroxeter Fortress** (2)	**Caerleon Fortress** (3)
Site occupation period	Usk foundations c. 58 CE and operational 60-66 CE	Wroxeter legionary fortress foundations late 50s CE and occupied until c. 90 CE	Caerleon legionary fortress foundations built in the mid 70s CE and occupied until c. 4th century CE.
The character of the site	Fortress Usk was key in a system of forts in South Wales and the Marches. In 66/7 CE, *Legio XX* moved to Wroxeter, leaving a reduced garrison at Usk	The fortress was key to the control of the central Severn valley and access to it. It was garrisoned by *Legio XIV* (55-66 CE) and *Legio XX* (66-79 CE)	Caerleon legionary fortress was garrisoned throughout the Roman period, along with the fortress at Chester. There was an extensive settlement attached to the fortress that included the fortress baths
Later history	Demolition in 70 CE or possibly 74 CE	Demolition 90-100 CE	Abandoned in the 4th century CE.
Site location	Located on the banks of the River Usk. Roads to the south and east of the fortress. The fortress was 13 kms north of Caerleon on the River Usk estuary	Located on the River Severn close to the River Trent. Primary road access was Watling Street, but also via a major north-south road	Located on the estuary of the River Usk

Sources: (1) (Manning, 1981) *(2)* (Burnham *et al.*, 2010) *(3)* (Zienkiewicz, 1986; Mason and Macdonald, 2010)

The Wales and the Marches area is relevant to this study in that it included the Usk fortress that was central to the early control of the area. This was replaced as a legionary fortress by Caerleon in south Wales that was closer to the Severn estuary. The Wroxeter fortress was strategically located further north in the Severn valley and close to the River Trent and the River Dee and Mersey estuaries. The three sites had differences in occupation that may be reflected in the material evidence excavated from archaeological sites.

The Caerleon fortress assemblages were from the fortress defences and the baths sites, with the profile shape for the Caerleon fortress a combined profile for the defences (ramparts) and the baths at the fortress. The site vessel sample size increased from 27 for the defences to 131 including the baths and that changed the overall site proportional representation. The excavation site was the southern defences of the fortress, and the natural common blue-green glass bottle fragments were found in either the ramparts or dumps for wastes and dated to the 1st and 2nd centuries (Allen, 2010). The archaeological excavation report noted that the southern defences ramparts included storerooms and turrets (Mason and Macdonald, 2010, p. 40). Over time these appeared to have been re-used to dump wastes and as these site deposition places were near to the fortress cooking ovens, it is likely that the contents of the waste rubbish would have been associated with the latter, hence the proportion of large container bottles in the glass assemblages. In contrast, the excavation site of the fortress baths was the *frigidarium* drain sediments (Zienkiewicz, 1986). There were varied finds from the drain that collected finds lost in the waste waters that represented not just the soldiers but also women and children for the period 75-230 CE (Zienkiewicz, 1986, p. 11).

The sites vessel class percentage counts are shown in the Table 4.22 and Figure 4.10 for the fortresses at Usk, Wroxeter and Caerleon.

Table 4.22 Comparison Fortress Sites Class Percentage Counts

Glass class	**Caerleon**	**Usk**	**Wroxeter**	**Roman Britain**
container-large	27.5	13.2	10.7	31.5
container-small	6.9	7.9	5.0	2.9
drinking	6.1	15.8	30.8	17.9
table-storage	41.2	52.6	49.1	42.5
no-class	18.3	10.5	4.4	5.2
Total	100.0	100.0	100.0	100.0

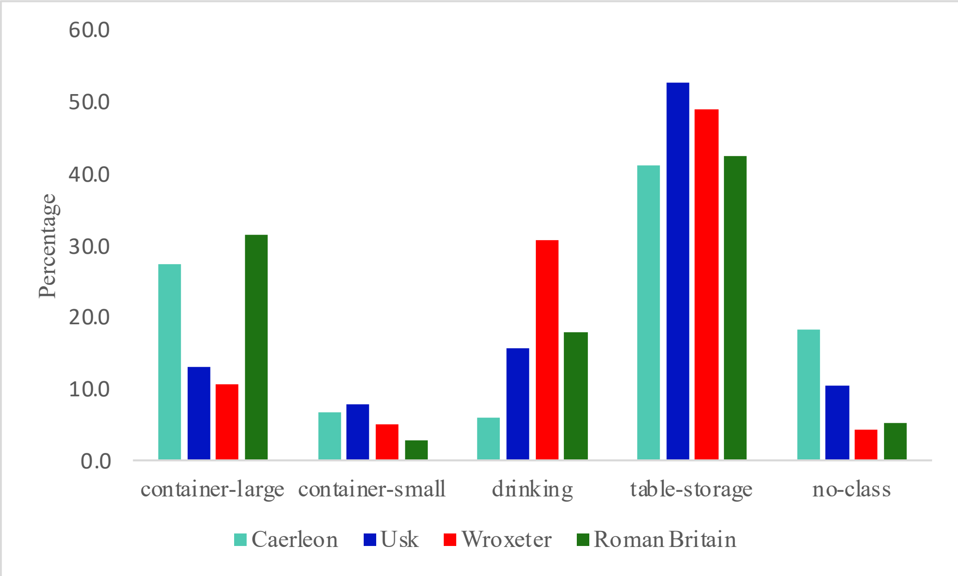


Figure 4.10 Comparison Fortress Sites Class Percentage Counts

The greater large container proportions for Caerleon would have been influenced by the occupation of the fortress into the 4th century CE and that bottles were found in most late 1st and 2nd century sites. In contrast, the Usk and Wroxeter fortresses were occupied just in the 1st century CE. The variation between Wroxeter and Usk drinking vessel proportions could be explained by the longer occupancy of the Wroxeter fortress than for Usk, and also the Wroxeter excavations included centurial quarters and barracks whereas at Usk the excavated barracks buildings were possibly also stables for the cavalry (Manning, 1981; Marvell, 1996; Webster and Chadderton, 2002). The overall accession line percentage counts profile shapes are otherwise similar for the vessel classes (e.g. containers, drinking and tableware) for Usk, Wroxeter and Caerleon and similar to the Romano-British corpus profile. The sample sizes are similar for each of the sites with vessel counts of 114, 159 and 131 respectively.

The two areas of the fortress (baths and defences) have been presented in Figure 4.11 to compare with the fortress archaeology.

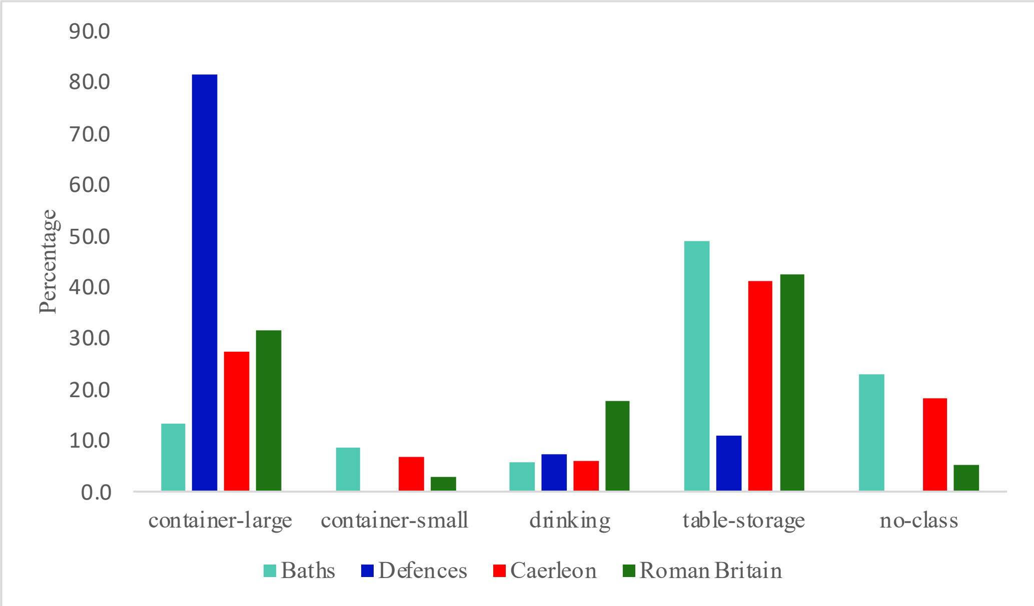


Figure 4.11 Comparison Caerleon Fortress Defences and Bath Sites Percentage Counts

The two class profiles for the baths and defences are proportionally different to each other and to the combined site profile. The defences profile has a high proportional percentage count of bottles (81.5%) relative to the other sites and to the Romano-British corpus. The main evidence from the baths profile was the presence of small container unguent bottles not seen in the defences.

The overall Caerleon glass class finds profile is similar to that for Usk and Wroxeter. The excavations at Usk included the fortress itself and the stone bath-house near the west gate and the *Via Principalis* (Manning, 1981, pp. 5, 130); the excavations at the Wroxeter fortress may have included a stone bath-house (Webster and Chadderton, 2002, p. 22). This validates the presentation of the data for all the fortress sites as being equivalent in representing the respective defences and baths.

The glass vessel type percentage profiles for Usk, Wroxeter and Caerleon fortresses are detailed in Table 4.23 and shown graphically in Figure 4.12 below, noting that the operational chronologies differ as discussed previously.

Table 4.23 Fortress Sites Vessel Type Percentage Counts (43–500 CE)

Glass type	**Caerleon**	**Usk**	**Wroxeter**	**Roman Britain**
bottle	27.5	13.2	10.7	31.5
unguent	6.9	7.9	5.0	2.9
beaker	2.3	4.4	20.1	6.8
cup	2.3	8.8	9.4	9.2
goblet	-	-	-	-
bowl	6.9	24.6	31.4	15.1
flagon	-	-	-	1.4
flask	23.7	1.8	3.1	3.2
jar	0.8	6.1	-	4.7
jug	3.1	13.2	10.1	9.7
plate	4.6	0.9	-	0.4
drinking	1.5	2.6	1.3	1.9
tableware	2.3	6.1	4.4	8.1
no-class	18.3	10.5	4.4	5.2
Totals	100.0	100.0	100.0	100.0

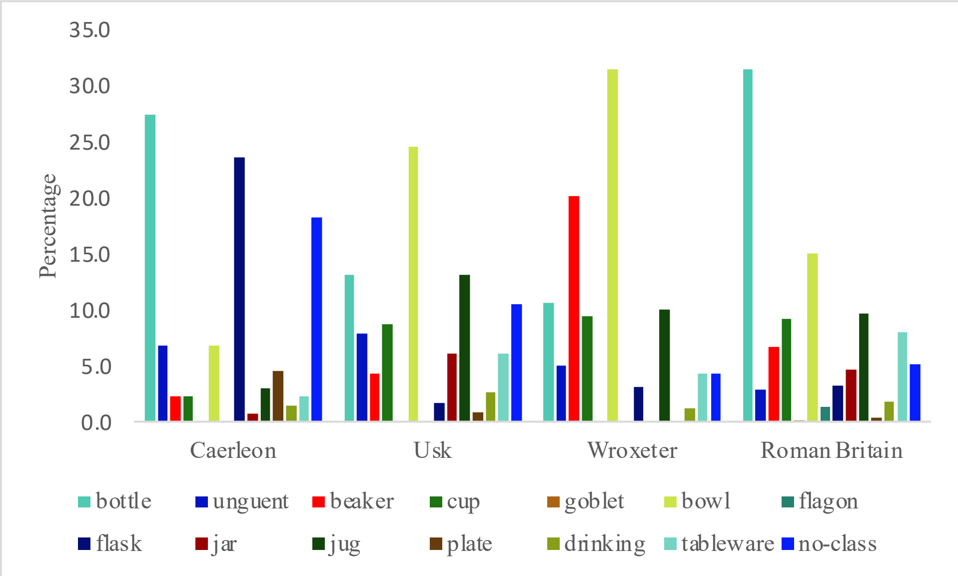


Figure 4.12 Fortress Sites Vessel Type Percentage Counts (43-500 CE)

These show that the glass vessel type counts percentage profiles are similar in shape for Usk and Wroxeter with bowls significant on both sites. The dominance of bottles from the defences and flasks from the baths impacts the profile for Caerleon. The drinking vessel types show variations across the sites with beaker percentage counts more pronounced for Wroxeter and an absence of cups at Caerleon. While all the vessel classes are similarly represented on all the sites, there are differences for the bottle, drinking vessels and flask vessel types.

The glass forms represent uniquely identifiable vessel types and are set out in Table 4.24 and Figures 4.13, 4.14, 4.15 that show the percentage counts of the glass forms in comparison with the Romano-British corpus percentage.

Table 4.24 Comparison Fortress Glass Forms Site Percentage Counts

Glass form	Caerleon	Usk	Wroxeter	Roman Britain
cylindrical bottle	3.8	-	0.6	4.4
frontinus-bottle	-	-	-	4.5
square-bottle	5.3	6.1	1.3	0.2
arcaded-beaker	-	-	0.6	22.3
cylindrical-cup	-	0.9	-	0.5
indented-beaker	-	0.9	1.9	1.3
amphorisk jug	-	0.9	0.6	0.2
bath-flask	15.3	-	-	0.1
conical-jug	-	6.1	-	12.5
cylindrical-bowl	-	0.9	-	0.2
pillar-moulded-bowl	2.3	15.8	20.1	0.5
ribbed-bowl	-	-	5.7	0.1

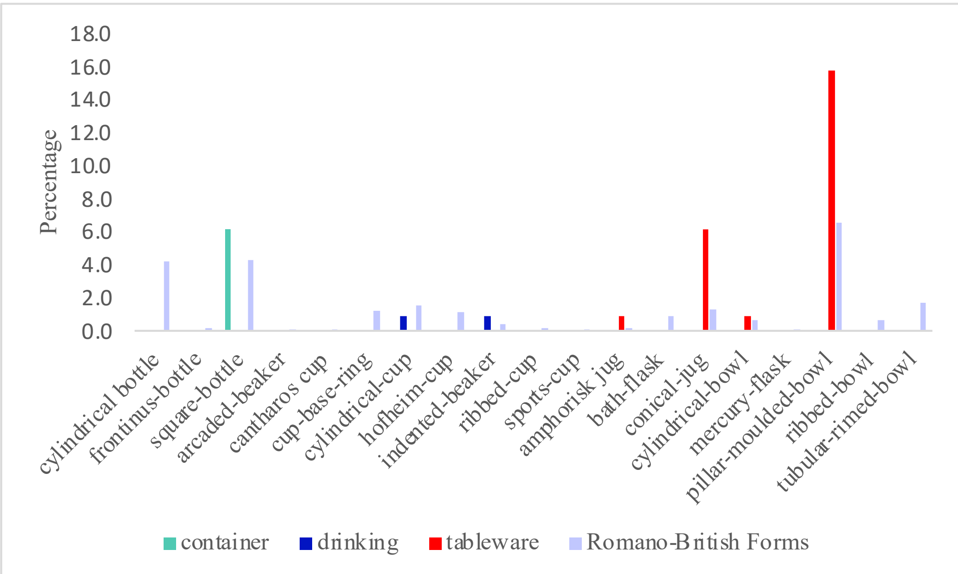


Figure 4.13 Usk Fortress Glass Form Percentage of the Total Vessel Counts

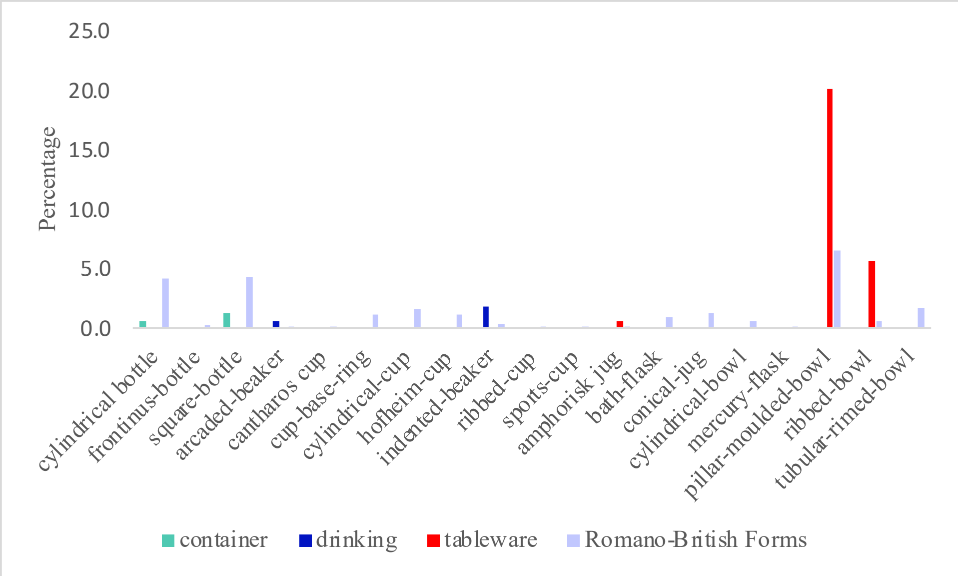


Figure 4.14 Wroxeter Fortress Glass Form Percentage of the Total Vessel Counts

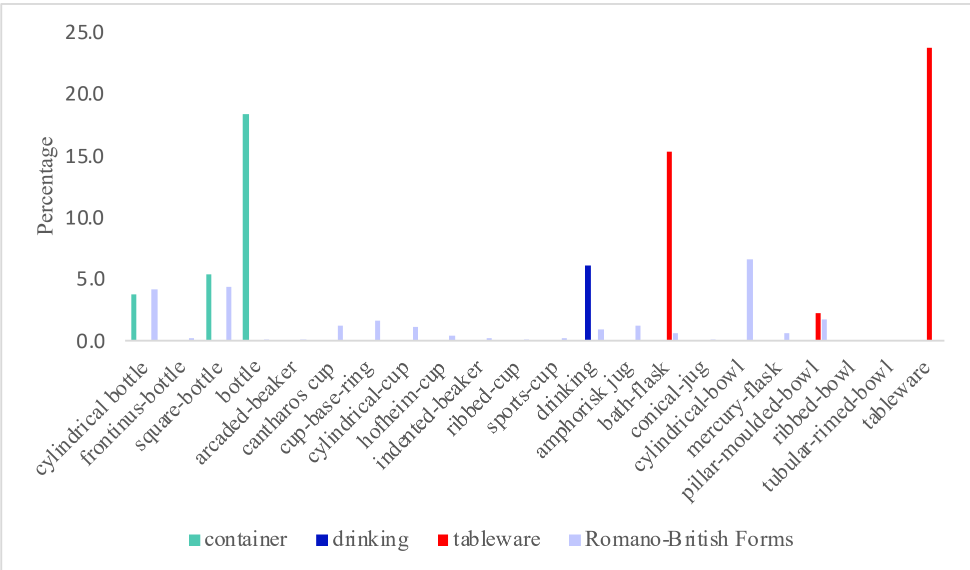


Figure 4.15 Caerleon Fortress Glass Form Percentage of the Total Vessel Counts

The flask profile for Caerleon includes the bath-flask forms that are shown higher in proportion to the corpus as would be expected given the baths deposition context. Similarly, the cylindrical, square and *Frontinus* bottle forms at Caerleon reflect the higher proportion of bottles from the defences. The pillar-moulded bowl was a common cast glass bowl in the 1st century and was well represented on both the Usk and Wroxeter fortress sites; the smaller proportion at Caerleon perhaps reflects the later date of the fortress. The amphorisk jug fragments found at Usk and Wroxeter represent a two-handled convex jug and not very common in Britain with date range 43–*c.* 65/70 CE (Price and Cottam, 1998, p. 147). This form is a particular convex shape of a jug distinguishable from the very common conical jugs in Britain in the 1st – 2nd centuries CE.

In summary, the archaeological evidence and the glass assemblage data is considered a reliable indication of the glass deposited during the Roman period to be used for analysis.

4.3.3 Lancashire and Yorkshire

The region of Lancashire includes the fort at Ribchester fort and for Yorkshire the fort at Castleford and the York fortress. The following Table 4.25 summarises the historical context for the Ribchester and Castleford forts and the York fortress.

Table 4.25 Historical context for the Ribchester and Castleford Forts and the York Fortress

Context	**Ribchester Fort** (1)	**Castleford Fort** (2)	**York Fortress** (3)
Site occupation period	Timber fort c. 72/3 CE. Renovated in late 70s CE and replaced with stone early in the 2nd century CE. Fell into decline after c. 135 CE. Abandoned by the end of the 2nd century CE.	Fort I: Phase I c. 71/4 CE - c. 86 CE. Fort II c. 85/90 CE - 95-100 CE. Phase III c. 100-250 CE, then abandoned. Phase IV 250-400 CE.	Foundations and construction 71 CE and defences rebuilt in stone 107/8 CE. Defences rebuilt in the early 3rd century CE. Occupation continued until the end of the Roman occupation in Britain.
The character of the site	Fort at Ribchester was strategic to control the River Ribble and the development of road networks. Part of a chain of forts running inland up the river. Extramural settlement associated with the fort.	The fort was an auxiliary fort south-east of Leeds (16km) and south-west of York (32km). The evidence suggests infantry and cavalry occupied the fort. The *vicus* included evidence of manufacturing and repair.	*Legio IX* until c. 120 CE, then *Legio VI* until the end of the Roman period. Emperor Severus made York a base for campaigns 208-11.
Later history	Abandoned by the end of the 2nd century CE and general decay to the 4th century CE.	Abandoned in the 2nd century CE. The occupation of the *vicus* was longer than for the fort.	York civil settlement conferred as a *colonia* in 237 CE.
Site location	On the banks of the River Ribble. Roads to the south of Manchester and on to Chester. To the north to Carlisle and Hadrian's Wall.	Situated below the confluence of the Rivers Calder and Aire, with road access to York and Leeds.	The fortress faced south-west towards the River Ouse.

Sources: (1) (Buxton and Howard-Davies, 2000) *(2)* (Cool and Philo, 1998) *(3)* (Cool *et al*., 1995; Wacher, 1998, pp. 44–45)

The accession line class percentage profiles are shown in Table 4.26 and Figure 4.16 for the Ribchester, Castleford and York sites with a comparison with the Roman Britain corpus.

Table 4.26 Vessel Class Percentage Counts for Ribchester Castleford and York

Glass class	**Ribchester**	**Castleford**	**York**	**Roman Britain**
container-large	68.8	19.3	20.9	31.5
container-small	1.5	2.6	3.3	2.9
drinking	4.4	34.4	27.0	17.9
table-storage	23.4	37.8	26.0	42.5
no-class	2.0	5.9	22.8	5.2
Total	100.0	100.0	100.0	100.0

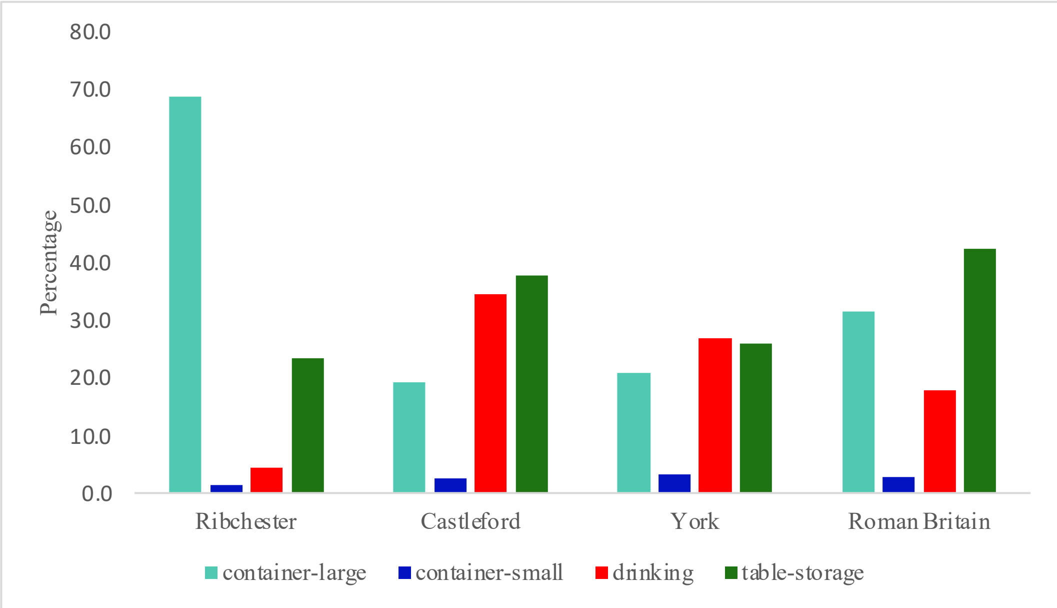


Figure 4.16 Ribchester, Castleford and York Vessel Site Percentage Profiles (43-500 CE)

The class profiles are broadly similar for the accession line vessel percentage counts for Ribchester, Castleford, and York with the exception of the size of the bottle proportion at Ribchester, that was reported as being greater than usually expected with much of the glass recovered as large fragments, an indication of the taphonomy disposal process (Buxton and Howard-Davies, 2000, p. 286). This suggests that recycling was not as systematically applied at Ribchester as bottle glass is often found in glass-working cullet dumps. There is a suggestion that the location of the finds in a ditch was from a military site clearance rather than regular disposal or recycling (Buxton and Howard-Davies, 2000, p. 88). The Ribchester glass assemblage was dominated by residual 1st century material that indicates possible long-term use of materials and late 2nd century disposal (Buxton and Howard-Davies, 2000, pp. 120, 293).

The glass vessel type percentage profiles for the Ribchester and Castleford forts, and the York fortress are detailed in the following Table 4.27 and Figure 4.17 with a comparison with the Romano-British corpus.

Table 4.27 Comparison Lancashire-Yorkshire Sites Percentage Type Counts

Glass type	Ribchester	Castleford	York	Roman Britain
bottle	68.8	19.3	20.9	31.5
unguent	1.5	2.6	3.3	2.9
beaker	2.9	8.5	13.5	6.8
cup	1.5	25.2	7.4	9.2
goblet	-	-	-	-
bowl	3.4	14.4	12.1	15.1
flagon	-	-	-	1.4
flask	-	2.2	1.9	3.2
jar	1.0	2.6	4.2	4.7
jug	13.7	9.6	3.3	9.7
plate	-	0.4	0.5	0.4
drinking	-	0.7	6.0	1.9
tableware	5.4	8.5	4.2	8.1
no-class	2.0	5.9	22.8	5.2
Totals	100.0	100.0	100.0	100.0

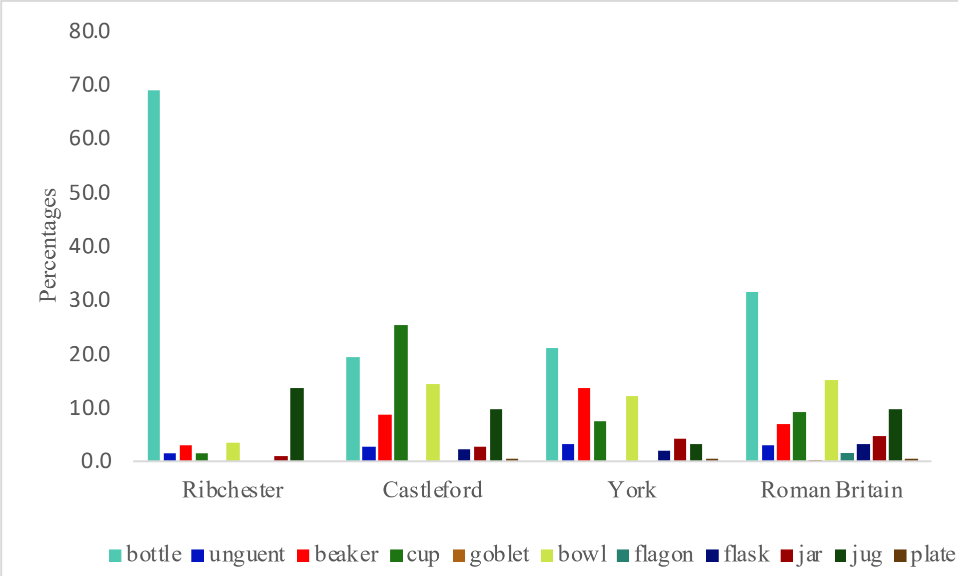


Figure 4.17 Comparison Lancashire-Yorkshire Sites Percentage Type Counts with Romano-British Corpus

The vessel type profiles can be seen to have similar proportions on all the sites with the exception being Ribchester given the high proportion of bottle counts already discussed that impacts the other percentages. Ribchester had archaeological evidence of a bath-house (Buxton and Howard-Davies, 2000, pp. 7, 421) with no evidence of bath-flasks but with unguent bottles that can be associated with bath-house regimes. The Castleford and York evidence included bath-houses and small bath-flasks were included in the glass evidence (Cool and Philo, 1998, p. 149).

The comparison of the Usk, Caerleon and York fortress site profiles is shown in Figure 4.18 below. They are broadly similar in shape with the exception of Caerleon that has different proportions of bottle, bowl and flask types, more than likely because the profile is a combination of baths and fortress defences, with the main sample of evidence from the former deposition site. The York and Usk contexts were both internal fortress areas (Cool *et al*., 1995, p. 1513; Marvell, 1996, p. 77).

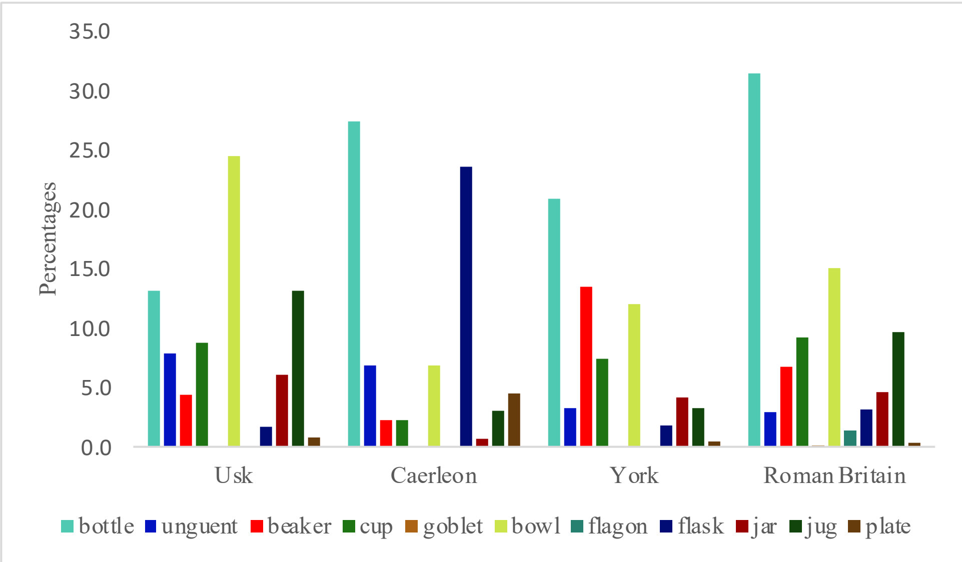


Figure 4.18 Comparison Fortress Sites Percentage Type Counts with Romano-British Corpus

The glass forms are set out in Table 4.28 and Figures 4.19, 4.20 and 4.21 that show the percentage counts of the vessel forms.

Table 4.28 Comparison of Vessel Forms Site Percentages at Ribchester, Castleford and York

Glass form	Ribchester	Castleford	York	Roman Britain
cylindrical bottle	9.8	3.0	2.8	4.4
square-bottle	1.5	5.6	0.9	0.2
arcaded-beaker	-	-	0.5	22.3
cup-base-ring	-	5.2	-	0.1
cylindrical-cup	-	2.2	1.9	0.5
hofheim-cup	-	0.4	-	0.1
indented-beaker	-	-	1.4	1.3
amphorisk jug	-	-	0.5	0.2
bath-flask	-	0.4	-	0.1
conical-jug	3.4	3.3	0.9	12.5
pillar-moulded-bowl	2.9	5.9	12.1	0.5
ribbed-bowl	-	1.1	-	0.1

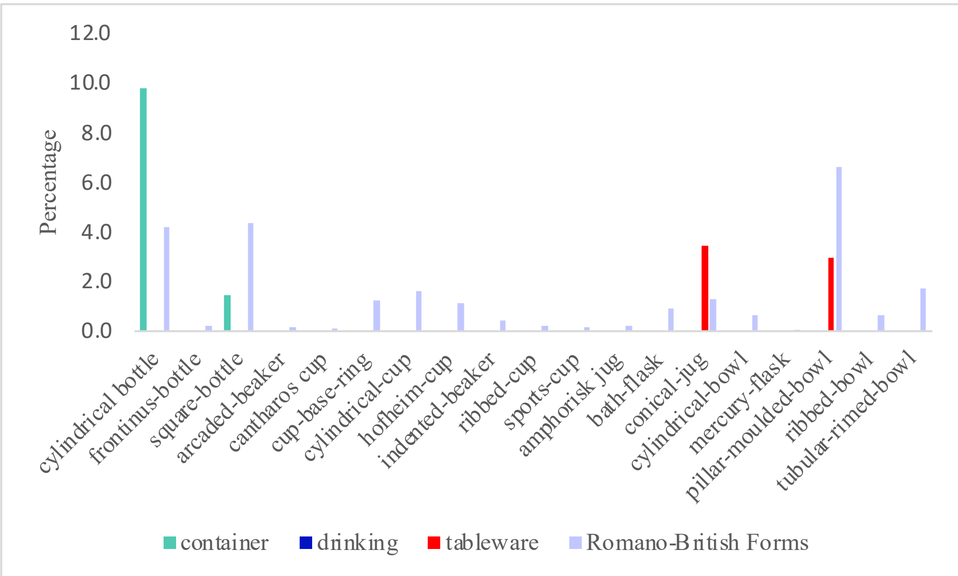


Figure 4.19 Ribchester Glass Form Percentage of the Total Vessel Counts

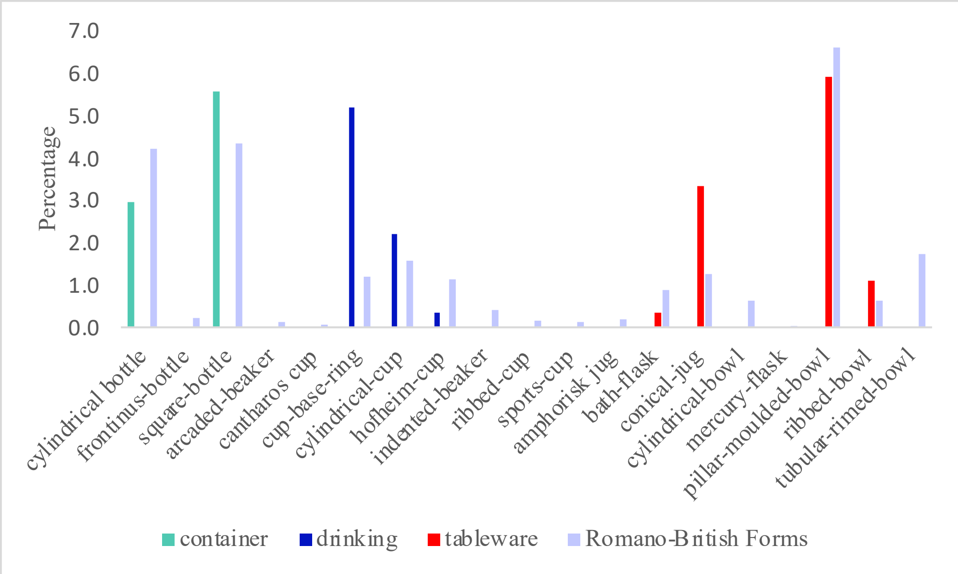


Figure 4.20 Castleford Glass Form Percentage of the Total Vessel Counts

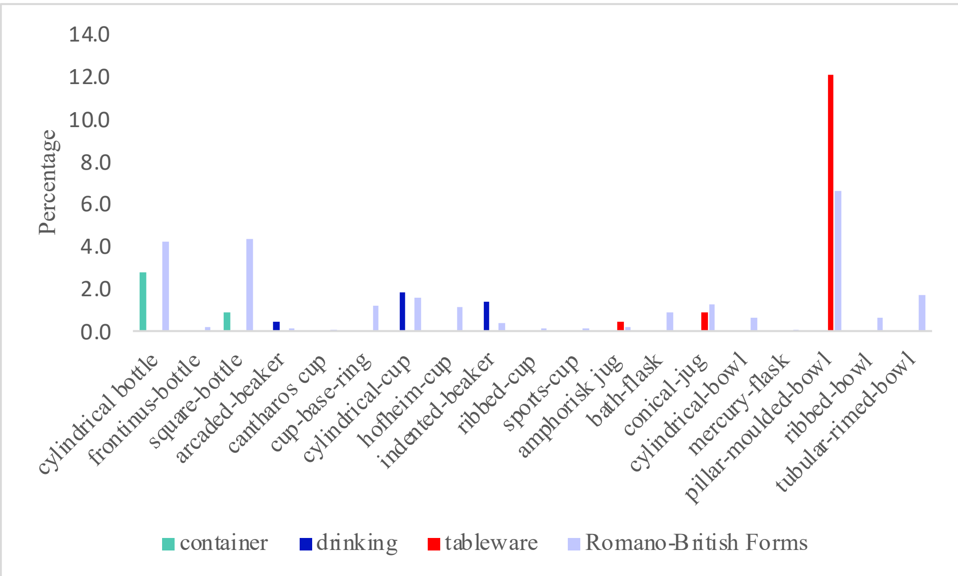


Figure 4.21 York Glass Form Percentage of the Total Vessel Counts

The two most common glass bottle forms from Roman Britain are the cylindrical and square types, with both very commonly seen on all 1st century CE settlements with the longer-lasting square bottle glass form (Figure 4.110) continuing towards the end of the 2nd century CE (Price and Cottam, 1998). Bottles were common containers for liquids or foodstuff and many have wear marks on the rims and bases of the bottles that suggest day-to-day use of the bottles being lifted in and out of their protective straw jackets over long periods of time (Cool and Price, 1995; Wilmott, 1997; Price and Cottam, 1998, p. 9). Evidence for this was recorded at Ribchester, with one base fragment with a circular inside band of wear suggesting secondary use of the cylindrical bottles (Buxton and Howard-Davies, 2000, p. 287). There were fragments of the hexagonal bottle form at Ribchester that is very exceptional (Buxton and Howard-Davies, 2000, p. 289). The glass report noted the presence of bottle base designs, with some similarities to fragments from Carlisle. Bottle base designs are found on most square bottles (Price and Cottam, 1998, p. 194; Cool, 2022).

4.3.4 Cumbria and Northumberland

The Cumbria and Northumberland region includes the forts at Watercrook, Ravenglass, and Piercebridge. The following Table 4.29 summarises the context for each of the forts.

Table 4.29 : Historical context for the Watercrook, Ravenglass and Piercebridge Forts

Context	**Watercrook Fort** (1)	**Ravenglass Fort** (2)	**Piercebridge Fort** (3)
Site occupation period	Construction started c. 90/5 CE with stone walls c. 135-45 CE. Two further phases with reduction (c. 150-170 CE) and enlargement c. 270 CE. Occupation ended c. 400 CE. The fort could have been occupied as a *cohors quingenaria pedita.*	An auxiliary fort established c. 130 CE with a military *vicus*. Settlement extended away from the fort in the mid 2nd century along the main roads. Occupation ended c. 300 CE.	Military occupation of the site late 2nd century with a significant legionary presence in the early 3rd century. The fort was built in the mid 3rd century CE. By 4th century, occupation concentrated in the fort.
The character of the site	The fort included ramparts, buildings with barracks, gates, two granaries, principia and a bathhouse. There was evidence of a kiln. The area of the fort was 1.57ha. A *vicus* was associated with the fort	Auxiliary cohort fort with administrative buildings, barrack blocks and bathhouse. Iron working waste finds and high temperature works.	Major 2nd century centre that changed when the fort wall was built. The Roman fort is on the north bank of the River Tees and to the east is a civil settlement in Tofts Field. South of the river is a further civil settlement, along the line of Dere Street.
Later history	Abandoned in the 4th century CE.	Abandoned in the 4th century CE.	Abandoned in the 6th century CE.
Site location	Watercrook was south of Kendalat a loop in the River Kent. It was located to control the lowlands of southern Cumbria and had access to Morcambe Bay and coastal routes. The main road from Ribchester to Carlisle was east to the fort.	Ravenglass is on the Cumbrian coast situated on a natural harbour between the estuaries of the Rivers Esk and Mite. The road network included a road to Hardnott fort, Ambleside, Brougham and Penrith, with a link to the coastal route to Carlisle.	The site lies at the point where Dere Street crosses the River Tees. Dere Street is a main north-south Roman road connecting York with Corbridge.

Sources: (1) (Potter, 1979) (2) (Hunter-Mann, 2015) (3) (Cool and Mason, 2008)

The Ravenglass and Watercrook forts were occupied from the early 2nd century and located to the west of the Pennines with access by sea, river and the road network from Manchester to Carlisle. The construction and occupation of a fort and *vicus* at Piercebridge has been suggested as 260-280 CE and remained operational until the 5th century CE (Cool and Mason, 2008, p. 306). The development of the fort and the quantity and quality of the finds suggest that Piercebridge was an important military centre in the 3rd century CE (Cool and Mason, 2008, p. 307). The origin of the settlement at Piercebridge was a major centre that could be described as a garrison town in the 2nd-3rd century CE. The industrial centre at Catterick was in close proximity. There was road access between York and Corbridge and river and sea routes from the east coast. The accession line class counts, and percentage profiles are shown in the following Table 4.30 and Figure 4.22 for the military sites with a comparison with the selected Romano-British corpus. The class profiles are broadly similar for all the sites with the observation that no drinking vessels were recorded for Watercrook. The Watercrook site sample size was 24 counts and for the nearby fort at Ravenglass it was 19 counts. The contexts for the Watercrook and Ravenglass sites included the forts and the *vici* (Potter, 1979, pp. 12, 149–150; Hunter-Mann, 2015).The range of containers and tableware for the individual sites are broadly similar, even though the sites' sample sizes were low.

Table 4.30 Vessel Class Site Percentage Counts for Ravenglass, Watercrook and Piercebridge

Glass class	Ravenglass	Watercrook	Piercebridge	Roman Britain
container-large	63.2	66.7	51.4	31.5
container-small	5.3	4.2	2.6	2.9
drinking	10.5	-	31.1	17.9
table-storage	15.8	16.7	13.6	42.5
no-class	5.3	12.5	1.2	5.2
Total	100.0	100.0	100.0	100.0

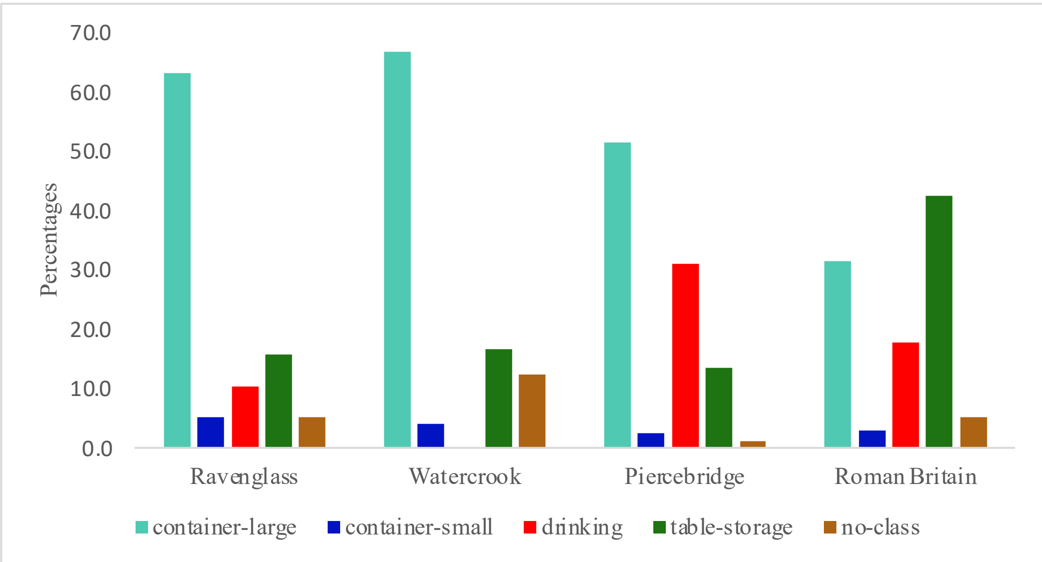


Figure 4.22 Vessel Class Site Percentage for Ravenglass, Watercrook and Piercebridge

The vessel type profiles for the forts are shown in Table 4.31 and Figure 4.23.

Table 4.31 Vessel Type Site Percentage Counts for Ravenglass, Watercrook and Piercebridge

Glass type	Ravenglass	Watercrook	Piercebridge	Roman Britain
bottle	63.2	66.7	51.4	31.5
unguent	5.3	4.2	2.6	2.9
beaker	10.5	-	3.1	6.8
cup	-	-	25.1	9.2
goblet	-	-	-	-
bowl	-	4.2	3.3	15.1
flagon	10.5	8.3	-	1.4
flask	-	-	3.1	3.2
jar	-	4.2	0.2	4.7
jug	-	-	4.3	9.7
plate	5.3	-	0.5	0.4
drinking	-	-	2.9	1.9
tableware	-	-	2.2	8.1
no-class	5.3	12.5	1.2	5.2
Totals	100.0	100.0	100.0	100.0

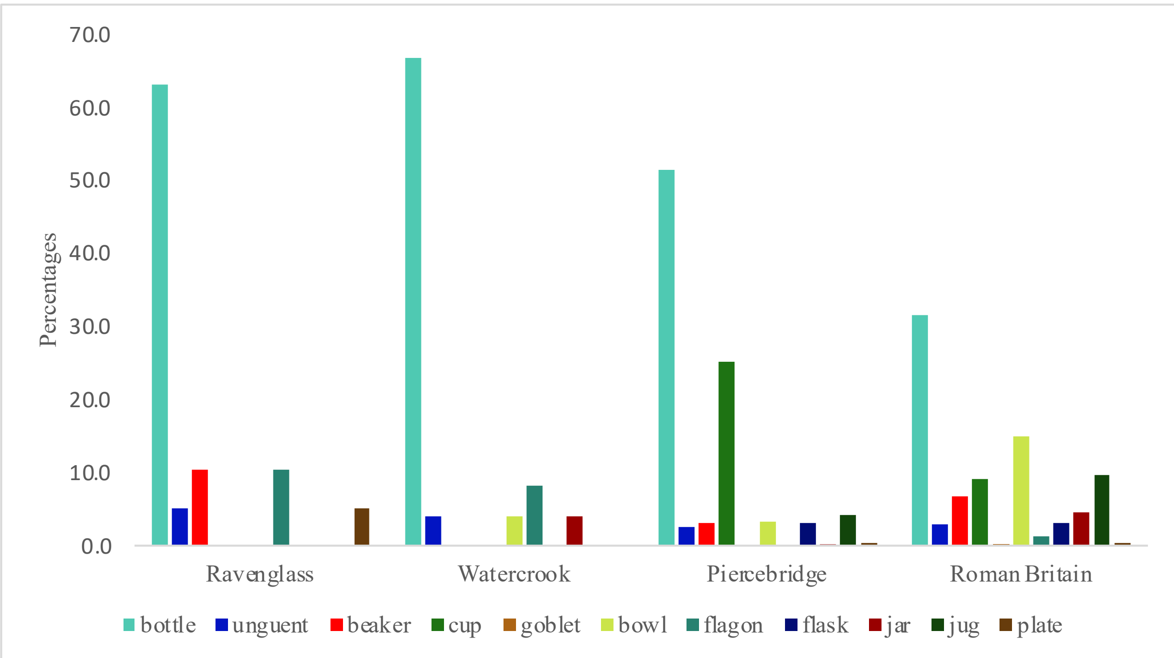


Figure 4.23 Vessel Type Percentages for Ravenglass, Watercrook and Piercebridge

While there is evidence of the beaker type at Ravenglass, this is of two fragments from inside the fort. The majority of finds at military sites are bottles with on average *c.* 40% of the vessel totals. For low sample size sites as at both Watercrook and Ravenglass, some types could be missing and the proportions could be unrepresentative. The report of glass at Watercrook noted a large quantity of small fragments with many that could not be identified (Charlesworth, 1979: 230). That is an indication of the difficulties of vessel identification with likely only the thicker walled vessels such as bottles being recorded.

The glass forms represented at Watercrook, Ravenglass and Piercebridge are set out in the following Table 4.32 and Figures 4.24, 4.25, 4.26 that shows the percentage counts of the vessel types represented.

Table 4.32 Vessel Forms Site Percentages at Ravenglass, Watercrook and Piercebridge

Glass form	Ravenglass	Watercrook	Piercebridge	Roman Britain
cylindrical bottle	-	25.0	2.9	
frontinus-bottle	-	-	0.2	4.5
square-bottle	5.3	37.5	6.9	0.2
cup-base-ring	-	-	4.1	0.1
cylindrical-cup	-	-	11.2	0.5
ribbed-cup	-	-	1.0	1.7
mercury-flask	-	-	0.2	1.4
tubular-rimed-bowl	-	-	0.7	0.8

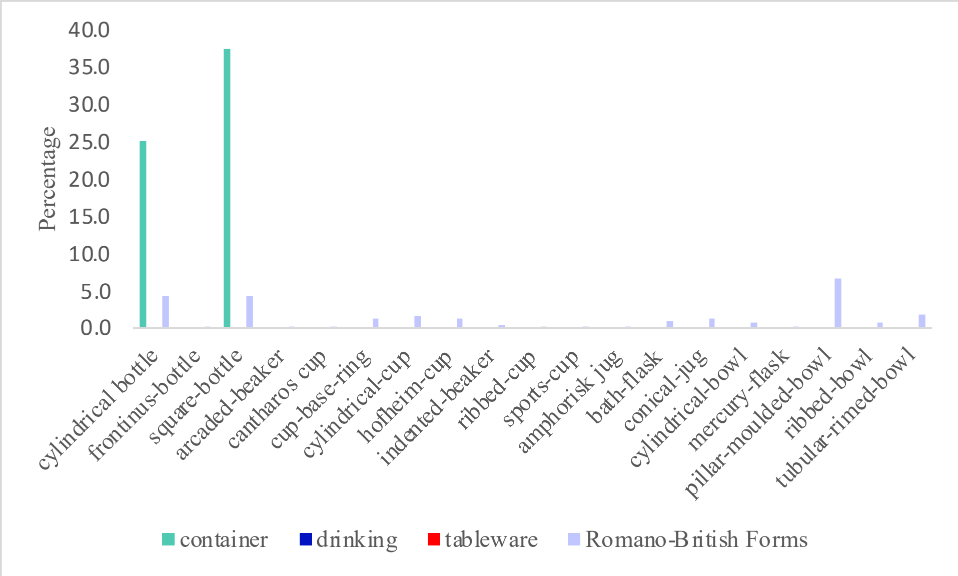


Figure 4.24 Watercrook Glass Form Percentage Counts of the Total Vessel Counts

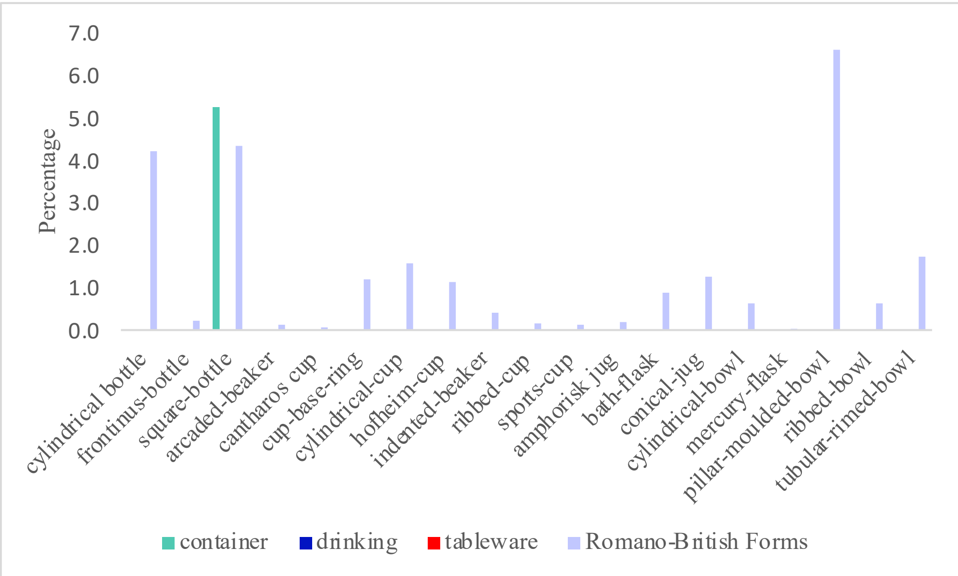


Figure 4.25 Ravenglass Glass Form Percentage Counts of the Total Vessel Counts

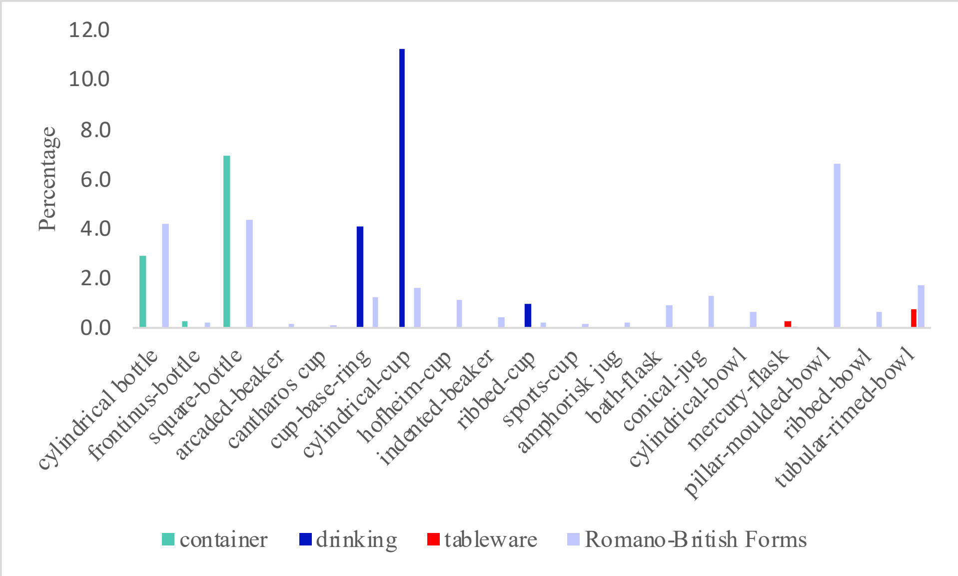


Figure 4.26 Piercebridge Glass Form Percentage Counts of the Total Vessel Counts

The reference details for all the above forms are consistent with glass finds in Roman Britain with bottle forms dominant, more than likely for the reasons noted above. The site sample size at Piercebridge was 432 accession lines and a broad range of glass forms of containers, drinking vessels and tableware is shown. The finds data for all the forts are considered valid to be included in the material record, but with a caution regarding making inferences of absent forms and of the site percentage proportions from possible bias for Ravenglass and Watercrook.

In comparison, the Roman forts in Yorkshire and Lancashire were larger and had regional roles in Roman Britain than the West Cumbria forts of Watercrook and Ravenglass that were comparatively smaller, but still had important functions in controlling specific areas and routes. The later 3rd century fort at Piercebridge was similar in size to York and also controlled routes in Northumberland. The larger sites of Ribchester, Castleford, York and Piercebridge had similar broad glass profiles. The range of glass vessels were narrower for the West Cumbria forts with the cup type absent from both sites.

4.3.5 Hadrian's Wall

The Hadrian's Wall region includes the forts at Carlisle, Corbridge, and Birdoswald. The following Table 4.33 summarises the context for each of the forts for the Carlisle, Corbridge and Birdoswald sites.

Table 4.33 Historical context for the Carlisle, Corbridge, and Birdoswald Forts

Context	**Carlisle Fort** (1)	**Corbridge Fort** (2)	**Birdoswald Fort** (3)
Site occupation period	Timber fort I c. 72/3 CE. Refurbished 83/4 CE and 93/4 CE. Fort I demolished 103/5 CE. Fort II rebuilt c. 105 CE. Demolition of fort II in the 140s CE. Fort built in stone early 3rd century CE.	Fort I 90-105 CE. Fort II 105-120 CE. Fort III 120-130 CE. Fort IV c. 158 - c. 163 CE	Stone defences and turf wall ditch 117-138 CE. Major structural changes 193-211 CE with further alterations 220-290 CE. Re-excavation of fort ditches 290-350 CE. Collapse and re-use 350-400+ CE.
The character of the site	Carlisle fort was adjacent to the northern border of *Britannia* , below Hadrian's Wall and close to Stanwix fort on the Wall. Carlisle (*Luguvalium*) was a major urban centre and Roman *civitas* . There was an extramural settlement and a supply depot in the annexe	The Corbridge fort was at a strategic crossing place for the River Tyne. It was affected by if not part of Hadrian's Wall forts. There is evidence of extramural features asssociated with the fort that developed into a town in the 3rd century CE.	Emperor Hadrian's visit to Britain in 122 CE coincided with major stone works across Hadrian's Wall. There is a western and eastern *vicus* .
Later history	Demolition of the fort early in the 5th century CE or later with robbing of most of the stone buildings.	Abandoned by the end of the 2nd century CE.	Possible continued occupation post-Roman into the 5th century CE.
Site location	Situated next to the River Caldew and below the confluence with the River Eden. Major roads to the north and south of the fort.	On the banks of the River Tyne. Corbridge is connected to York via Dere Street that crossed Stangate and continued to the Antoinine Wall, Scotland.	Situated on Hadrian's Wall c. 20km east of Carlisle and on a high spur beside the River Irthing. It had a strategic position at the River Irthing crossing.

Sources: (1) (Zant, 2009) *(2)* (Bishop and Dore, 1988) *(3)* (Wilmott, 1997, 2012)

These forts were connected by roads following the route of Hadrian's Wall and the Stanegate. Corbridge was the node in the road transport system from York, Piercebridge through Corbridge to Elginhaugh in Scotland. The vessel class percentage counts are shown in the following Table 4.34 and Figure 4.27 for the Carlisle, Corbridge and Birdoswald forts on Hadrian's Wall.

Table 4.34 Vessel Class Percentage Counts for Carlisle, Corbridge and Birdoswald

Glass class	Carlisle	Corbridge	Birdoswald	Roman Britain
container-large	82.8	15.6	46.5	31.5
container-small	0.0	4.4	0.0	2.9
drinking	3.9	31.1	15.5	17.9
table-storage	12.9	42.2	29.6	42.5
no-class	0.4	6.7	8.5	5.2
Total	100.0	100.0	100.0	100.0

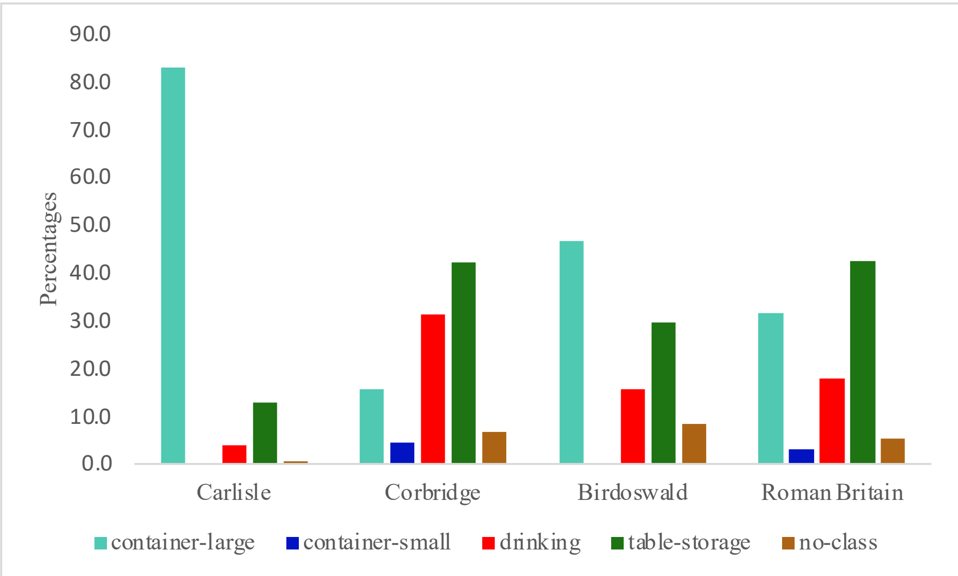


Figure 4.27 Vessel Class Percentage Counts for Carlisle, Corbridge and Birdoswald

There are missing glass assemblages waiting to be catalogued from this Corbridge archive (personal communication from Frances McIntosh, English Heritage, 16.06.2022). While there is a full range of the glass types represented at Corbridge, this could explain the lower than expected Corbridge bottle proportion. The accession line vessel percentage counts for Carlisle and Birdoswald are dominated by the proportion of bottles that skew the relative proportions of all vessel classes, similar to the class profiles for Caerleon and Ribchester. The high bottle counts at Carlisle were mainly prismatic blue-green glass bottles, and 90% were excavated from the Castle Gardens site (MIL5) that included the *Principia*, *Praetorium* and the fort southern barracks (Zant, 2009, p. 97). The deposited glass was dated to the 1st to early 3rd century for contexts that included officers and army living quarters rather than extramural settlements. It would have been associated with the occupation of the first fort at Carlisle and the bottle counts could be representative of the original population of glass bottles. The bottles at Birdoswald were found in the stone fort buildings with over 50% of the fragments found as bottles (Price and Cottam, 1999, p. 347). The context for Corbridge again indicates that over 50% of the fragments were bottles (Allen, 1988, p. 287). The reported accession lines for Corbridge however are based on selected reports of fragments with figures and may actually under-represent the original population as noted previously. However, Corbridge was retained in the study as the site was strategically located on Dere Street on a major route north from Piercebridge and developed as a fort and a significant trading *vicus* (Wacher, 1998, pp. 153, 209).

The glass vessel type percentage counts are shown in Table 4.35 and Figure 4.28 for the Hadrian's Wall forts.

Table 4.35 Vessel Type Percentage Counts for Carlisle, Corbridge and Birdoswald

Glass type	Carlisle	Corbridge	Birdoswald	Roman Britain
bottle	82.8	15.6	46.5	31.5
unguent	-	4.4	-	2.9
beaker	-	22.2	1.4	6.8
cup	3.9	8.9	12.7	9.2
goblet	-	-	-	-
bowl	5.2	11.1	12.7	15.1
flagon	6.0	-	-	1.4
flask	-	6.7	4.2	3.2
jar	0.9	4.4	2.8	4.7
jug	-	4.4	4.2	9.7
plate	-	-	-	0.4
drinking	-	-	1.4	1.9
tableware	0.9	15.6	5.6	8.1
no-class	0.4	6.7	8.5	5.2
Totals	100.0	100.0	100.0	100.0

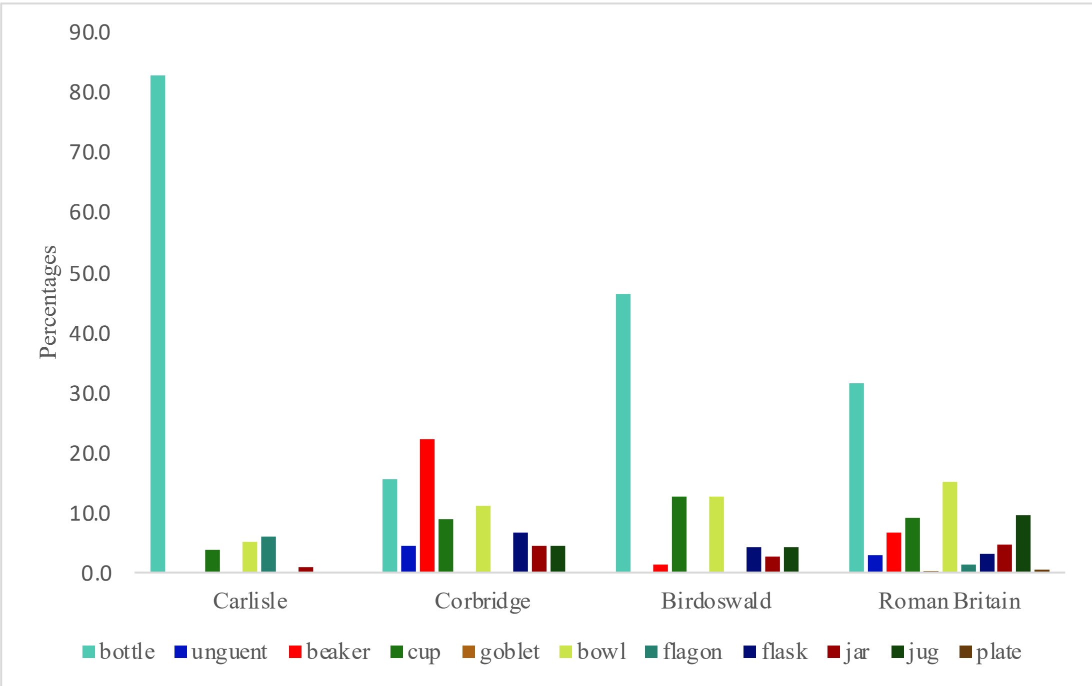


Figure 4.28 Vessel Type Percentage for Carlisle, Corbridge and Birdoswald

These show the ranges of the glass vessel types from the counts' percentage profiles for Carlisle, Birdoswald and Corbridge. The presence of unguent bottles at Corbridge is noted, particularly as they are absent from the other two sites. These small container bottles were thought to be used for scents or perfumes and associated with well-being (Derrick, 2021). The possibility of 1st and 2nd century bath-houses were recorded for Corbridge that could be associated with the presence of these vessels (Bishop and Dore, 1988, pp. 3, 11). The excavations at Birdoswald included the presence of a bath-house at the fort that with other buildings was restored in the 4th century (Wilmott, 1997, p. 99, 2012, p. 394). The reported presence of the bath-flask form at Birdoswald in the 4th century reinforces the connection between archaeological structures and the glass evidence.

The other difference is the presence of the cup type at Corbridge and Birdoswald but not at Carlisle. The absence of a glass type does not mean that this type of vessel was not present in the original population of glass at the location. However, in this case, we could assume that the glass cup was not present in any significant quantity in the Carlisle barracks. The pottery cup forms were *c.* 1% of the Samian vessel types at Carlisle (McCarthy *et al.*, 1982; Howard-Davies, 2009, p. 544 table 13). This does not exclude the possibility of more pottery cups being used but does match the glass proportional view. In contrast, the majority of the cup finds from Birdoswald were from a basilica-type of building within the fort (Wilmott, 1997). The evidence of glass cups from Corbridge were from the barracks and the central area of the fort (Bishop and Dore, 1988). These could be seen as places with more general occupancy and close to the officers' quarters and therefore the evidence of a higher cup type presence could be expected.

The records of glass forms found on these sites is shown in Table 4.36 and Figures 4.29, 4.30, 4.31. All the glass forms of cups, bowls and bottles could be expected as common forms seen on settlements in Britain in Roman times.

Table 4.36 Vessel Forms Percentage Counts at Carlisle, Corbridge and Birdoswald

Glass form	Carlisle	Corbridge	Birdoswald	Roman Britain
cylindrical bottle	6.4	-	1.4	4.4
square-bottle	76.0	8.9	4.2	0.2
cup-base-ring	-	4.4	-	0.1
cylindrical-cup	-	4.4	-	0.5
amphorisk jug	-	2.2	-	0.2
bath-flask	-	-	1.4	0.1
cylindrical-bowl	-	-	1.4	0.2
pillar-moulded-bowl	4.3	2.2	-	0.5

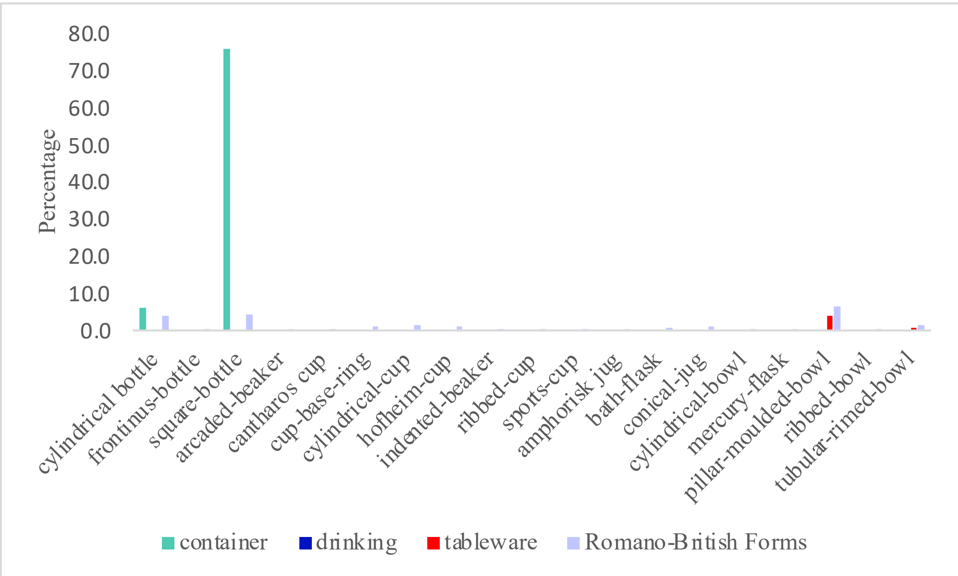


Figure 4.29 Carlisle Glass Form Percentage Counts of the Total Vessel Counts

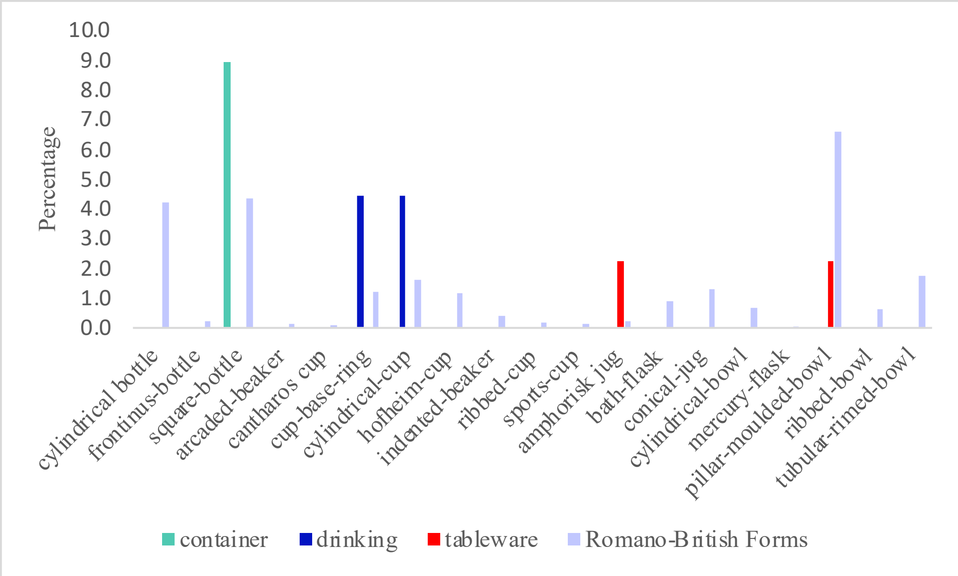


Figure 4.30 Corbridge Glass Form Percentage Counts of the Total Vessel Counts

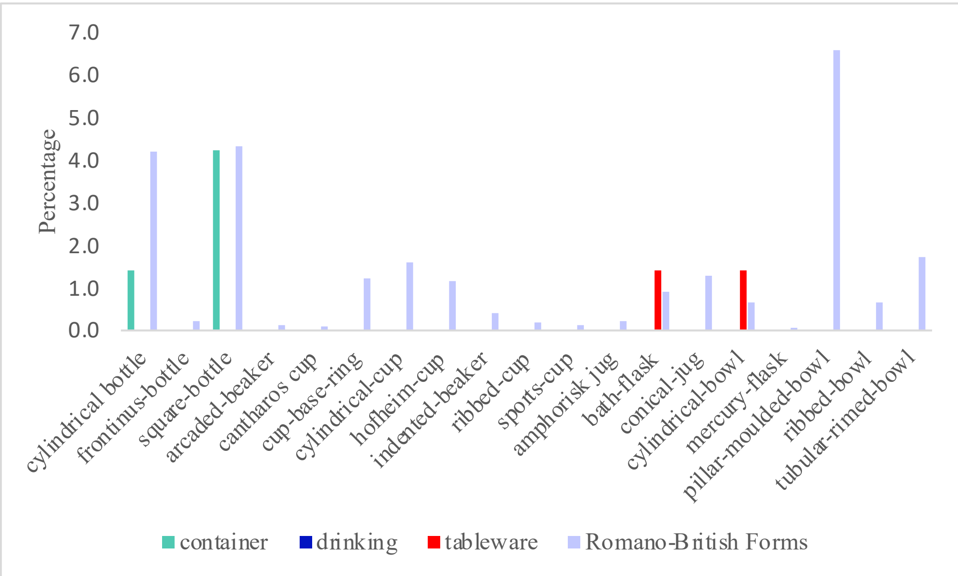


Figure 4.31 Birdoswald Glass Form Percentage Counts of the Total Vessel Counts

The single fragment of an amphorisk (Figure 4.99) found at Corbridge in the *retentura* barracks, dated late 1^{st} – 2^{nd} centuries CE, is the same form seen at the Usk, Wroxeter and York fortresses. The fact that Corbridge was connected to York via Dere Street may have been a factor with this not very common form that could simply have travelled as personal possessions between Corbridge and York.

The excavation report narrative noted that 197 fragments of square mould-blown bottles were recovered at Carlisle (Howard-Davies, 2009, p. 772). However only two of the catalogued accession lines were explicitly noted as the form in the report. Assuming most of the prismatic bottles were of the square form, this would mean 177 accession lines. This is a very common long-lived form, seen on many later 1st and 2nd century CE sites in Britain. The 1st century cylindrical bottle form (Figure 4.110) was reported for Carlisle as 6.4% of the site vessels that complements the twenty narrative fragments (Howard-Davies, 2009, p. 772). The glass assemblage mainly dates to the late 1st to the 3rd centuries CE and the deposition contexts were in the fort central areas that included the barracks, roads and *praetorium*.

4.3.6 Scotland

The next region is the southern area of Scotland that includes the forts at Strageath and Elginhaugh on the eastern part of the Antonine Wall region and the fortress at Inchtuthil. Table 4.37 summarises the historical contexts for the Strageath, Inchtuthil, and Elginhaugh sites.

Table 4.37 Historical context for the Strageath, Elginhaugh Forts and the Inchtuthil Fortress

Context	**Strageath Fort** (1)	**Inchtuthil Fortress** (2)	**Elginhaugh Fort** (3)
Site occupation period	Fort I built in the late 1st century CE, attributed to Julius Agricola, as a *quintenary cohors equitata*. Fort II (Antonine I) built for the re-occupation of Scotland c. 142 CE as a *cohort equitata*. Fort II (Antonine II) built c. 158 CE as a *cohors equitata*.	Short occupation between 83-86 CE. Associated with a defensive line of auxiliary forts facing the Highland front.	Occupation of the fort thought to be mid Flavian from 77/8 CE. Withdrawal from the fort by 88 CE.
The character of the site	Strageath is c. 5.2 miles south-east of Crieff, situated between the Firth of Tay and the Firth of Forth, a mid-point of Scotland and north of the Antonine Wall.	Situated west of the Firth of Tay and north of Strageath. All the buildings were timber, with some not finished.	Little evidence of associated settlements.
Later history	Final evacuationc. 164 CE as a result of policing the Pennine and Hadrian's Wall.	Evacuated c. 86 CE and deliberately demolished and abandoned.	Evacuated c. 88 CE and deliberately demolished and abandoned.
Site location	Overlooking the River Earn and built to protect the crossing at the river ford. Guarding the road north to Inchtuthil in the 1st century.	Located on the bank of the River Tay near the Dunkeld gorge. Little known of Roman roads in the area.	Situated at the most northerly stretch of Dere Street from York and built to guard the crossing of the River Esk, south of Inveresk.

Sources: (1) (Frere and Wilkes, 1989) (2) (Pitts and St. Joseph, 1985) (3) (Hanson *et al.*, 2007)

These military sites all represent periods of Roman occupation in Scotland in the late 1st and mid 2nd centuries. The deliberate demolition and abandonment of the Inchtuthil fortress and the Elginhaugh fort was because of a shortage of troops elsewhere in the empire and could have led to a change in policy for Britain (Pitts and St. Joseph, 1985, p. 279; Wacher, 1998, pp. 30, 33; Hanson *et al.*, 2007, p. 649). The vessel class counts are shown in Table 4.38 and Figure 4.32 for the military sites in Scotland.

Table 4.38 Vessel Class Percentage Counts for Strageath, Inchtuthil and Elginhaugh

Glass class	**Strageath**	**Inchtuthil**	**Elginhaugh**	**Roman Britain**
container-large	30.4	45.0	72.0	31.5
container-small	-	-	1.7	2.9
drinking	21.7	-	6.8	17.9
table-storage	39.1	40.0	19.5	42.5
no-class	8.7	15.0	-	5.2
Total	100.0	100.0	100.0	100.0

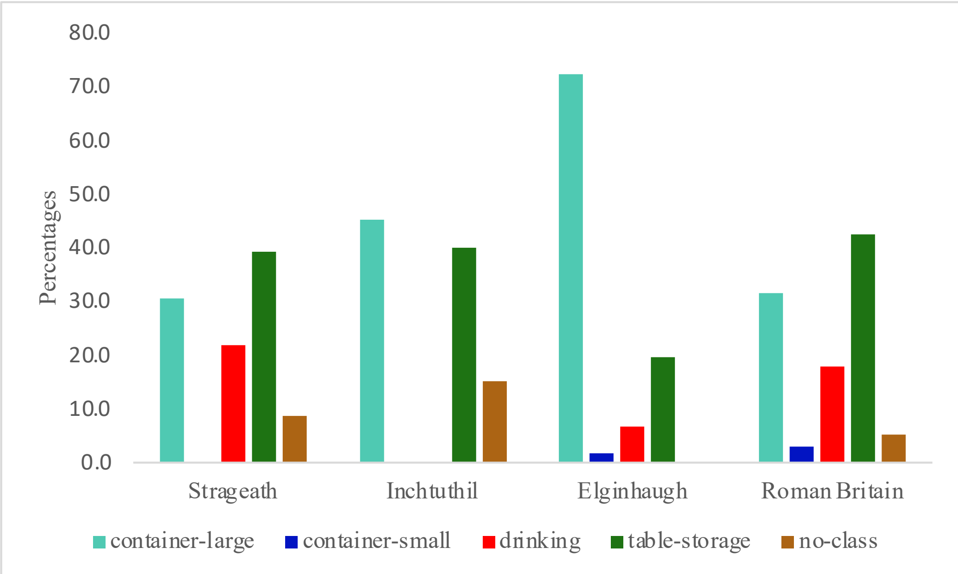


Figure 4.32 Vessel Class Percentage Counts for Strageath, Inchtuthil and Elginhaugh

The accession line class counts (e.g. containers, drinking and table classes) for Strageath and Inchtuthil are small in comparison with Elginhaugh that was fully excavated. The proportional counts show broadly similar profile shapes for Strageath and Elginhaugh with the dominance of large containers and tableware on all the sites. The fort Strageath I was operational for a similar period to both Inchtuthil and Elginhaugh in the latter 1st century only. The vessel percentage counts for Strageath I are low with 8 of the total 23 site counts, but with the proviso of bias, the Strageath I vessel proportional counts are compared with Inchtuthil and Elginhaugh in Figure 4.33.

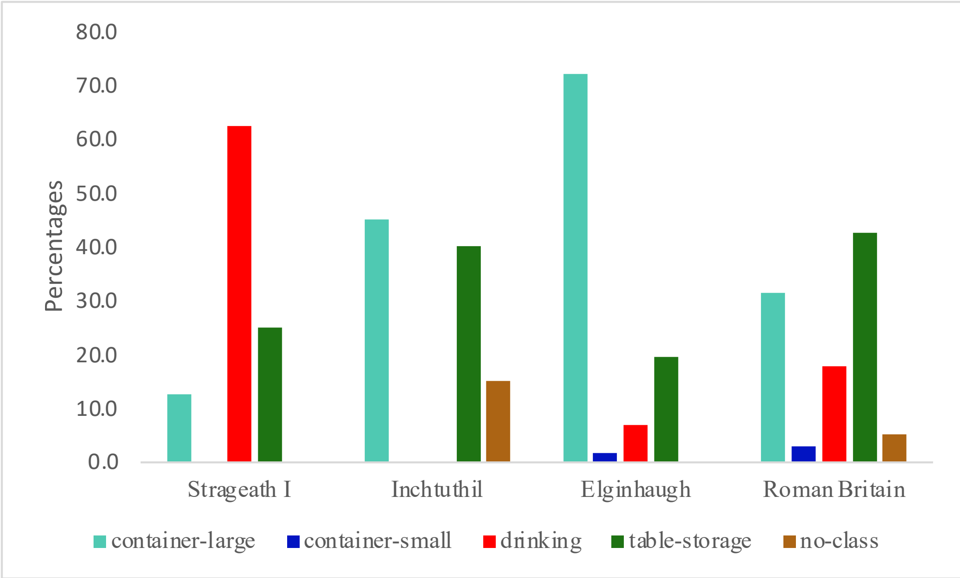


Figure 4.33 Vessel Class Percentage Counts for Strageath I, Inchtuthil and Elginhaugh

This shows that even with the small sample, drinking vessel cups were found for Strageath I. The absence of drinking vessels at Inchtuthil could be due to the low site sample counts as so little was excavated but could also represent a short-lived fort occupation as this was a legion on campaign and not settled in (Pitts and St. Joseph, 1985, p. 279). There were also comparatively few pottery finds at Inchtuthil.

The vessel type percentage counts are shown in the Table 4.39 and Figure 4.34 below for the military sites in Scotland.

Table 4.39 Vessel Type Percentage Counts for Strageath, Inchtuthil and Elginhaugh

Glass type	Strageath	Inchtuthil	Elginhaugh	Roman Britain
bottle	30.4	45.0	72.0	31.5
unguent	-	-	1.7	2.9
beaker	-	-	3.4	6.8
cup	21.7	-	1.7	9.2
goblet	-	-	-	-
bowl	4.3	5.0	10.2	15.1
flagon	-	-	-	1.4
flask	4.3	-	-	3.2
jar	4.3	-	1.7	4.7
jug	13.0	35.0	4.2	9.7
plate	-	-	-	0.4
drinking	-	-	1.7	1.9
tableware	13.0	-	3.4	8.1
no-class	8.7	15.0	-	5.2
Totals	100.0	100.0	100.0	100.0

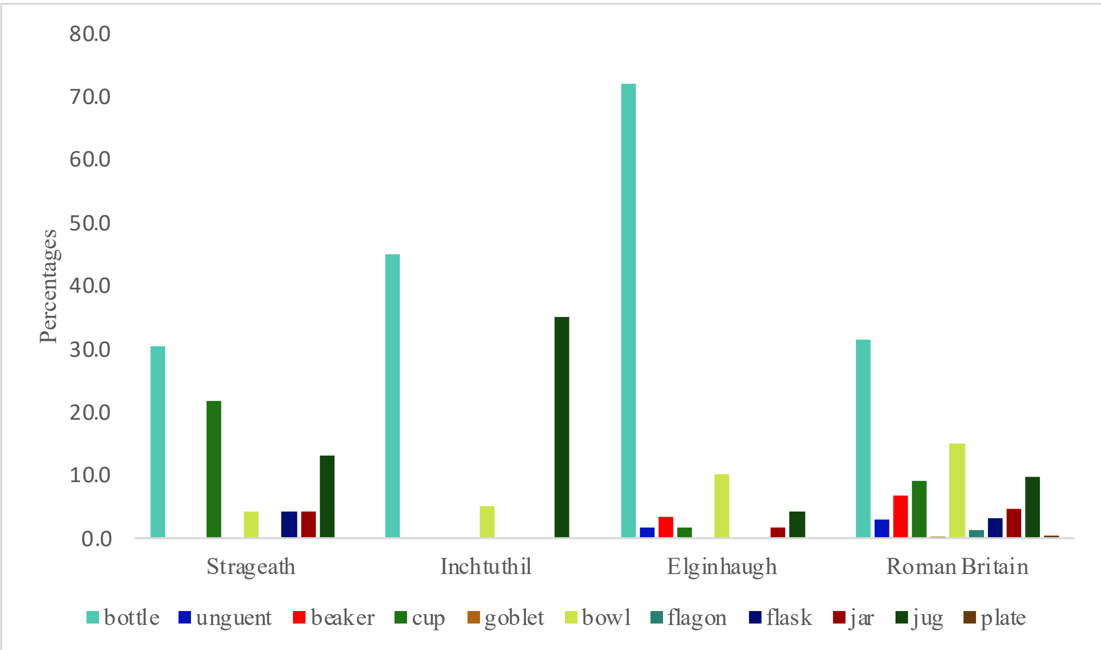


Figure 4.34 Vessel Type Percentages for Strageath, Inchtuthil and Elginhaugh

The excavation report narrative for the short-lived Inchtuthil legionary fortress refers to the small number of vessels represented by the finds as containers and tableware (Pitts and St. Joseph, 1985, p. 303). Further to the earlier discussion, the only reference to a drinking vessel is the “hemispherical drinking cup” that is catalogued as a bowl or a cup and from the rim diameter was probably the latter. This is a single fragment from the site 23 vessel counts and we should be cautious about making too many inferences from the proportions. However, the archaeology does suggest that the fortress was not fully operational with principal buildings not completed when it was rapidly demolished and evacuated at the time of the withdrawal of the legion from Scotland (Pitts and St. Joseph, 1985, p. 279). This would be an explanation for the small sample size and the absence of drinking vessel finds.

The Strageath fort was occupied in three periods as the Flavian fourth quarter of the 1st century, the Antonine I from c. 142-154 CE, and the Antonine II c. 158-163 CE following which time it was decommissioned (Frere and Wilkes, 1989, p. 135). The garrisons of the auxiliary fort comprising infantry and cavalry could validate the broad range of the glass types as the fort was occupied from the late 1st to the mid 2nd centuries CE during a period of expansion of the glass industry. The excavation was carried out over 13 seasons on the main fort buildings and streets. The low sample size may have been due to a combination of material recovery for reuse to clear the site for decommissioning and the original deposition from the auxiliary force.

The Elginhaugh excavation work was carried out in 1986-7 prior to development of the site (Hanson *et al.*, 2007). The site was large and the rescue work was planned based on aerial and ground surface mapping of the Roman fort structures and streets. The strategy was to optimise the position of trenches so that the whole site was examined in order to obtain as much detail as possible prior to the site being released back to the developer. Standard excavation processing techniques were used with the latest digital technology of the time. The site glass vessel profile and the sample size of 118 gives confidence that the glass fragments are a reasonable representation of the original population of glass across the fort, the defences, and the bath-house.

The fragmentary bottle counts (container-large) at Elginhaugh were over 78% of the total vessel counts which is similar to Carlisle, Ribchester and Caerleon. The majority of the identified bottle forms were cylindrical bottles that were common in the 1st century. While the proportion of bottles tends to increase in northern sites in the 2nd century, the form and dating of the assemblages at Elginhaugh validate that this represents the presence of glass bottles in the original population of used on the site over approximately two decades (Hanson *et al.*, 2007, p. 451). The finds were mainly found as demolition fill of pits that suggests the glass was simply disposed of as broken glass waste. This would be reasonable to expect with the short period of occupancy and with no systems in place to collect glass fragments for recycling.

There were two fragments of window glass at Strageath, one at Inchtuthil but none at Elginhaugh even though that site had a bath-house (Hanson *et al.*, 2007, p. 246). The Elginhaugh report does suggest careful dismantling of the bath-house was undertaken with the removal of valuable items before stonework demolition and that the glass windows were removed for possible reuse. Glass as a material was commonly recycled in Roman times (Cool and Price, 1995; Degryse and Shortland, 2009; Rehren and Brüggler, 2020). It reinforces the notion that the return of glass for reuse could be a reason for low site window glass sample counts, and not just the result of waste disposal and recycling of glass for remelting. Elginhaugh was located at a strategic river crossing on the River Esk (Hanson *et al.*, 2007, p. 2). The reference to the 'Elginhaugh Coast' in Figure 3.5 refers to the possible use of the sea and river for the transport of military materials to and from military forts, most of which could be supplied by river (Selkirk, 1983, p. 101).

Table 4.40 and Figures 4.35, 4.36, 4.37 below detail the percentage of the vessel types recorded as glass forms. The records of catalogued glass forms found on these sites again reinforce the presence of cylindrical bottles, pillar-moulded bowls, and square bottles on all these excavated forts and on the previous forts in Wales, Lancashire, and West Yorkshire.

Table 4.40 Vessel Forms Percentage Counts at Strageath, Inchtuthil and Elginhaugh

Glass form	Strageath	Inchtuthil	Elginhaugh	Roman Britain
cylindrical bottle	4.3	35.0	45.8	4.4
square-bottle	4.3	5.0	0.8	0.2
arcaded-beaker	-	-	0.8	22.3
cantharos cup	-	-	0.8	2.9
modiolus cup	-	-	0.8	0.02
conical-jug	4.3	15.0	2.5	12.5
pillar-moulded-bowl	4.3	5.0	7.6	0.5
tubular-rimed-bowl	-	-	1.7	0.8

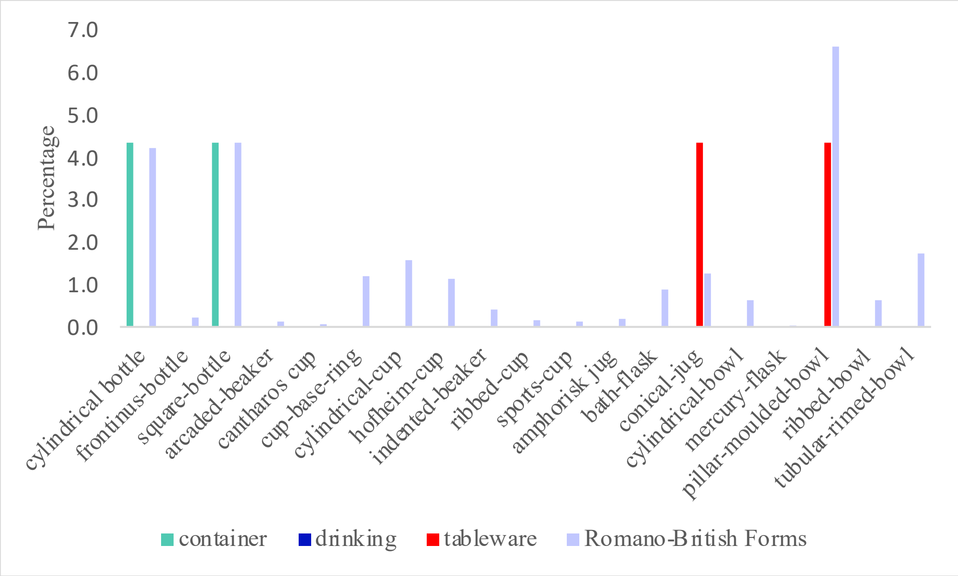


Figure 4.35 Strageath Glass Form Percentage Counts of the Total Vessel Counts

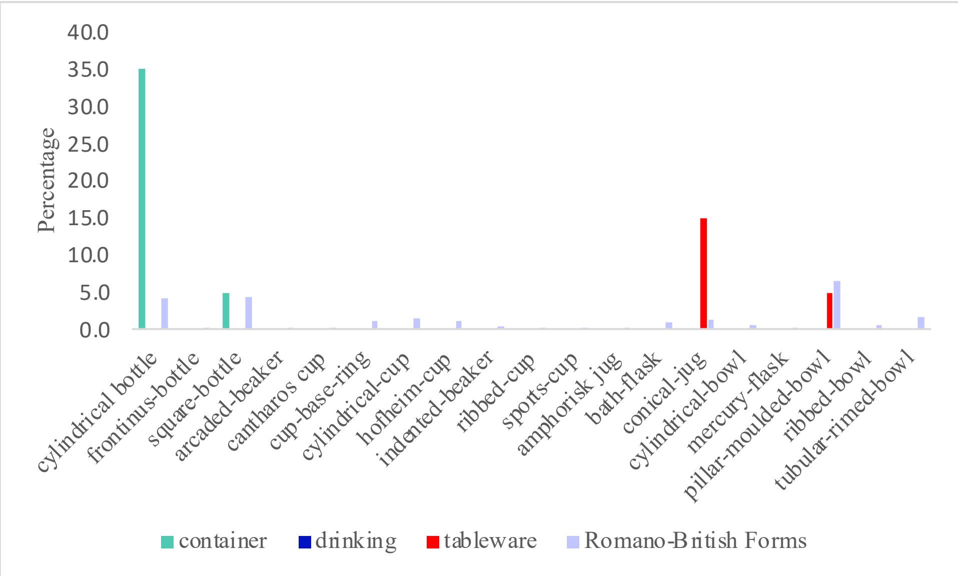


Figure 4.36 Inchtuthil Glass Form Percentage Counts of the Total Vessel Counts

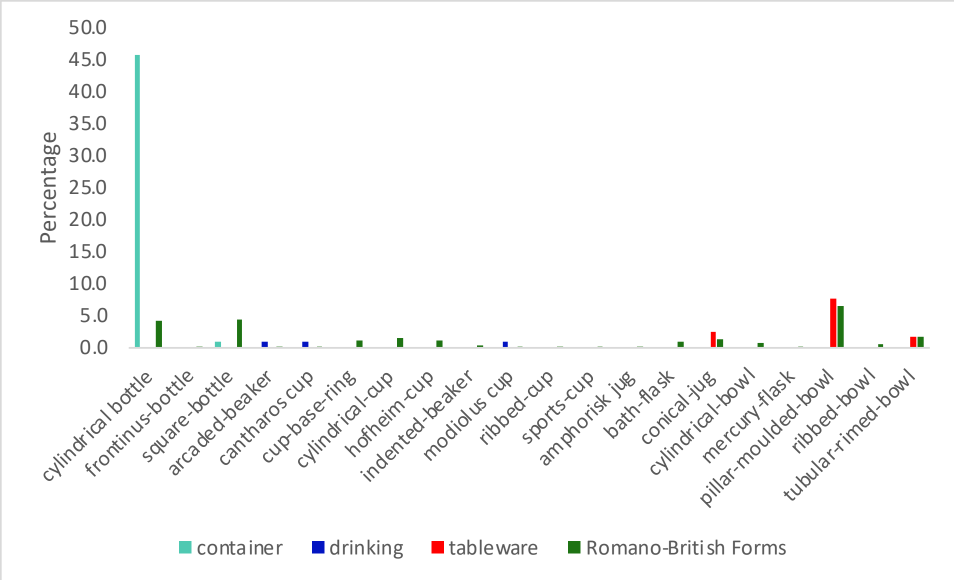


Figure 4.37 Elginhaugh Glass Form Percentage Counts of the Total Vessel Counts

There is a breadth of forms recorded for Elginhaugh, possibly due to the larger sample size than for either Strageath or Inchtuthil. The arcaded beaker has been found at the Wroxeter fortress as previously noted. The cantharus, or cantharos, (Figure 4.86) is a cup with a stepped rim and stemmed base, not very common and seen on some early sites in southern Britain (Price and Cottam 1998:68). The *modiolus* cup (Figure 4.86) is described as a deep cup with stepped rim and one curved ribbon handle and is rare in Britain (Price and Cottam, 1998, p. 70). The presence of these glass forms at Elginhaugh may be because Inveresk - Elginhaugh was at the end of a main Roman road, Dere Street, that was the connection with York, the administration centre and *colonia* for the north of England and therefore better connected for trade and distribution than the other sites. This is an hypothesis that will be assessed in Chapter 6.

The above archaeology outlines reinforced that the data is valid for use by analysis and the presence of the original vessels is reflected in the archaeological record, and there are possible explanations for the situation where there is an absence of particular glass types.

In summary, all the forts and fortresses were part of the military occupation network in the north of Britain and would have had local trade and longer distance military supply trade links via water and road to settlements such as Scotch Corner and Catterick, that are evaluated in the next section in this chapter.

4.4 Civil Sites Evaluation

Roman civil settlements are categorised in this research as (1) town - industrial settlements that could provide services to supply the military; (2) rural farming settlements that can be high status developments such as large villa farmsteads, or as basic level farms possibly operated at subsistence level, and (3) the large cities as administration centres.

4.4.1 Town - Industrial Settlements

This section presents sites to the west and east of the Pennines that would correspond to the main military supply lines north the northern frontier. Industrial centres would be located with network connections to Roman army bases forts and fortresses. These bases would have needed regular supplies of construction materials, drinking vessels and tableware and that would have involved the distribution of goods from industrial centres to the military sites. The following map (Figure 4.38) shows the selected sites connected to the Roman roads network based on Margary (1973). These are Wilderspool and Walton-le-Dale to the west of the Pennines and Scotch Corner and Catterick on the east of the Pennines. These were civil industrial centre sites that included the manufacture of traded goods and military supply.

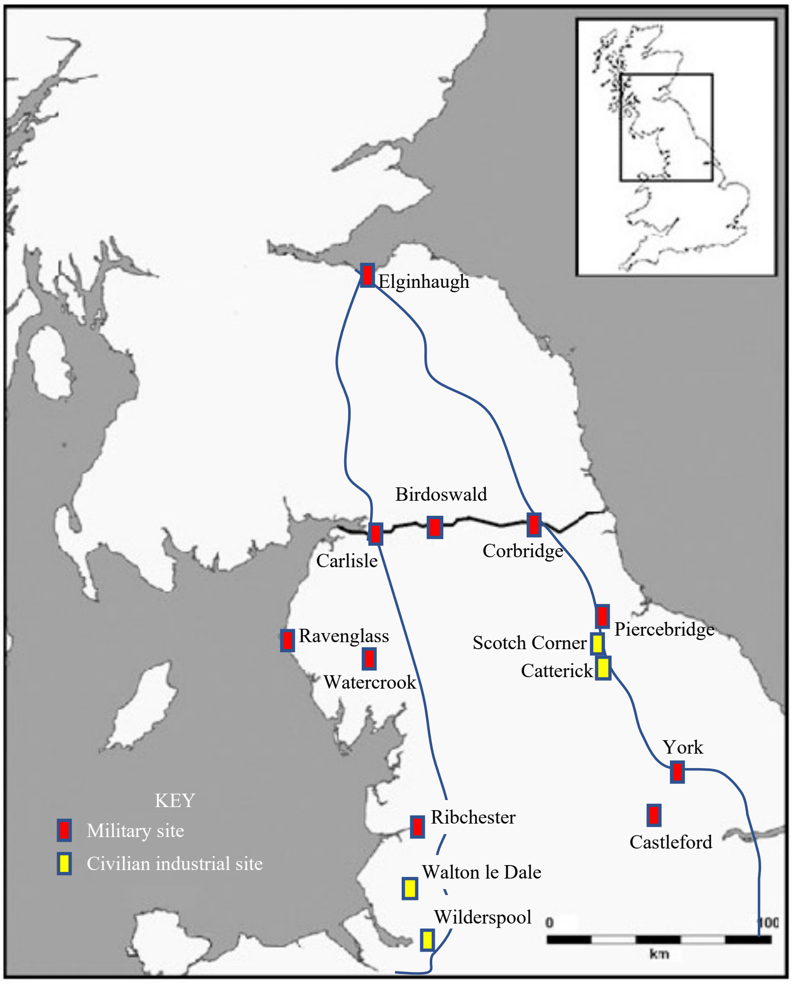


Figure 4.38 Industrial Centre Settlement Sites and Roman Roads c. 2nd Century CE

Source: (Margary, 1973)

The following Tables 4.41 and 4.42 present a brief overview of the historical contexts for the industrial centres at Wilderspool, Walton-le-Dale, Scotch Corner and Catterick.

Table 4.41 Historical Contexts for Wilderspool and Walton-le-Dale

Context	**Wilderspool** (1)	**Walton-le-Dale** (2)
Site occupation period	The Roman industrial site (Brewery Area) started at the end of the 1st century CE, then declined in the mid 2nd century CE. The Loushers Lane area activity was from the early 2nd century until the 3rd century CE.	Activity started in the late 1st century CE with 2nd century major occupation
The character of the site	The Brewery area included buildings and fenced enclosures with ironwork finds. The Loushers Lane area included timber structures, furnaces and pottery kilns. The structure of the site is similar to a small town, with irregular planned and organised structures	Regular laid-out structures suggest military influence and interpreted as a military supply base with iron-working and pottery kilns
Site location	The site was probably at a ford crossing point of the River Mersey, at Warrington Stockton Heath. A road runs north towards Preston and there was a road connection to Chester.	The site was situated on the south bank of the River Ribble at Preston and on the 'secondary' north-south route to the main road 7 that connected Wilderspool to Ribchester and Lancaster.

Sources: (1) (Hinchcliffe and Williams, 1992) *(2)* (Gibbons and Howard-Davis, 2001)

Table 4.42 Historical Contexts for Scotch Corner and Catterick

Context	**Scotch Corner** (1)	**Catterick** (2)
Site occupation period	Late Iron Age settlement c. 55 BCE that developed from the mid 1st century CE with Roman influence. From c. 70 CE, engineered roads with a link to Catterick. Between 85-150 CE, a significant contraction in occupation	From military origins c. 80 CE to the 5th century CE. The first military phase came to an end c. 120 CE, re-established 160 CE and occupied to c. 200 CE, when a civilian settlement developed with stone buildings.
The character of the site	A settlement with workshops for metals that developed to importing pottery, glass and mineral processing as a possible Roman military supply base. Association with the roads and vessel distribution. New roads by-passed in the mid 2nd century CE.	Roman town settlement. Inscriptions recording the administration link the site had with the area (Vindolanda Tab 343) refer to Catterick as a supply centre for hides and other goods.
Site location	The site is located along an Iron Age routeway from north-south connected to Dere Street.	Located where Dere Street crossed the River Swale.

Sources: (1) (Fell, 2020) *(2)* (Wilson, 2002 a)

These sites were all situated on main road networks in the northwest and northeast of England. The proportional profiles of the industrial centres' sites are shown in Table 4.43 and Figure 4.39.

Table 4.43 Vessel Class Percentage Counts for Wilderspool, Walton-le-Dale, Scotch Corner and Catterick

Glass class	**Wilderspool**	**Walton-le-Dale**	**Scotch Corner**	**Catterick**	**Roman Britain**
container-large	73.3	16.0	26.2	44.4	31.5
container-small	-	8.0	-	1.0	2.9
drinking	-	24.0	23.0	15.3	17.9
table-storage	20.0	44.0	47.5	37.8	42.5
no-class	6.7	8.0	3.3	1.5	5.2
Total	100.0	100.0	100.0	100.0	100.0

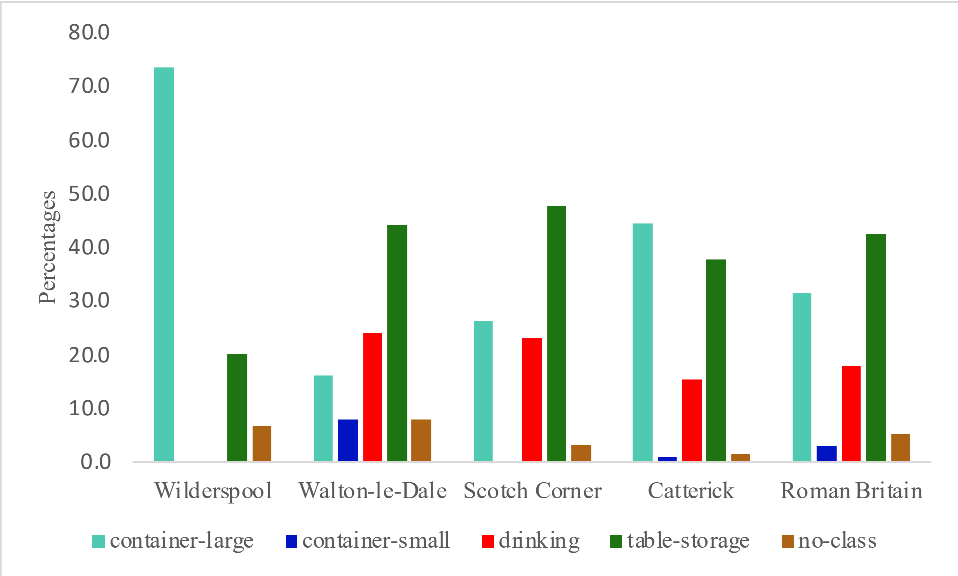


Figure 4.39 Vessel Class Percentage Counts for Wilderspool, Walton-le-Dale, Scotch Corner and Catterick

The common features of the profiles are the presence of the large container bottles, tableware and drinking vessels with similar shapes for the sites except for Wilderspool. The low glass sample size at Wilderspool (15) could account for the absence of drinking vessel finds. The site ground was light sandy soils that coupled with the fact that the sites were at the lowest fording point on the River Mersey could have led to losses of finds from the river flooding (Hinchcliffe and Williams, 1992, p. 11). The other relevant aspect is that the excavations have indicated that the complete Roman settlement was larger than the sites and the excavations may have just revealed the industrial parts of the town (Hinchcliffe and Williams, 1992, p. 13). These profiles present a pattern of table vessels and large containers (bottles) that with drinking vessels as cups and beakers is like the overall Roman Britain profile.

The detail of the vessel types is shown in Table 4.44 and Figure 4.40.

Table 4.44 Vessel Type Percentage Counts for Wilderspool, Walton-le-Dale, Scotch Corner and Catterick

Glass type	Wilderspool	Walton-le-Dale	Scotch Corner	Catterick	Roman Britain
bottle	73.3	16.0	26.2	44.4	31.5
unguent	-	8.0	-	1.0	2.9
beaker	-	12.0	1.6	3.6	6.8
cup	-	12.0	21.3	11.2	9.2
goblet	-	-	-	-	-
bowl	-	16.0	31.1	10.2	15.1
flagon	-	8.0	-	-	1.4
flask	13.3	-	-	4.6	3.2
jar	6.7	4.0	-	3.6	4.7
jug	-	4.0	9.8	11.2	9.7
plate	-	8.0	-	-	0.4
drinking	-	-	-	0.5	1.9
tableware	-	4.0	6.6	8.2	8.1
no-class	6.7	8.0	3.3	1.5	5.2
Totals	100.0	100.0	100.0	100.0	100.0

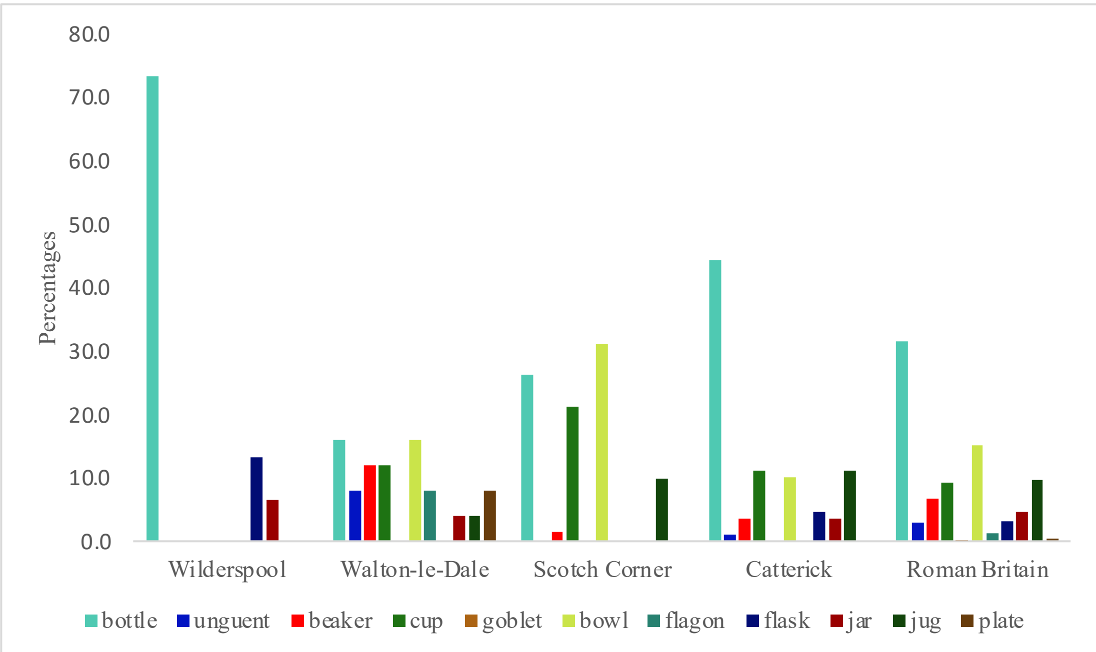


Figure 4.40 Vessel Class Percentage Counts for Wilderspool, Walton-le-Dale, Scotch Corner and Catterick

The type profiles present bottle, bowl and cup proportions close to the Romano-British profile for each of the sites, except for Wilderspool. The profiles at Walton-le-Dale and Catterick are proportionally like the Romano-British corpus. The flagon type seen at Walton-le-Dale is similar to a conical jug form and the combined data would be similar to the jug proportions for the Scotch Corner and Catterick sites. Walton-le-Dale includes the plate type that is seen in the corpus at several locations as detailed in Tables 4.6, 4.7, 4.8, and 4.9. The shape of the bowl and plate can be close and therefore this should be seen as a tableware type and not unexpected. Scotch Corner has just the bowl and jug tableware types represented. These types were common during the 1st century and expected given the decline of this site from the end of the 1st century.

By looking more closely at glass identified forms evidenced on the two sites, the representation of glass types at a lower level can be seen. The glass form percentage site counts are detailed in Table 4.45 and Figures 4.41, 4.42, 4.43 and 4.44.

Table 4.45 Vessel Forms Percentage Counts for Wilderspool, Walton-le-Dale, Scotch Corner and Catterick

Glass form	Wilderspool	Walton-le-Dale	Scotch Corner	Catterick	Roman Britain
cylindrical bottle	6.7	-	8.2	3.1	4.4
frontinus-bottle	-	-	-	0.5	4.5
square-bottle	26.7	4.0	1.6	3.6	0.2
cup-base-ring	-	-	-	2.0	0.1
cylindrical-cup	-	-	-	6.1	0.5
ribbed-cup	-	-	6.6	-	1.7
bath-flask	-	-	-	2.6	0.1
conical-jug	-	-	3.3	2.0	12.5
cylindrical-bowl	-	-	1.6	4.1	0.2
pillar-moulded-bowl	-	4.0	26.2	0.5	0.5
tubular-rimed-bowl	-	4.0	1.6	0.5	0.8

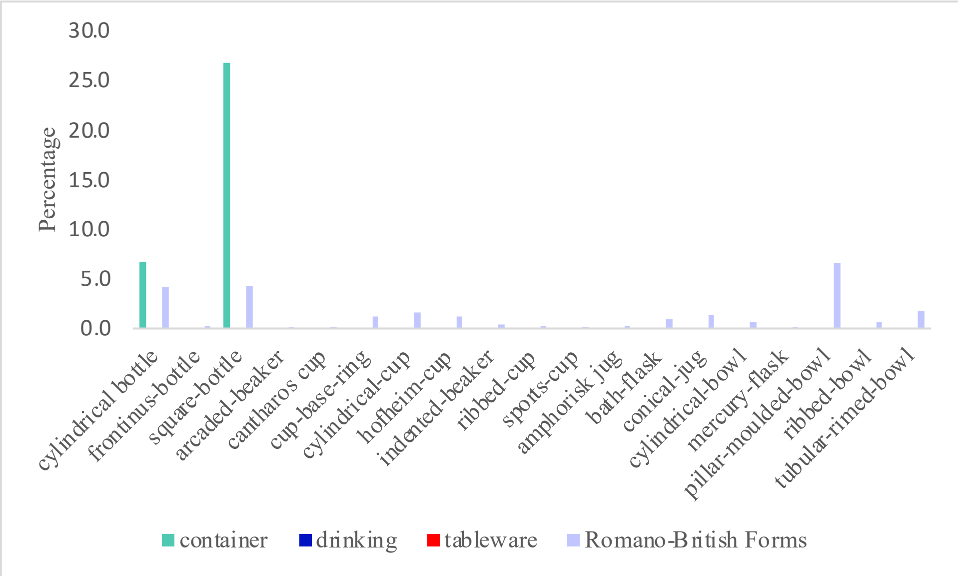


Figure 4.41 Wilderspool Glass Form Percentage Counts of the Total Vessel Counts

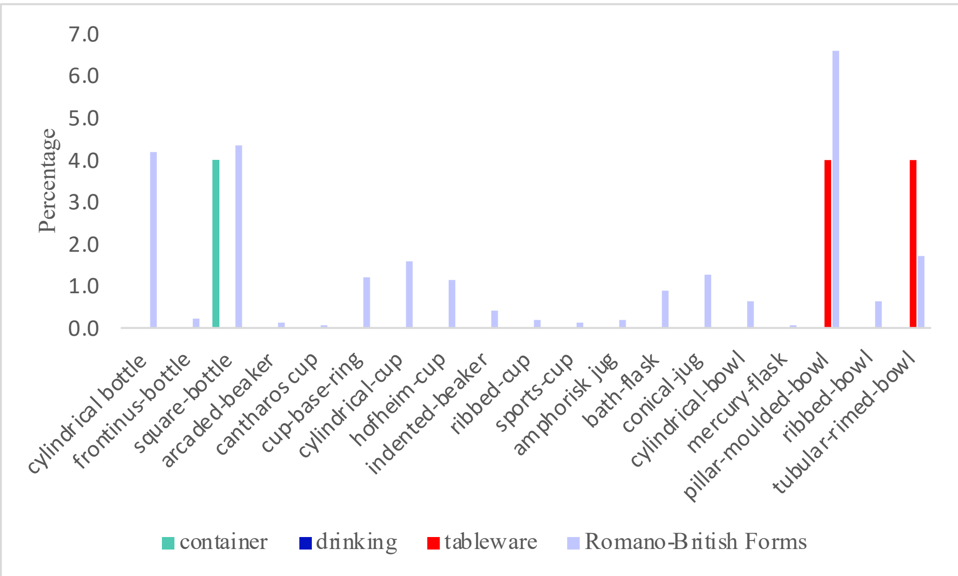


Figure 4.42 Walton-le-Dale Glass Form Percentage Counts of the Total Vessel Counts

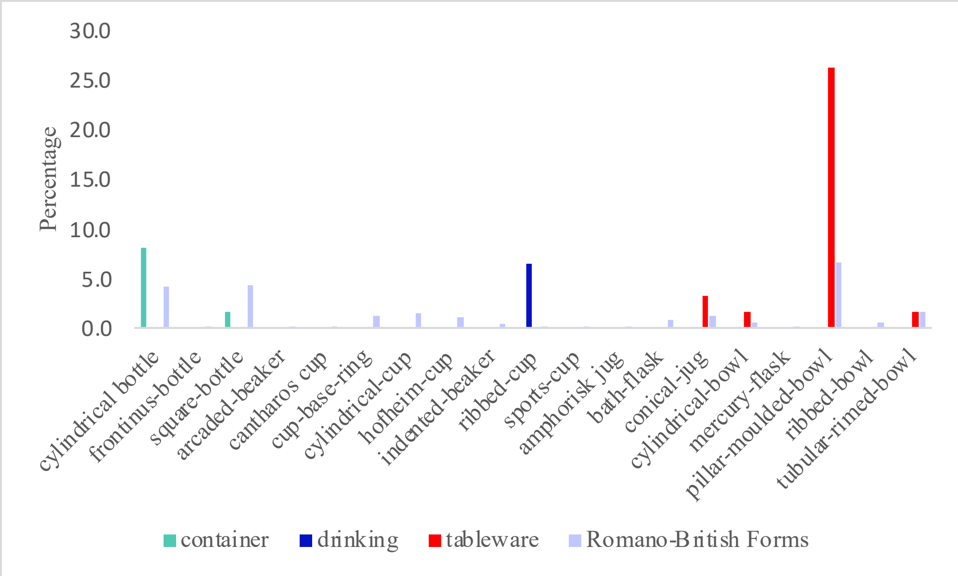


Figure 4.43 Scotch Corner Glass Form Percentage Counts of the Total Vessel Counts

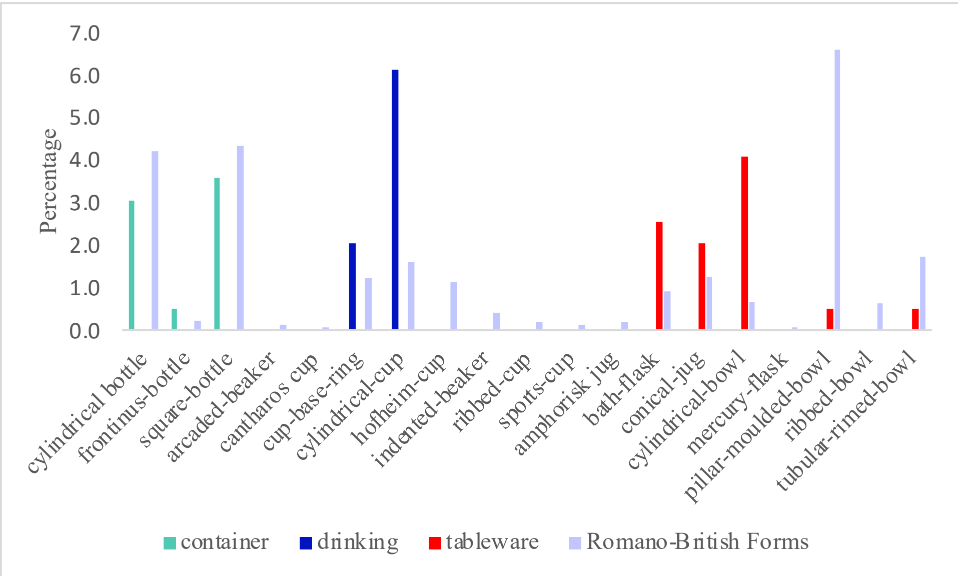


Figure 4.44 Catterick Glass Form Percentage Counts of the Total Vessel Counts

The vessel form profiles present the detailed shaped glass types of containers, drinking vessels and tableware. The common forms of square bottles are reported for all the sites; cylindrical bottles on all except Walton-le-Dale; and the corrugated shaped *Frontinus* bottle at Catterick. The *Frontinus* bottle (Figure 4.117) is a cylindrical bottle with a corrugated body. It is noted as being fairly common on Romano-British sites (Price and Cottam, 1998, p. 209) mainly on sites in the south of England (Price and Cottam, 1998, p. 211) with examples on the large cities of Colchester and Wroxeter, and the settlement at Gorhambury (reported later in this section). The form was manufactured by blowing glass into a three-part mould and 1st and 2nd century CE bottles were usually blue-green, as at Catterick, with later examples greenish or yellow-green.

The bath-flask form is noted at Catterick and the archaeology report includes a bath-house in a stone *mansio* (Wilson, 2002 a, p. 50). This would be expected at Catterick given the reported administration role of the town for the region (Wilson, 2002 a, p. xxi).

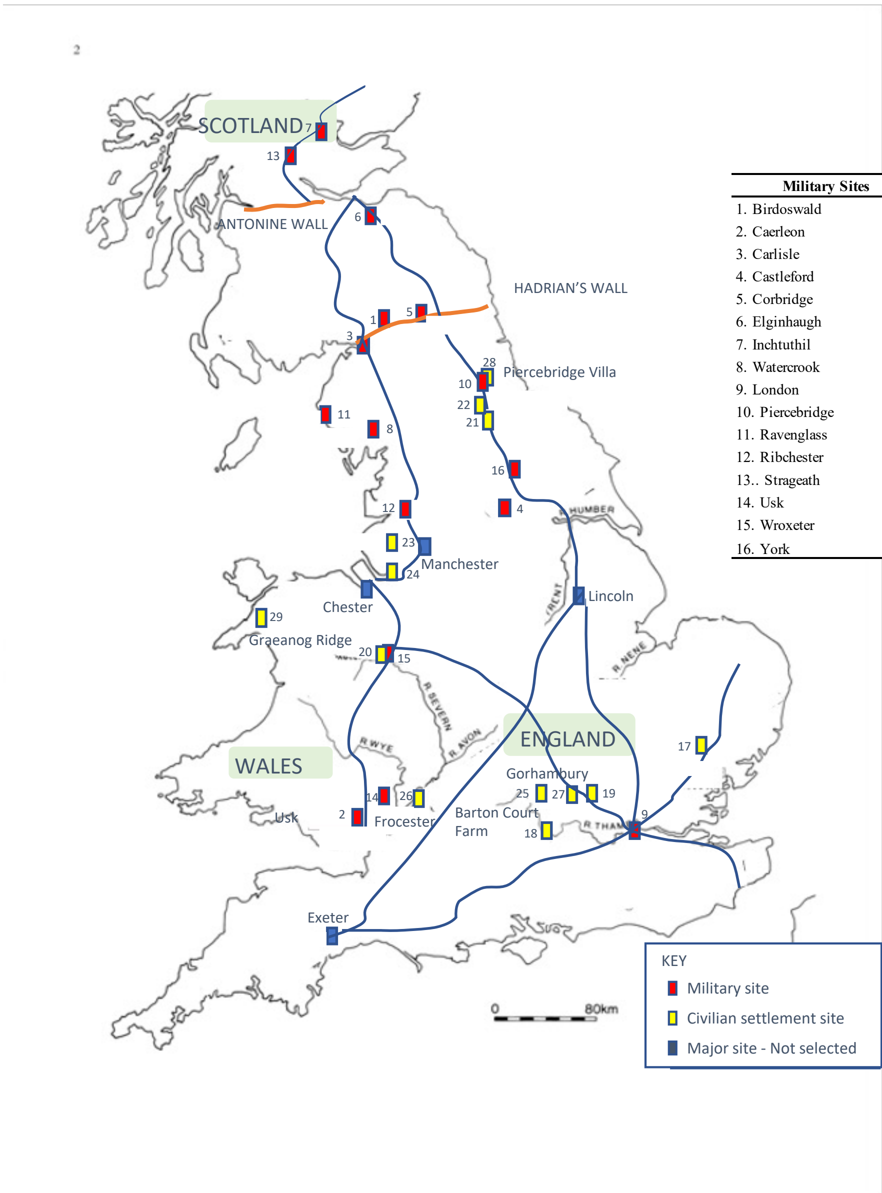
The pillar-moulded bowl as a glass form has been discussed previously with evidence at London, the Wales and The Marches sites, the sites in Scotland and the northeast of England at Scotch Corner and Catterick. This is a common tableware vessel form reported in the 1st century CE and so expected on sites with occupation in that time or later as residual finds. Pillar moulded bowls were very common to the end of the first century CE (Price and Cottam, 1998, p. 44). The operations at Scotch Corner had declined by the mid 2nd century CE that could explain the higher percentage of pillar-moulded bowls at Scotch Corner compared to Catterick that continued operationally into the 4th century.

The tubular-rimmed bowl is noted as not common but found on some sites in southern Britain with a date range of 43-65 CE (Price and Cottam, 1998, p. 77). The finds in the northeast and northwest of Britain are an indication of the wider distribution of this glass form than expected based on the recorded reported finds (Price and Cottam, 1998, pp. 77, 79). This glass form has also been included in the evidence for Carlisle and Piercebridge in the north of Britain (Tables 4.10 and 4.13).

4.4.2 Rural Farming Settlements

Frocester, Gorhambury, Barton Court Farm, Piercebridge Villa and Graeanog Ridge were rural farming settlements with the status of the settlements based essentially on the size of the settlement and the types of buildings and defined as native farms or villas in the respective excavation reports (Miles, 1986, p. 12; Neal *et al*., 1990, pp. 3, 6, 32; Fasham *et al*., 1998, p. xi; Price, 2000, p. 94; Cool and Mason, 2008, p. 127). There is not a clear concise definition of a villa as expounded by (Wacher, 1998, p. 115). In general, excavation reports note that farms with a large 'Romanised' building are called villas and the smaller farms with more basic structures as native farms or farmsteads. Such structures can be indications of the socio-economic conditions at the peak of the settlement lifetimes and associated with the material cultures at the sites. The term 'villa' will be used for these sites with 'rural farms' for the more remote settlements.

The map of the region (Figure 4.45) shows Frocester, Barton Court Farm and Gorhambury were very well connected to major roads and large cities. In contrast, the Graeanog Ridge farm was remotely located on the west coast of Wales, although it was near Roman military sites. Graeanog Ridge just had a single bowl fragment, although there were also a few unstratified bottle fragments. In order to make comparison more meaningful with the southern English rural sites, the Piercebridge Villa site was included in the study scope. Piercebridge Villa was situated in the north of England in the vicinity of Scotch Corner and Catterick and Dere Street. This was developed as a Roman villa in the late 1st century CE, on the opposite site of the River Esk from the later Piercebridge Fort and was one of the most northerly Roman villa sites in Britain.



Military Sites	Civil Sites
1. Birdoswald	17. Colchester
2. Caerleon	18. Silchester
3. Carlisle	19. St Albans
4. Castleford	20. Wroxeter
5. Corbridge	
6. Elginhaugh	21. Catterick
7. Inchtuthil	22. Scotch Corner
8. Watercrook	23. Walton le Dale
9. London	24. Wilderspool
10. Piercebridge	
11. Ravenglass	
12. Ribchester	25. Barton Court Farm Villa
13.. Strageath	26. Frocester
14. Usk	27. Gorhambury Settlement
15. Wroxeter	28. Piercebridge Villa
16. York	29. Graeanog Ridge

Figure 4.45 Locations of Rural Settlement Sites

Distribution of villas with good agricultural land are found in the south of England as shown in Figure 4.46.

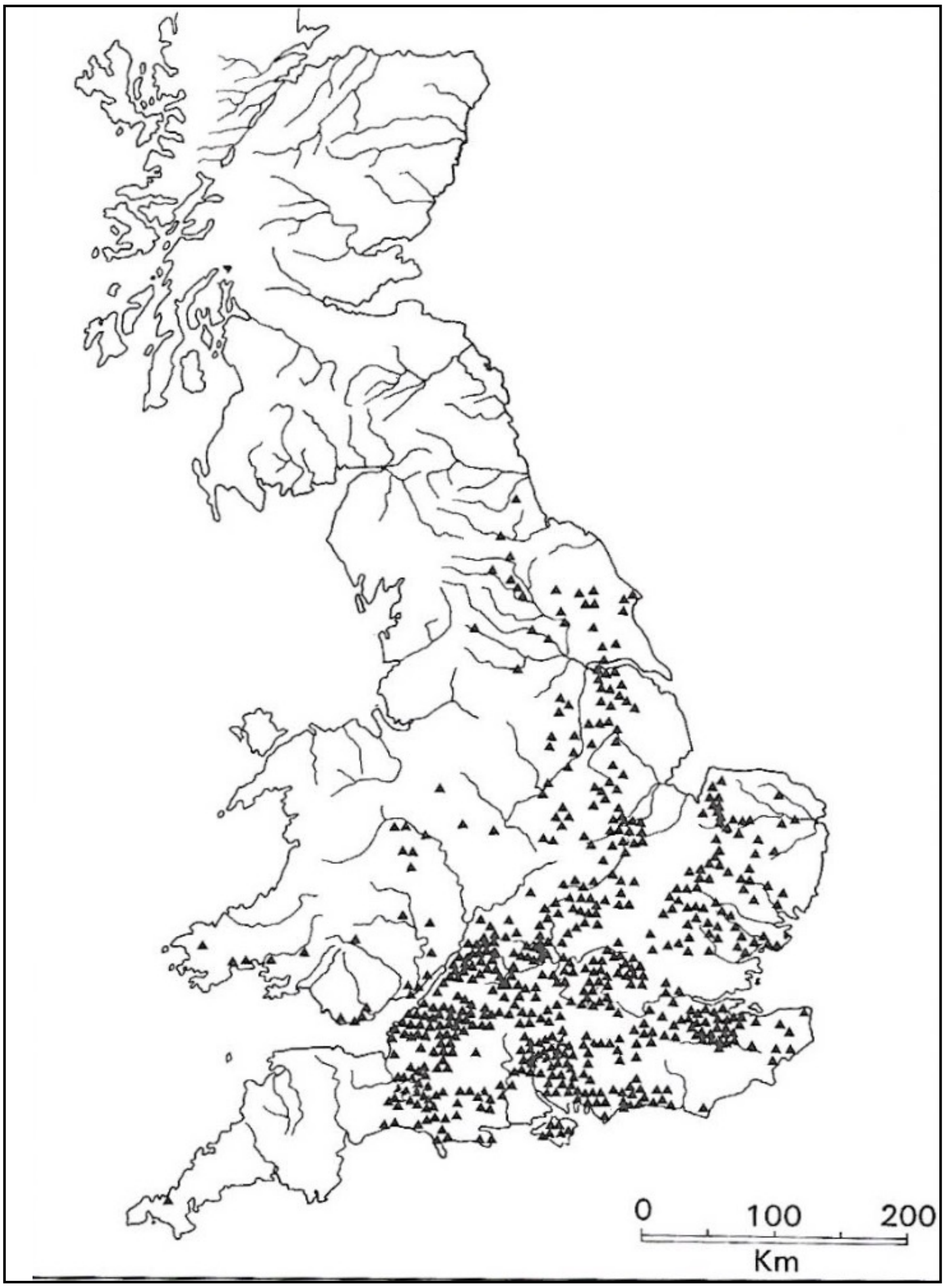


Figure 4.46 Distribution of Villas

Source: (Wacher, 1998, p. 130 figure 67)

The historical contexts for these rural sites are presented in Tables 4.46, 4.47.

Table 4.46 Historical Contexts for Frocester and Gorhambury

Context	**Frocester** (1)	**Gorhambury** (2)
Site occupation period	Site was occupied since before the Iron Age and continued to be farmed until the 6th century CE, when the site was just used as land.	A Late Iron Age site in origin, occupied until the mid 4th century CE.
The character of the site	The site is 2.8ha and has been occupied as an agricultural farmstead with stone buildings. It was established as three substantial Roman settlements and a number of smaller farms.	The site origin included Iron Age enclosures with a dyke system that was developed from 43-62 CE with rectangular buildings. Stone buildings and a villa 100-175CE until 250-300 CE. The 3rd century villa was 0.7ha.
Site location	Frocester is a Gloucesterhire village, 19.8km south of Gloucester.	Gorhambury is 1km north-west of St Albans.

Sources: (1) (Price, 2000) *(2)* (Neal *et al*., 1990)

Table 4.47 Historical Contexts for Barton Court Farm, Graeanog Ridge and Piercebridge Villa

Context	**Barton Court Farm** (1)	**Graeanog Ridge** (2)	**Piercebridge Villa** (3)
Site occupation period	Late Neolithic, Iron Age, Romano-British and Saxon settlements were on the site.	An Iron Age and Romano-British settlement until c. 500-550 CE.	Originally an Iron Age settlement, developed into a villa in the late 1st century CE. Enlarged mid 2nd century and then abandoned at the end of 2nd century. Developments in the vicinity to late 4th century.
The character of the site	The Roman famsteads were divided into domestic, storage and animal farmyard areas. The main villa was a late 3rd century CE construction.	Farming settlements started 2nd century BCE and continued until after the 4th century CE. Round houses initially, then an enclosed farmstead with rectangular buildings.	Iron Age circular buildings replaced in the late 1st century by a rectangular primary building. Enlarged in the 2nd century with an apisidal suite including a bath house.
Site location	Barton Court Farm is 1.5km from Abingdon, 60kms north of Silchester, close to the River Thames and the River Ock.	Siutated on the Llyn peninsula south of Anglesey, Wales.	Situated at the most northerly stretch of Dere Street from York at the crossing of the River Esk, south of Inveresk. The site was close to the river and abandoned in the 2nd century due to possible flooding.

Sources: (1) (Price, 1973; Miles, 1986) *(2)* (Fasham *et al*., 1998)*, (3)* (Cool and Mason, 2008)

The class percentage counts for the sites as shown in Table 4.48 and Figure 4.47.

Table 4.48 Vessel Class Percentage Counts for Frocester, Gorhambury, Barton Court and Piercebridge Villa

Glass class	**Frocester**	**Gorhambury**	**Barton Court**	**Piercebridge Villa**	**Roman Britain**
container-large	21.6	8.7	15.4	21.4	31.5
container-small	-	1.1	-	-	2.9
drinking	15.7	19.6	7.7	78.6	17.9
table-storage	45.1	70.7	53.8	-	42.5
no-class	17.6	-	23.1	-	5.2
Total	100.0	100.0	100.0	100.0	100.0

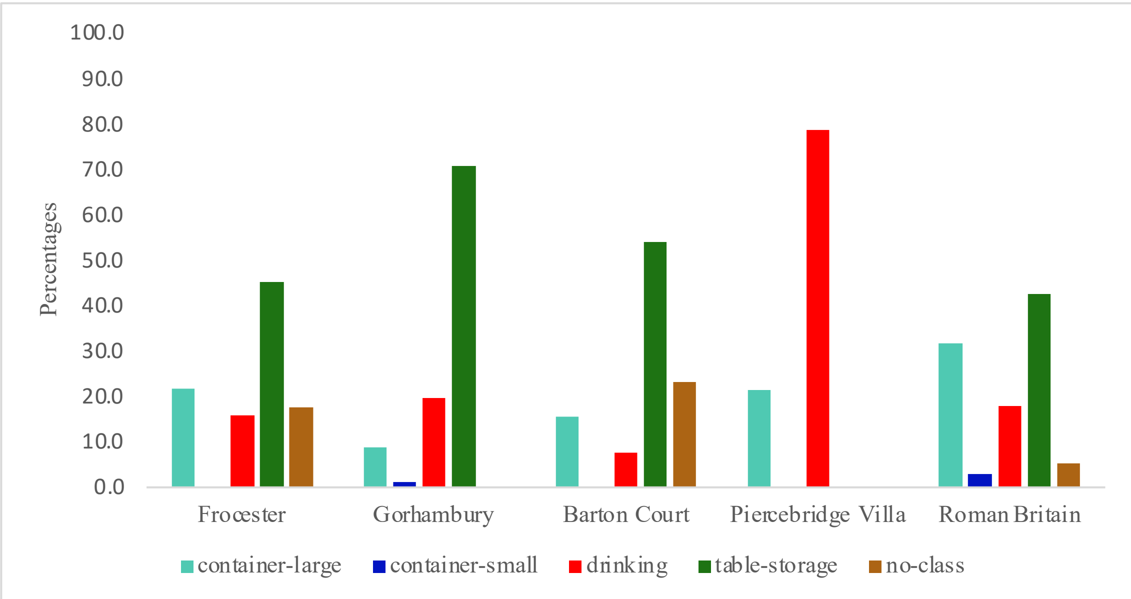


Figure 4.47 Vessel Class Percentage Counts for Frocester, Gorhambury, Barton Court and Piercebridge Villa

The Piercebridge Villa profile includes just bottle and drinking vessel assemblages that were dated mainly in the 2nd century CE. The bottle finds were mainly blue-green fragments found in the bathhouse and the drinking vessel cups and beakers were mostly colourless and found in the main building (Cool and Mason, 2008, p. 240). In contrast to the Piercebridge fort for the same period, there was an absence of any tableware in the assemblages (reference Table 4.31). The glass class proportions for the other sites are all very similar both in proportion with each other and to the Romano-British corpus. Window glass and glass tesserae were finds at Frocester, which in the 3rd century stone villa had signs of baths, a warming and hot bath with a separate plunge pool (Price, 2000, p. 100). Window glass was also found on the Piercebridge villa site with the greatest quantity from the bathhouse drain (Cool and Mason, 2008, p. 148).

The detail of the vessel types is shown in Table 4.49 and Figure 4.48 graphically displaying the percentage profiles.

Table 4.49 Vessel Type Percentage Counts for Frocester, Gorhambury, Barton Court and Piercebridge Villa

Glass type	Frocester	Gorhambury	Barton Court	Piercebridge Villa	Roman Britain
bottle	21.6	8.7	15.4	21.4	31.5
unguent	-	1.1	-	-	2.9
beaker	9.8	12.0	-	28.6	6.8
cup	5.9	5.4	7.7	50.0	9.2
goblet	-	-	-	-	-
bowl	27.5	29.3	38.5	-	15.1
flagon	-	-	-	-	1.4
flask	2.0	-	-	-	3.2
jar	-	19.6	-	-	4.7
jug	11.8	17.4	15.4	-	9.7
plate	-	-	-	-	0.4
drinking	-	2.2	-	-	1.9
tableware	3.9	4.3	-	-	8.1
no-class	17.6	-	23.1	-	5.2
Totals	100.0	100.0	100.0	100.0	100.0

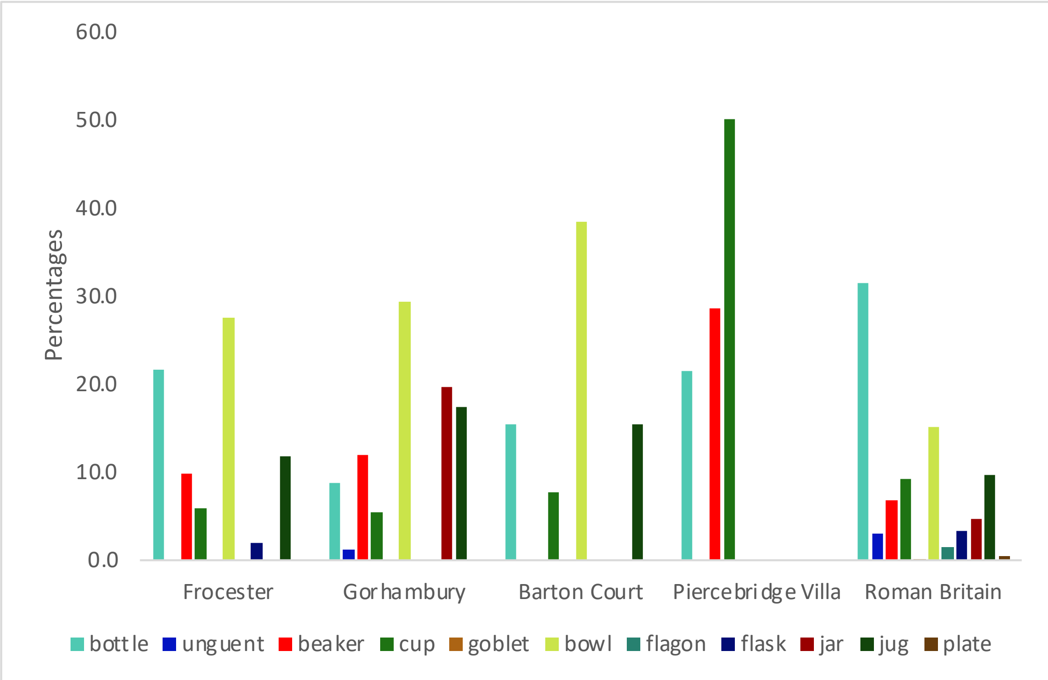


Figure 4.48 Vessel Type Percentage Counts for Frocester, Gorhambury, Barton Court and Piercebridge Villa

The profiles of the Frocester, Gorhambury and Barton Court sites were very similar for the bowl and jugs proportions across the sites. The Barton Court drinking vessels include just cups and are lower in proportion to the combined beaker and cup proportions for Frocester and Gorhambury. This is relevant even with taking into account the no-class proportions where vessel fragments could not be confidently identified as a particular type. In addition, unguents and jars were found at Gorhambury. These differences may be due to the excavation recovery from the sites, but it is more likely that the social material preferences are the reason given the consistency across this group. In contrast, Piercebridge Villa did not include any tableware which is unusual for a settlement. The bottle assemblages came mainly from the area of the villa roundhouse and the colourless drinking vessels include mainly wheel-cut beakers were found in the bathhouse (Cool and Mason, 2008, p. 240). The glass forms are detailed in Table 4.50 and Figures 4.49, 4.50, 4.51 and 4.52.

Table 4.50 Vessel Form Percentage Counts for Frocester, Gorhambury, Barton Court and Piercebridge Villa

Glass form	Frocester	Gorhambury	Barton Court	Piercebridge Villa	Roman Britain
cylindrical bottle	-	5.4	7.7	-	4.4
frontinus-bottle	-	3.3	-	-	4.5
square-bottle	-	2.2	-	7.1	0.2
arcaded-beaker	-	2.2	-	-	22.3
cup-base-ring	2.0	-	-	-	0.1
cylindrical-cup	-	-	-	14.3	0.4
conical-jug	-	1.1	-	-	12.5
pillar-moulded-bowl	3.9	1.1	-	-	0.5
tubular-rimed-bowl	-	5.4	15.4	-	0.8

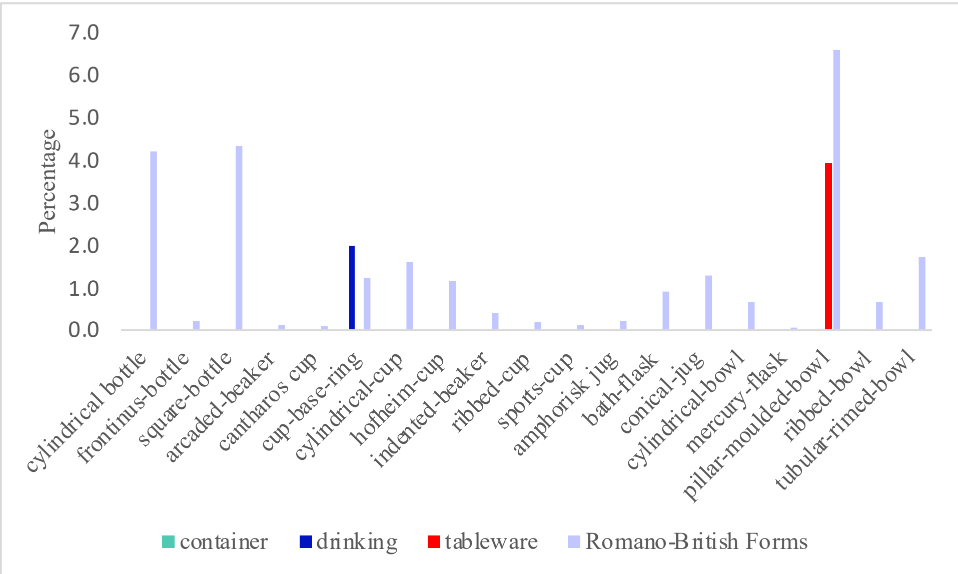


Figure 4.49 Frocester Glass Form Percentage Counts of the Total Vessel Counts

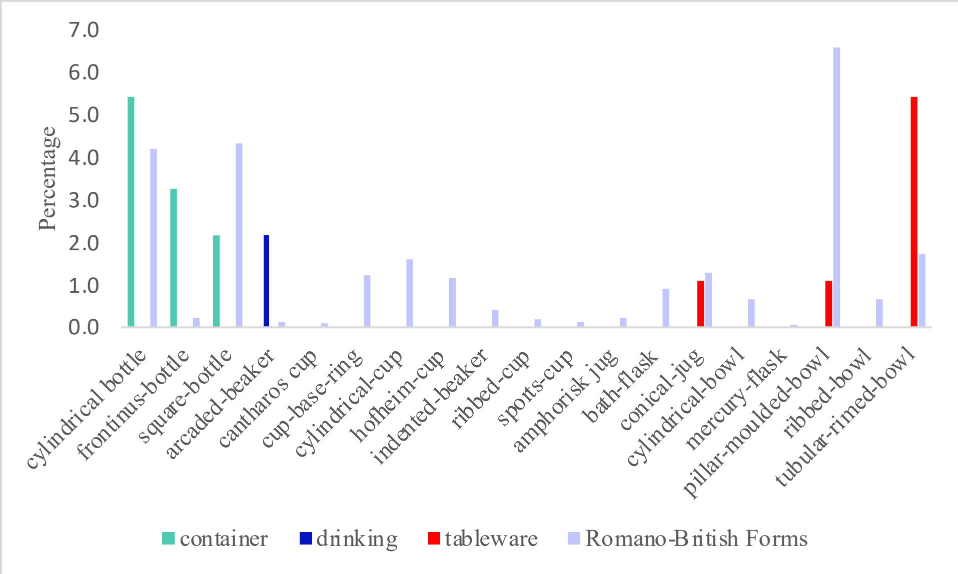


Figure 4.50 Gorhambury Glass Form Percentage Counts of the Total Vessel Counts

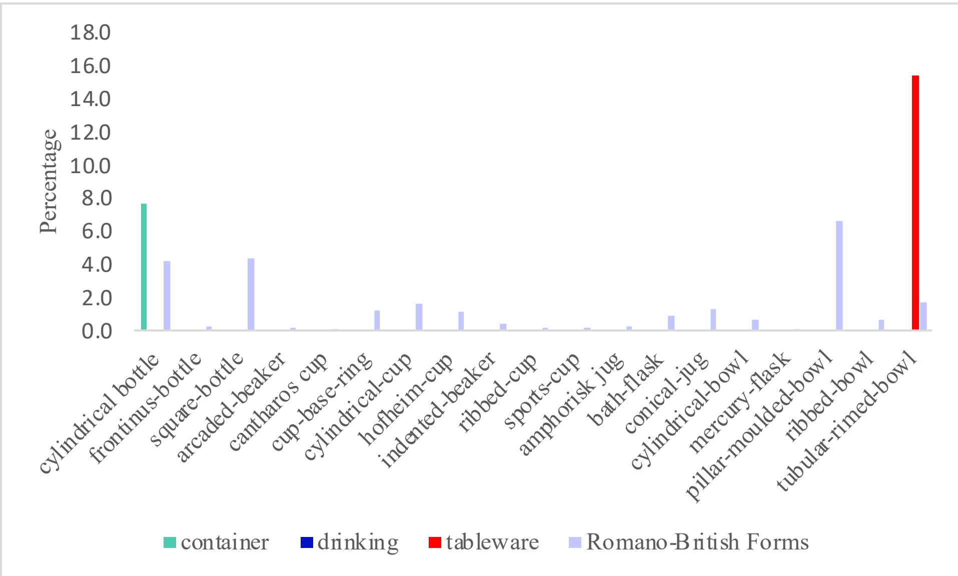


Figure 4.51 Barton Court Farm Glass Form Percentage Counts of the Total Vessel Counts

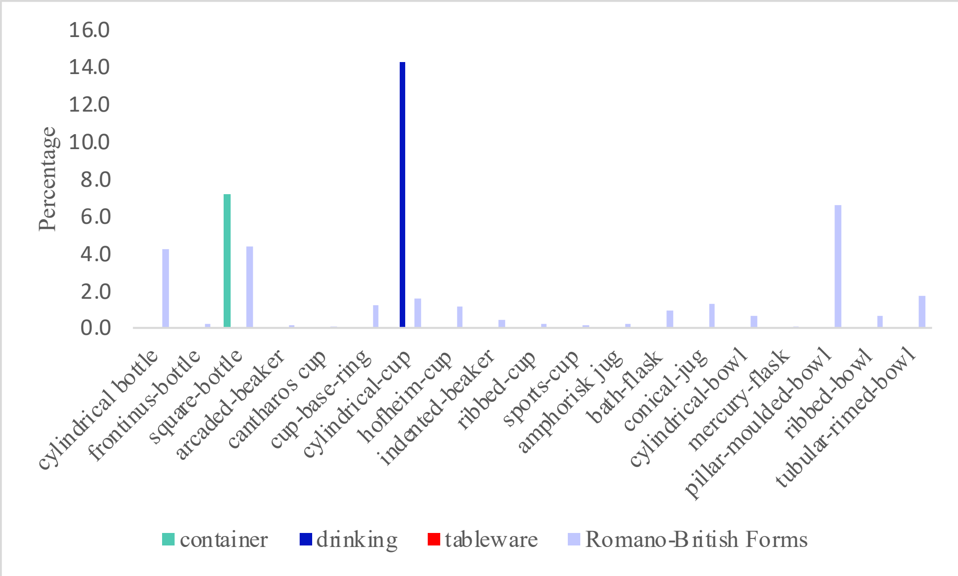


Figure 4.52 Piercebridge Villa Glass Form Percentage Counts of the Total Vessel Counts

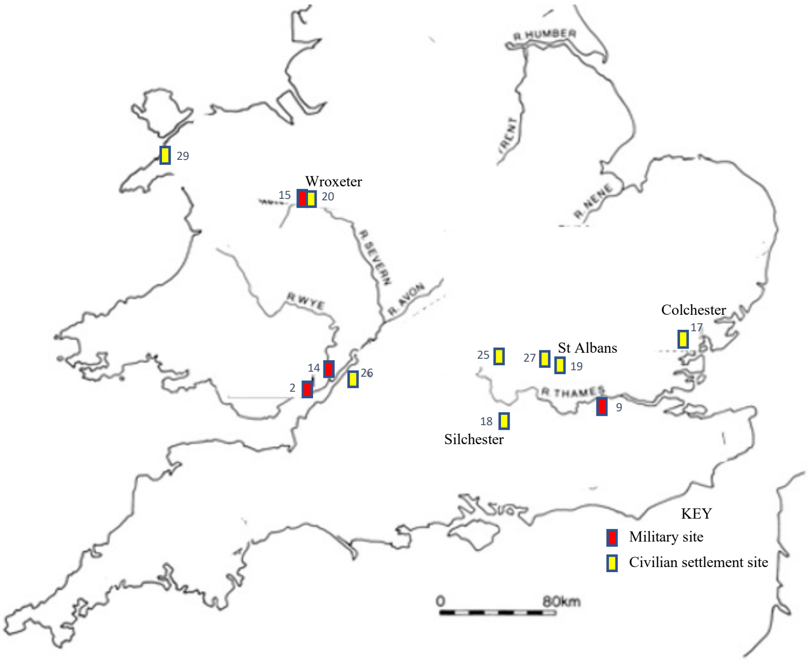
This shows the variety of the identifiable forms found at Gorhambury that were not found at Frocester or Barton Court Farm. Square, *Frontinus* and cylindrical bottles were found at Gorhambury. The barrel shaped *Frontinus* bottle was a fairly common form, with both blue-green fragments associated with 1st and 2nd centuries and the greenish-colourless fragments from later periods were found at Gorhambury (Price and Cottam, 1998, p. 210). The *Frontinus* bottle finds were also reported for Catterick and Piercebridge north of York on Dere Street. Gorhambury is close to Watling Street, the route from London past *Verulamium* to Wroxeter (Margary, 1973, p. 173). Frocester is on the Fosse Way, the main Roman road from Exeter to Lincoln. These were the ‘motorways’ of the Roman age that could have influenced the trade direct to the large cities or via local town markets.

The pillar-moulded bowl form has been earlier discussed in this chapter. The millefiori bowl is an example of a high quality glass vessel found at Gorhambury, with finds also at *Verulamium* Charlesworth in (Frere, 1984). This type of glass is not common in Roman Britain and has been associated with 1st century military sites (Neal, 1974, p. 205). The proximity of St Albans to Gorhambury clearly would have influenced the material culture and social practices in that villa. The excavation report notes a substantial bath-house on the site, which while no glass fragments were found, there were fragments of unguent bottles associated with perfume, spices, possibly bath salts. All of which builds a picture of a high standard of living, access to and an appreciation of luxury glass at Gorhambury.

The cylindrical bottle form is very common in Roman Britain in the 1st century CE, particularly in the last quarter of the century (Price and Cottam, 1998, p. 191). The tubular-rimmed bowl form was discussed earlier in this chapter for Walton-le-Dale and the fragment from Walton-le-Dale did not have any details of colour or shape. The shallow polychrome bowl form is not common (Price and Cottam, 1998, p. 77); the deep tubular-rimmed bowl form (1998, p. 78) was very common on settlements. There were two fragments recorded as finds from Barton Court Farm, both were monochrome yellow-green in colour and therefore more likely to be the deep bowl form.

4.4.3 Large Cities

Large cities are defined as centres of Roman administration. These would be economic and social centres for trade and consumption. Wroxeter, Silchester, St Albans and Colchester were the selected large cities in Roman Britain and the locations are shown on the map Figure 4.53.



Military Sites	Civil Sites
2. Caerleon	17. Colchester
9. London	18. Silchester
14. Usk	19. St Albans
15. Wroxeter	20. Wroxeter
	25. Barton Court Farm Villa
	26. Frocester
	27. Gorhambury Settlement
	29. Graeanog Ridge

Figure 4.53 Large Cities Locations – Wroxeter, Silchester, St. Albans and Colchester

The following Tables 4.51 and 4.52 set out the historical contexts for the cities.

Table 4.51 Historical Contexts for St Albans and Wroxeter

Context	St Albans (1)	Wroxeter (2)
Site occupation period	Short-lived military post followed by a city c. 49 CE that was developed as an administration centre and a *municipium*. The city, *Verulamium*, expanded and was occupied throughout the Roman period.	Wroxeter was under military rule 47-90 CE. Develped as a city, *Viroconium Cornoviorum*, became a *civitas* of the *Cornovii* tribe and was occupied throughout the Roman period.
The character of the site	Originally the capital of the *Catuvellauni* tribe, until Colchester was adopted. By the mid 1st century CE, houses, streets and public buildings were occupied. The city expanded following a fire c. 155-60 CE.	The early town developed 90-130 CE with stone public buildings erected that included baths, a *macellum* and *portico* .
Site location	Situated west of the present-day St Albans across the River Ver on Watling Street.	Situated on the east bank of the River Severn, overlooking the flood plain, at the end of Watling Street with links back to St Albans and London. Routes north to Chester annd Wilderspool.

Sources: (1) (Frere, 1972, 1984) *(2)* (White and Barker, 1998; Webster and Chadderton, 2002)

Table 4.52 Historical Contexts for Colchester and Silchester

Context	Colchester (1)	Silchester (2)
Site occupation period	A fortress was built in 44-5 CE followed by a city c. 49 CE that was developed as a *colonia* adminstration centre. The city, originally *Camulodunum*, expanded and was occupied throughout the Roman period.	The town was occupied in 43 CE and developed into a large city, *Calleva*, with continued occupation into the 4th century CE.
The character of the site	Developed as a centre of Roman administration, it was destroyed by the *Icenian* revolt in 60/1 CE. Rebuilt and continued as a civilian settlement until the end of the Roman period.	No evidence of a military structure. The town developed into a city. It was designated a *civitas* during the Flavian period and included a *forum* and amphitheatre built in stone.
Site location	Situated about 85km northeast of London.	Situated about 60kms west of London, close to the River Thames. At a cross-roads for roads west to South Wales, south to Dorchester, east to London, and north to Bicester and Alcester.

Sources: (1) (Cool and Price, 1995) *(2)* (Fulford *et al*., 2006; Fulford and Clarke, 2011; Fulford *et al*., 2020; Fulford, 2021)

The glass class accession lines count, and percentage profiles are detailed for St. Albans, Wroxeter, Silchester and Colchester in Table 4.53 and Figure 4.54.

Table 4.53 Vessel Class Percentage Counts for St Albans, Wroxeter, Colchester and Silchester

Glass class	St Albans	Wroxeter	Colchester	Silchester	Roman Britain
container-large	14.5	31.7	21.7	47.7	31.5
container-small	2.6	3.2	2.9	2.7	2.9
drinking	15.8	20.4	16.4	9.7	17.9
table-storage	64.8	42.6	55.7	33.7	42.5
no-class	2.3	2.1	3.4	6.3	5.2
Total	100.0	100.0	100.0	100.0	100.0

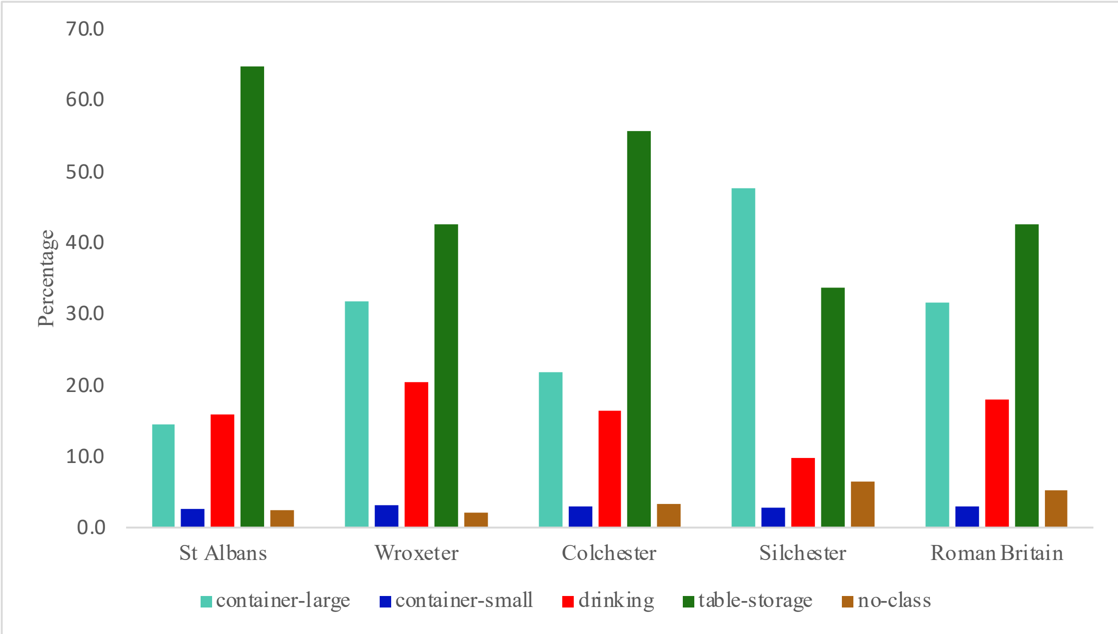


Figure 4.54 Vessel Class Percentage Counts for St Albans, Wroxeter, Colchester and Silchester

The relative proportions and shapes of the glass vessel classes percentage counts profiles for the large cities are similar to the Romano-British corpus profile, with large containers and tableware vessels dominating the finds. Patterns of difference between the large cities may be due to socio-economics and material culture of each settlement and the availability of traded glass in Roman Britain. The accession line vessel type details are presented in Table 4.54 and Figure 4.55 presenting the information graphically.

Table 4.54 Vessel Type Percentage Counts for St Albans, Wroxeter, Colchester and Silchester

Glass type	St Albans	Wroxeter	Colchester	Silchester	Roman Britain
bottle	14.5	31.7	21.7	47.7	31.5
unguent	2.6	3.2	2.9	2.7	2.9
beaker	15.8	9.2	5.9	3.0	6.8
cup	-	8.5	7.3	6.3	9.2
goblet	-	-	-	-	-
bowl	31.1	8.8	17.0	11.3	15.1
flagon	13.5	-	-	-	1.4
flask	4.9	7.0	2.1	1.0	3.2
jar	10.1	4.9	6.7	1.3	4.7
jug	3.1	15.5	13.5	10.3	9.7
plate	-	-	0.3	0.7	0.4
drinking	-	2.8	3.2	0.3	1.9
tableware	2.1	6.3	16.1	9.0	8.1
no-class	2.3	2.1	3.4	6.3	5.2
Totals	100.0	100.0	100.0	100.0	100.0

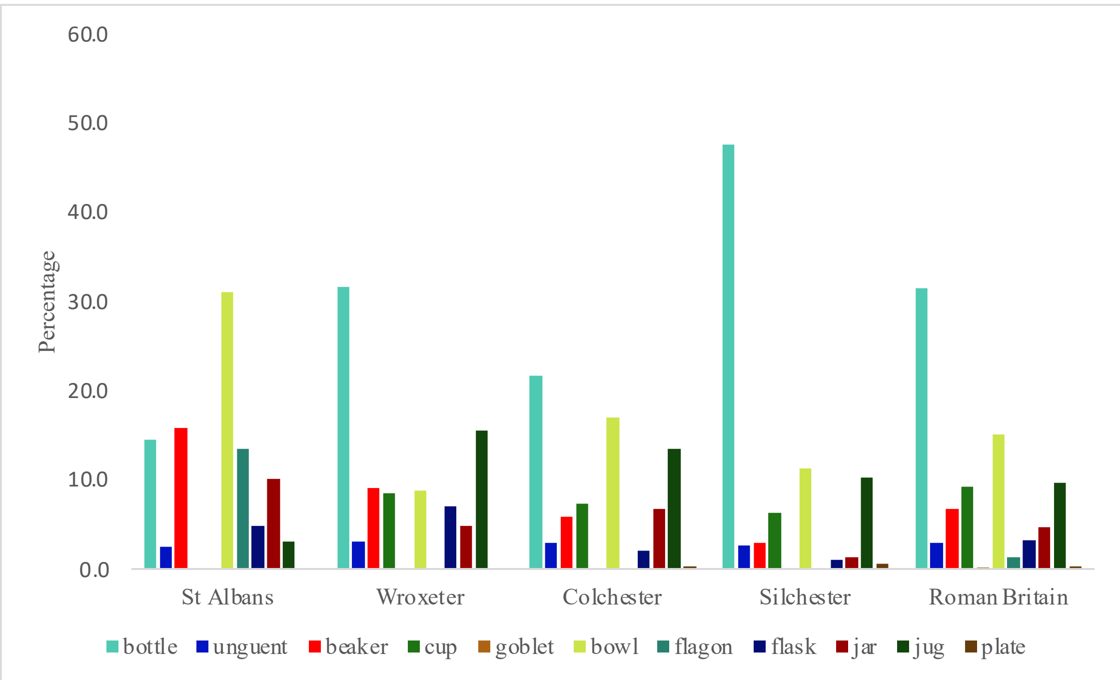


Figure 4.55 Vessel Type Percentage Counts for St Albans, Wroxeter, Colchester and Silchester

There is a breadth to the range of vessel types seen from the recovered and reported evidence for these large cities, with the exception that cups were not reported for St. Albans. The combined drinking vessels percentage counts of beaker and cup types were broadly equivalent for all sites. However, much of the glass found at St. Albans (*Verulamium*) could not be identified and therefore was not included in the catalogue (Charlesworth, 1972, p. 196). This means that the proportional representation of vessel types may not accurately reflect the original presence of glass at *Verulamium*.

The percentages of glass forms are detailed in Table 4.55 and Figures 4.56, 4.57, 4.58, 4.59 in context with the relevant glass classes.

Table 4.55 Vessel Form Percentage Counts for St Albans, Wroxeter, Colchester and Silchester

Glass form	St Albans	Wroxeter	Colchester	Silchester	Roman Britain
cylindrical bottle	0.8	5.3	1.8	7.3	4.4
frontinus-bottle	-	1.1	0.3	0.0	4.5
square-bottle	9.3	5.3	2.3	12.0	0.2
arcaded-beaker	-	-	0.1	-	22.3
cantharos cup	-	-	0.2	-	2.9
cup-base-ring	-	2.8	0.9	1.0	0.1
cylindrical-cup	-	1.1	0.3	0.3	0.5
hofheim-cup	-	3.5	2.9	0.3	0.1
indented-beaker	0.8	0.4	0.6	0.7	1.3
ribbed-cup	-	-	-	0.7	1.7
sports-cup	-	-	0.4	-	1.3
amphorisk jug	-	-	0.3	1.0	0.2
bath-flask	0.3	2.5	0.7	-	0.1
conical-jug	-	1.8	1.3	1.3	12.5
cylindrical-bowl	3.6	-	0.5	0.7	0.2
mercury-flask	-	-	0.1	0.3	1.4
pillar-moulded-bowl	4.1	4.9	10.1	5.3	0.5
ribbed-bowl	3.1	0.7	0.3	0.7	0.1
tubular-rimed-bowl	8.3	2.5	2.0	0.3	0.8

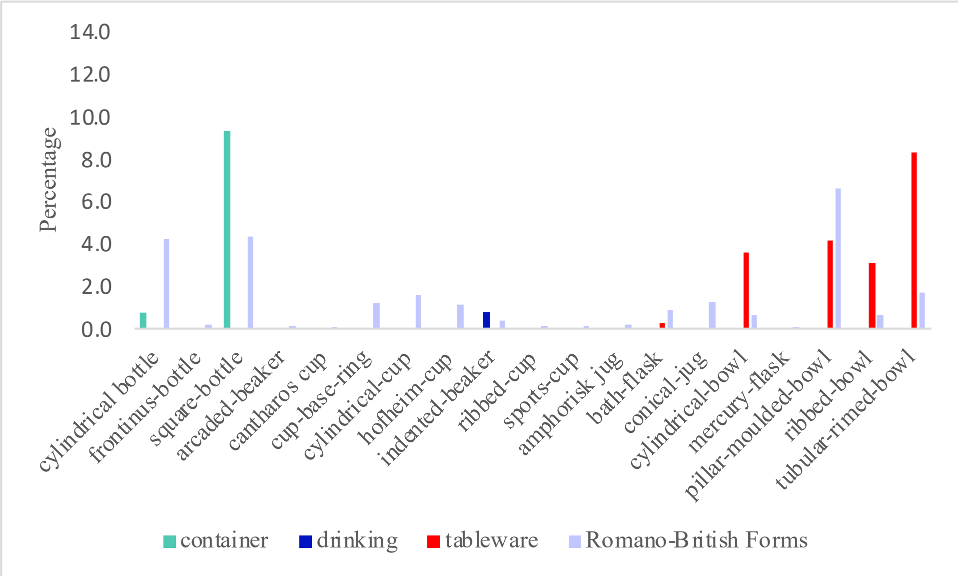


Figure 4.56 St Albans Glass Form Percentage Counts of the Total Vessel Counts

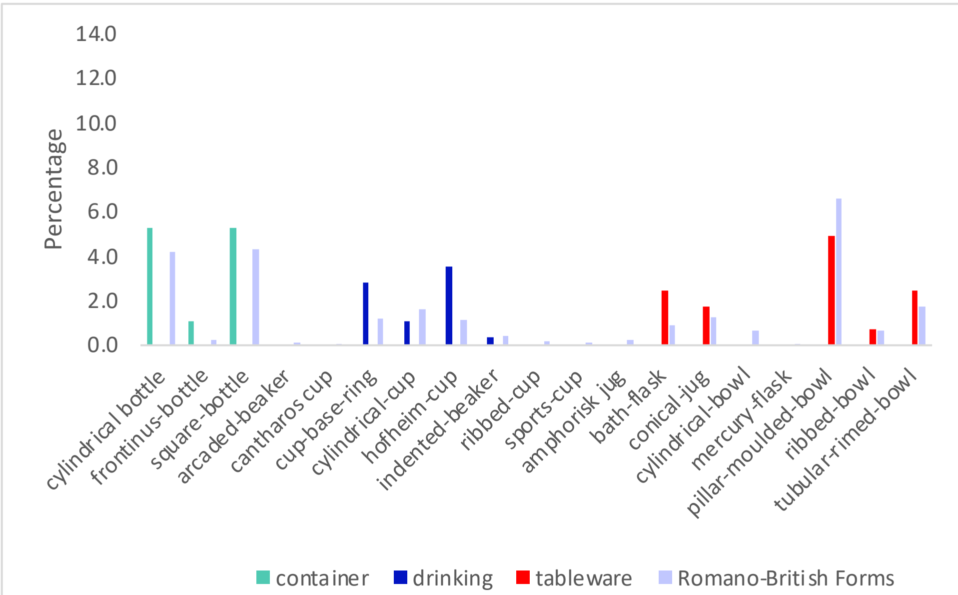


Figure 4.57 Wroxeter Glass Form Percentage Counts of the Total Vessel Counts

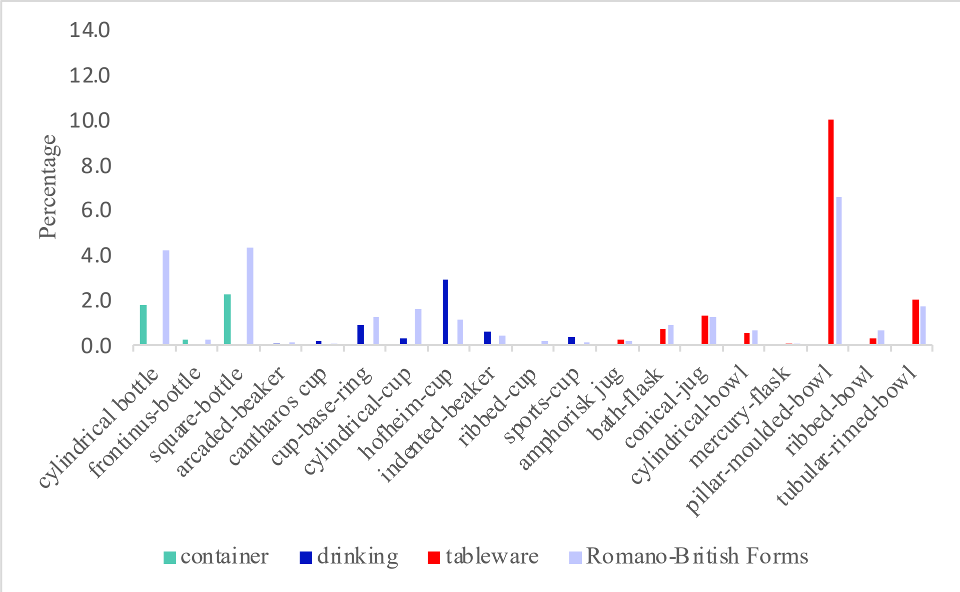


Figure 4.58 Colchester Glass Form Percentage Counts of the Total Vessel Counts

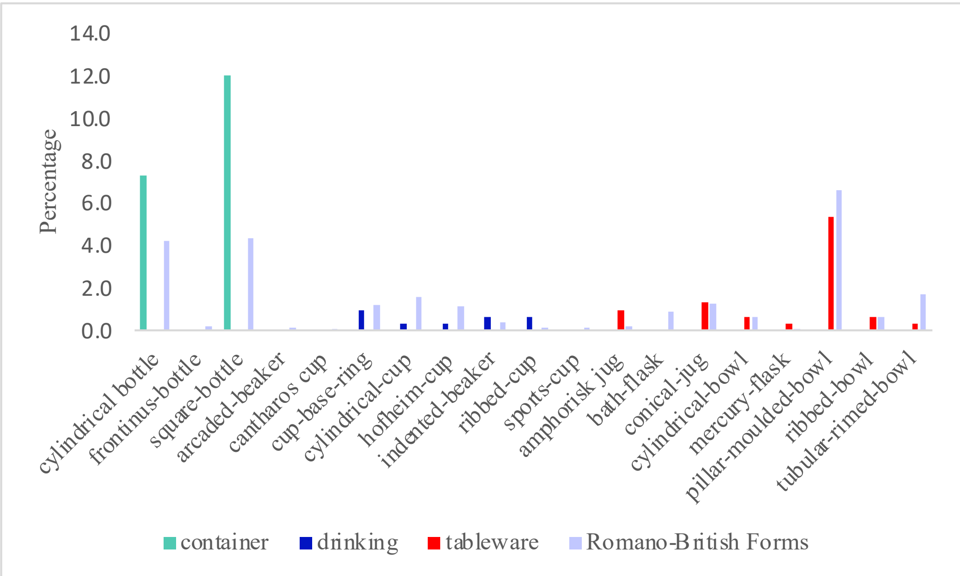


Figure 4.59 Silchester Glass Form Percentage Counts of the Total Vessel Counts

The common forms were identified as cylindrical and square bottles, the Hofheim cup and the cylindrical, tubular-rimmed, ribbed and pillar-moulded bowls. The presence of pillar-moulded bowls, square and cylindrical bottles have been noted as common forms for the 1st and 2nd centuries CE on Romano-British sites and noted in this chapter for the military and large city sites and so will not be commented on further.

Evidence of Hofheim cups (Figure 4.86) was noted at the London Plantation Place fort and at Wroxeter. This is a convex cup with wheel-cut lines and named after the Rhineland military site where many examples were found. In the research corpus, the examples at the Castleford and London forts have already been noted, and with examples from Colchester and Silchester. While these vessel forms are considered common in Roman Britain (Price and Cottam 1998: 71) it is interesting that the evidence in this study includes the London forts, Wroxeter, Colchester and Silchester that were all major locations in the Roman administration system and likely major locations in the trading network. This will be picked up in the later discussions on the sites and trade with the implication that Hofheim cups could have 'travelled' as personal objects.

The presence of cantharos cups was noted in the London Plantation Place fort and Colchester sites dated mid 1st century and at the Elginhaugh fort during the Flavian period (Cool and Price, 1995; Hanson *et al*., 2007; Dunwoodie *et al*., 2015). This example of a cup with a stepped rim and stemmed base is considered to be uncommon in Roman Britain (Price and Cottam, 1998, p. 68).

The amphorisk jug noted at both Colchester and Silchester is considered not very common and found on sites in southern Britain (Price and Cottam, 1998, p. 147) and in this study recorded at the Usk and York fortresses, at Corbridge near Hadrian's Wall and the large cities of Colchester and Silchester. The amphorisk jug form (Figure 4.99) is a convex jug with two handles and usually in strong colours particularly dark blue and blue-green (Price and Cottam, 1998, p. 149). The examples in this study fit that profile with a wide range of strong colours including polychrome represented. These jugs are likely to have been used as tableware for the storage of liquids and used in dining; such vessels would be expected to be found in large cities and it is interesting that fragments were found in the fortresses of York and Usk and this will be discussed in the next chapter.

The Mercury flask, sometimes designated as a bottle, is a very distinctive form. The form shape has a square body and made by blowing the glass into a mould, with a representation of the god Mercury depicted on the base that gives rise to the form name. These flasks are similar shapes to those of unguent bottles and would likely have been used for the storage of liquids. They are more commonly found on the Continent and the study database has records of six sites with Mercury flasks and this will be discussed in the next chapter.

The reporting of bath-flasks as forms present on both sites is not surprising given the status of both large cities as administration centres and both sites did include public bath-houses. Bath-flasks are small globular flasks with two looped handles that were very common in Roman Britain particularly in the 2^{nd} and 3^{rd} centuries (Price and Cottam, 1998, p. 188). They were a development of the tubular unguent bottle (1998, p. 169), a small container common in the mid 1^{st} century and associated with holding oil for bathing (Simmonds *et al.*, 2008, pp. 104–115). The association of bath-flasks with bathing was noted particularly with the finds from the Roman baths in Wroxeter with numerous bath-flasks excavated (Ellis, 2000).

The presence of millefiori vessels was reported at St. Albans as examples of a particular form of mosaic glass manufactured decoration that are discussed in the following Section 4.5 ‘Shrines and Burial Sites’ and further in the glass decoration in Section 4.6.3.

4.5 Shrines and Burial Sites

This section closes with Roman shrine at Uley and the burial sites at Stanway, Skeleton Green and Gloucester that were all associated with and close to urban cities. This section presents the glass finds from the selected shrines and burial sites in order to give some information about the customs and rituals of local communities through the use of glass. The following Figure 4.60 shows the site locations of the selected shrines in the south of England.

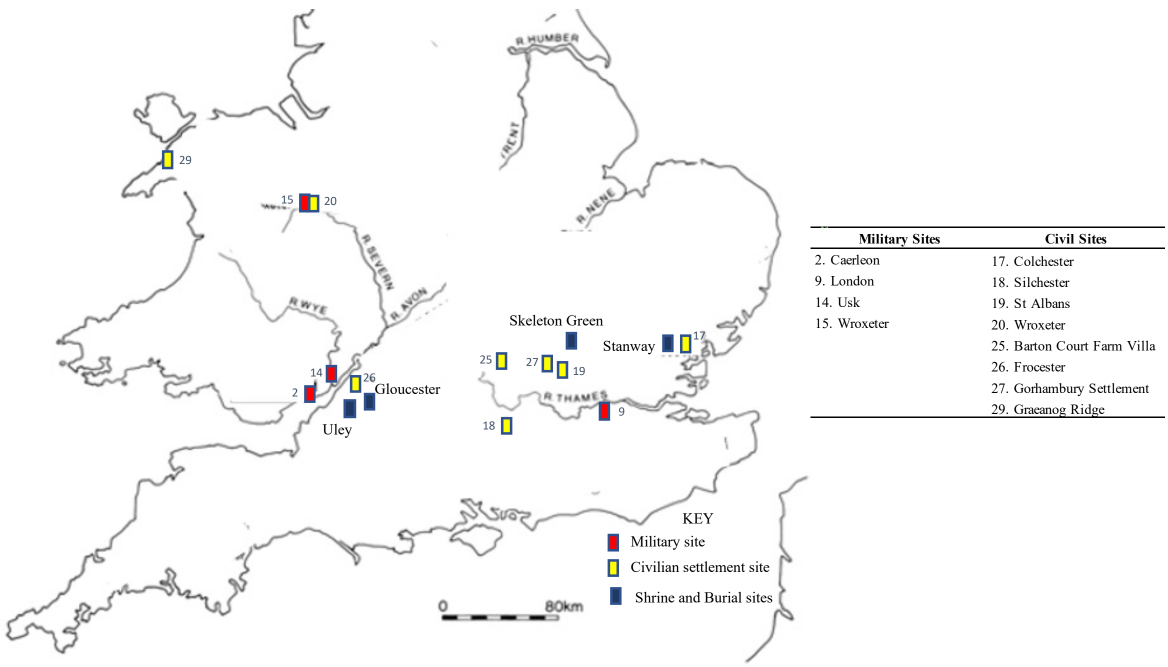


Figure 4.60 Site Locations of the Uley Shrine and the Gloucester, Skeleton Green and Stanway Burial Sites

The following Tables 4.56 and 4.57 set out the historical contexts for the shrines and burial sites.

Table 4.56 Historical Contexts for Stanway and Uley

Context	**Stanway** (1)	**Uley** (2)
Site occupation period	Stanway was a burial site with a number of enclosures dated to the 1st century CE.	Uley was a Romano-British religious site that was used from prehistory to the 7th / 8th century CE
The character of the site	Six cremation burials inside Enclosures 3-5 date probably to c. A.D. 40-60/75 with most in the range c. A.D. 40-60. The numbers of objects in graves varies from none to many in the well-endowed 'Warrior's burial' (BF64) and the 'Doctor's burial' (CF47).	At the end of the Iron Age an open-ended oval enclosure was developed to form enclosures with ditches and pallisades and two timber shrines. This shrine was replaced by a stone temple in the 2nd century CE that was further extended in the 4th century CE.
Site location	The site is on the edge of Colchester (*Camulodunum*).	The site is located in southern Gloucestershire south of Frocester and ajacent to Cirencester.

Sources: (1) (Crummy *et al.*, 2007) (2) (Woodward and Leach, 1993)

Table 4.57 Historical Contexts for Skeleton Green and Gloucester

Context	**Skeleton Green** (1)	**Gloucester** (2)
Site occupation period	The site was occupied from the first quarter of the 1st century until c. 60 CE. After occupation ceased, the site was used as a cemation burial cemetery.	The cemetary site was used for burials and for cremation from the 1st to the 4th centuries CE.
The character of the site	The site was in an area that traded with Italy and Gaul with the evidence of imported Roman goods. There is also evidence of a 2nd century group of burials.	The cemetary site finds include the glass unguent bottles and a gaming set associated with the first century cremation burials, together with personal ornaments in burials dated to the Antonine period and fourth century inhumation burials.
Site location	Skeleton Green lay on Ermine Street in the Puckeridge - Braughing area north of St Albans (*Verulamium*)	The Gloucester Roman Cemetary was situated on Ermin Street close to the Gloucester fortress and the Gloucester *Colonia* .

Sources: (1) (Partridge, 1981); (2) (Simmonds *et al*., 2008)

The glass class accession lines count, and percentage profiles are detailed for Stanway, Uley, Skeleton Green and Gloucester in Table 4.58 and Figure 4.61.

Table 4.58 Vessel Class Percentage Counts for Stanway, Uley, Skeleton Green and Gloucester

Glass class	**Stanway**	**Uley**	**Skeleton Green**	**Gloucester**	**Roman Britain**
container-large	-	17.4	9.5	-	31.5
container-small	55.6	-	-	100.0	2.9
drinking	5.6	26.1	14.3	-	17.9
table-storage	27.8	43.5	52.4	-	42.5
no-class	11.1	13.0	23.8	-	5.2
Total	100.0	100.0	100.0	100.0	100.0

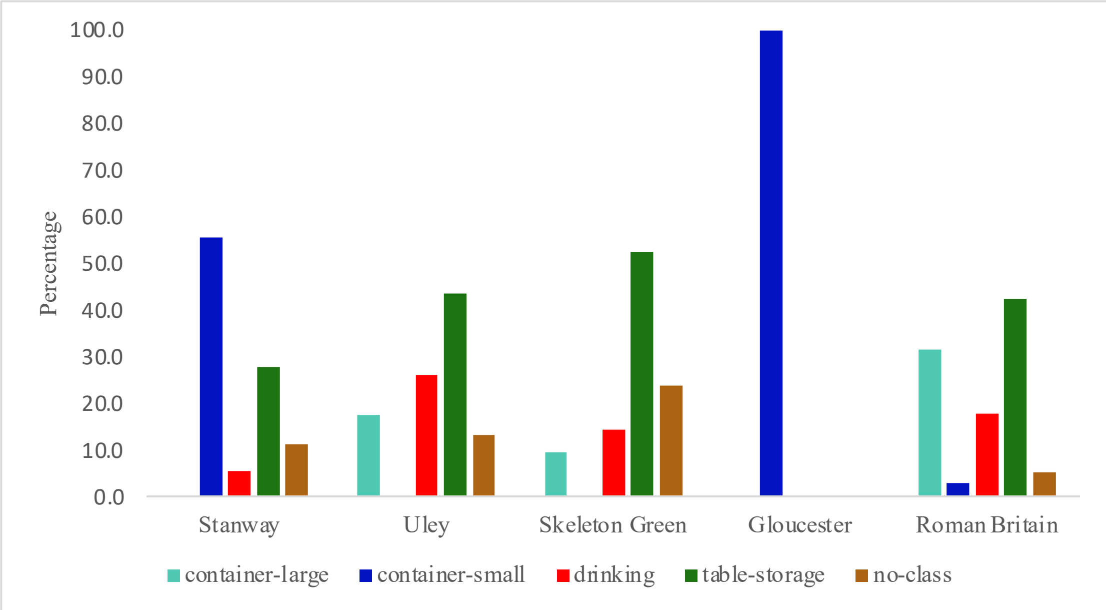


Figure 4.61 Vessel Class Percentage Counts for Stanway, Uley, Skeleton Green and Gloucester

The accession line counts for Gloucester are low and this could influence the percentage counts, however the data may still be relevant for the small container class of glass represented. The Stanway and Uley sites show more representation across all the glass classes.

The detail of the vessel types is shown in Table 4.59 and the Figure 4.62 graphically displays the profiles for Stanway, Uley, Skeleton Green and Gloucester.

Table 4.59 Vessel Type Percentage Counts for Stanway, Uley, Skeleton Green and Gloucester

Glass type	**Stanway**	**Uley**	**Skeleton Green**	**Gloucester**	**Roman Britain**
bottle	-	17.4	9.5	-	31.5
unguent	55.6	-	-	100.0	2.9
beaker	-	-	14.3	-	6.8
cup	-	26.1	-	-	9.2
goblet	5.6	-	-	-	-
bowl	27.8	21.7	28.6	-	15.1
flagon	-	-	4.8	-	1.4
flask	-	4.3	9.5	-	3.2
jar	-	-	-	-	4.7
jug	-	13.0	4.8	-	9.7
plate	-	-	-	-	0.4
drinking	-	-	-	-	1.9
tableware	-	4.3	4.8	-	8.1
no-class	11.1	13.0	23.8	-	5.2
Totals	100.0	100.0	100.0	100.0	100.0

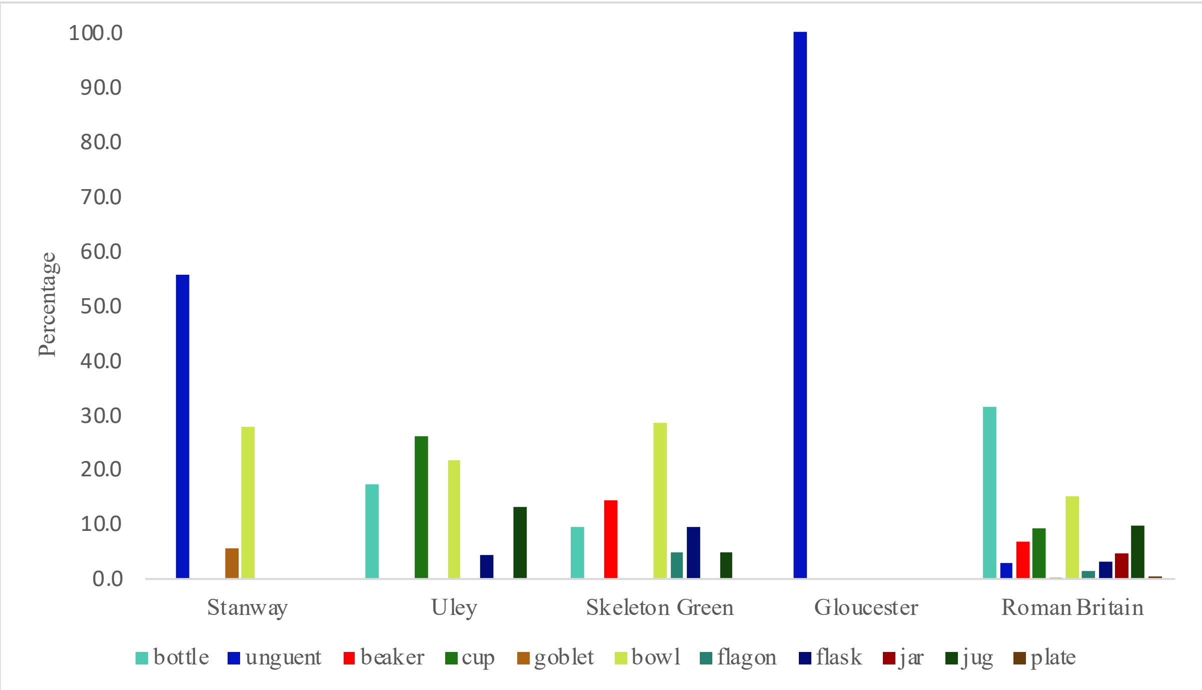


Figure 4.62 Vessel Type Percentage Counts for Stanway, Uley, Skeleton Green and Gloucester

There is a single corpus record of the goblet type at Stanway (Crummy *et al.*, 2007). The goblet form is described in (Isings, 1957, p. 37) as a bulbous cup with height 176mm and dated to the 1st century CE. The closest description to the Romano-British glass forms is the conical beaker (Figure 4.78) (Price and Cottam, 1998, p. 80). The goblet is similar to the cup and is better represented from excavation sites on the Continent (Isings, 1957, p. 113; Foy *et al.*, 2018). The Stanway site record of the glass goblet is retained for reference to their presence in Roman Britain noting that this record represents the placement of a goblet at a shrine rather than a representation of consumption within a community.

Small containers as unguent bottles were known to have been used as they were a common form of funeral object, perhaps used as part of the ceremony as they were common for cremation burials (Simmonds *et al.*, 2008). There were no identified forms of the small unguent bottles reported as finds at Stanway and Gloucester.

Table 4.60 and Figures 4.63 and 4.64 show the identified cases of the vessel forms reported for Uley and Skeleton Green, with no glass forms for Stanway and Gloucester.

Table 4.60 Vessel Form Percentage Counts for Stanway, Uley, Skeleton Green and Gloucester

Glass form	Stanway	Uley	Skeleton Green	Gloucester	Roman Britain
cylindrical bottle	-	4.3	-	-	4.4
square-bottle	-	4.3	9.5	-	0.2
cup-base-ring	-	4.3	-	-	0.1
cylindrical-cup	-	4.3	-	-	0.5

Sources: (Partridge, 1981; Woodward and Leach, 1993; Crummy *et al.*, 2007; Simmonds *et al.*, 2008)

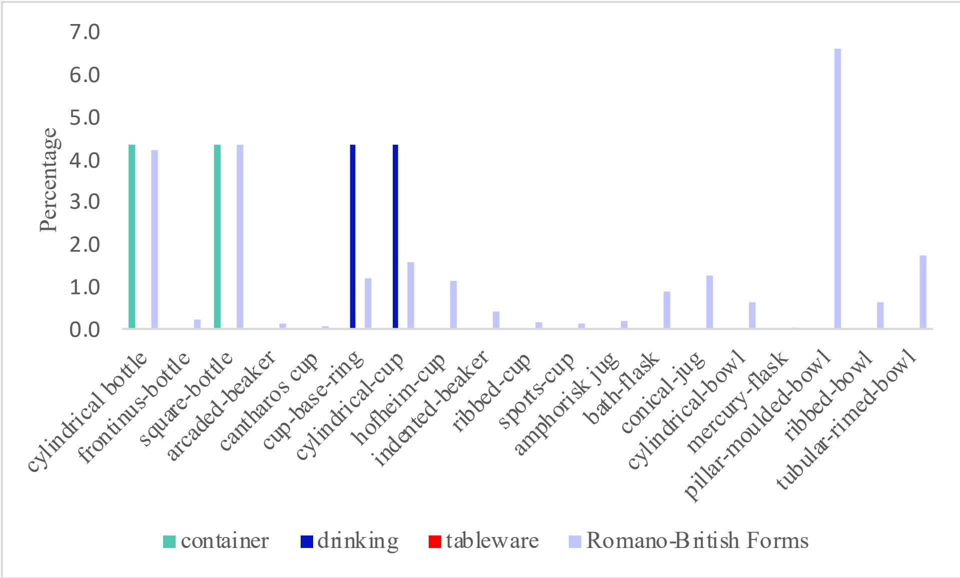


Figure 4.63 Uley Glass Form Percentage Counts of the Total Vessel Counts

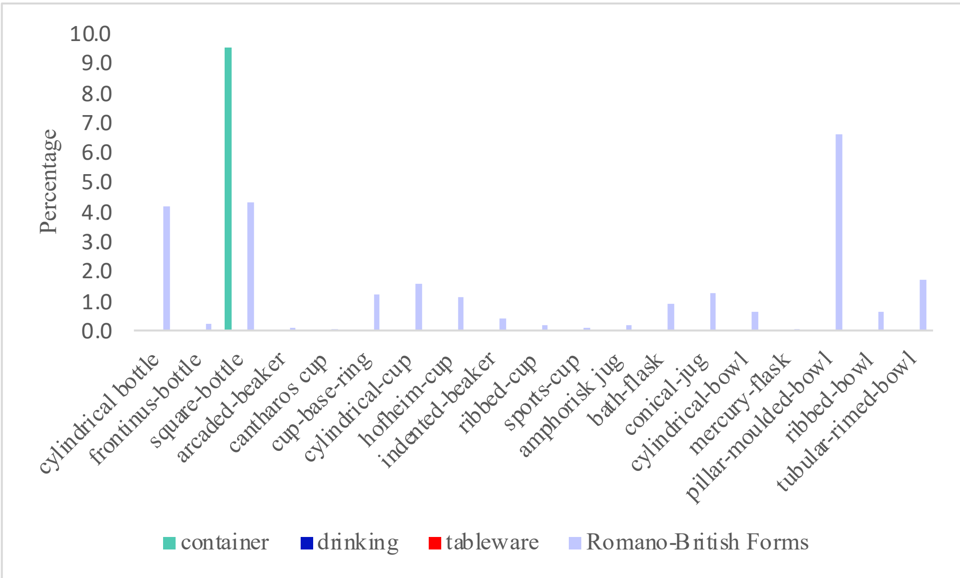


Figure 4.64 Skeleton Green Glass Form Percentage Counts of the Total Vessel Counts

There are patterns of difference between Stanway and Uley. Uley had large container forms with the common cylindrical and square bottles reported, whereas no bottle fragment evidence was reported for Stanway, that in the case of a burial where the goods are deliberately placed, could be significant. Bottles were used to hold cremation ashes, but there is no evidence that they were used for this purpose on this site. However, ten cylindrical and square bottles were found in one burial enclosure in a cemetery in the Netherlands (Nijmegen-west as the oldest Roman city) at the end of the 1st century CE; all had the same base mould markings and the same form dimensions, and so could have been used new (Koster, 2006).

The Stanway burials finds by contrast did not include large container bottles (Cool, 2007). Smaller unguent bottles, cups and a millefiori bowl fragment were in one enclosure. Whether these differences are relevant or just reflect community differences in performing rites will not be known. At Stanway, glass goods were only found in graves that were described by the other items in the graves. The instances comprise, the ‘doctor’s burial’ (*c.* 40-50 CE) identified from surgical instruments found with glass counters amongst other objects; the ‘warrior’s burial’ (*c.* 40-50 CE) was identified from a spear and shield alongside other items including a glass bowl, counters, unguent and beads, the ‘brooches burial’ had a glass goblet (pyxis) as well as the brooches, and another burial had fragments of a millefiori bowl. The glass objects found in burials included unguent bottles, beads and bowl fragments. What is relevant is that not all burials have grave goods deposited and there would have been a significance to what goods were deposited, and as glass was expensive, a millefiori bowl and a goblet (pyxis) is likely have had symbolic resonance.

4.6 Glass Vessel Characteristics

4.6.1 Context

The following sections assess the data related to the glass vessel characteristics for the sites. These include the reported characteristics of colour, vessel markings and decorations, and the dimensions of the vessels. The purpose of this section is to establish what associations the characteristics have with the vessel type and forms and whether any associations can be made relevant to patterns of site composition or regional distribution. The presentation of the data for vessel colour followed by the vessel marks and decoration is presented as a narrative of the key points with reference to the tables and figures of the sites shown as military and civil groups.

4.6.2 Sites Vessel Colour Profiles

The most common colour of Roman glass was the so-called natural blue-green that describes a range of different blue and green shades. In the 1st century and early 2nd centuries, the fashion was for strong translucent colours such as dark blue, yellow-brown and yellow-green for tableware with bottles and containers commonly blue-green. The value of colour to Roman society can be associated with the imitation of precious minerals such as rock salt for colourless drinking vessels (Cottam, 2019, p. 405). The transparent beakers and cups were commonly decorated with facets and grooves to enhance the effect. There are vessels of rare coloured glass, such as purple that was associated with elite status and rank and in fact could have had state restricted availability in society (Cottam, 2019, p. 338). By the end of the 3rd century, glass vessels tended to be more made from pale green and yellow green glass (Price and Cottam, 1998, p. 16).

The colour profiles of the individual sites' compositions are shown in Tables 4.61, 4.62, 4.63, 4.64 and Figures 4.65 and 4.66.

Table 4.61 Military Sites Colour Percentage Composition Profiles (1)

Glass Colour	Birdoswald	Caerleon	Carlisle	Castleford	Corbridge	Elginhaugh	Inchtuthil	London
opaque	-	-	-	0.4	2.2	-	-	0.5
polychrome	-	-	-	0.4	2.2	-	-	2.5
deep-blue	-	1.5	3.9	2.2	-	5.1	-	1.5
purple	-	-	-	1.5	-	-	-	-
peacock-blue	-	-	-	0.4	-	-	-	-
emerald-green	-	-	-	-	-	-	-	-
yellow-brown	-	-	1.7	3.3	2.2	-	-	0.5
yellow-green	1.4	7.6	-	3.0	2.2	3.4	15.0	1.0
light-green	1.4	-	0.4	3.7	-	0.8	-	-
colourless	8.5	19.8	3.9	35.9	31.1	3.4	-	14.7
blue-green	52.1	61.1	85.8	43.0	55.6	66.9	85.0	7.4
greenish-colourless	9.9	9.9	2.1	6.3	-	-	-	3.9
other-colours	-	-	2.1	-	4.4	7.6	-	49.5
no-colour-recorded	26.8	-	-	-	-	12.7	-	18.6
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4.62 Military Sites Colour Percentage Composition Profiles (2)

Glass Colour	Piercebridge	Ravenglass	Ribchester	Strageath	Usk	Watercrook	Wroxeter	York
opaque	-	-	-	-	-	-	-	0.5
polychrome	0.5	-	0.5	4.3	5.3	-	-	-
deep-blue	0.2	-	3.4	8.7	5.3	-	9.4	-
purple	-	-	0.5	-	-	-	0.6	-
peacock-blue	-	-	-	-	-	-	-	0.5
emerald-green	-	-	-	-	-	-	2.5	0.9
yellow-brown	-	5.3	1.5	4.3	5.3	-	5.7	0.5
yellow-green	-	-	2.9	-	2.6	4.2	6.3	1.4
light-green	7.2	-	0.5	4.3	2.6	-	5.0	7.4
colourless	33.6	10.5	3.9	21.7	6.1	12.5	14.5	29.3
blue-green	58.6	63.2	86.8	43.5	46.5	79.2	52.8	56.7
greenish-colourless	-	-	-	-	-	4.2	1.9	2.8
other-colours	-	21.1	-	-	8.8	-	1.3	-
no-colour-recorded	-	-	-	13.0	17.5	-	-	-
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

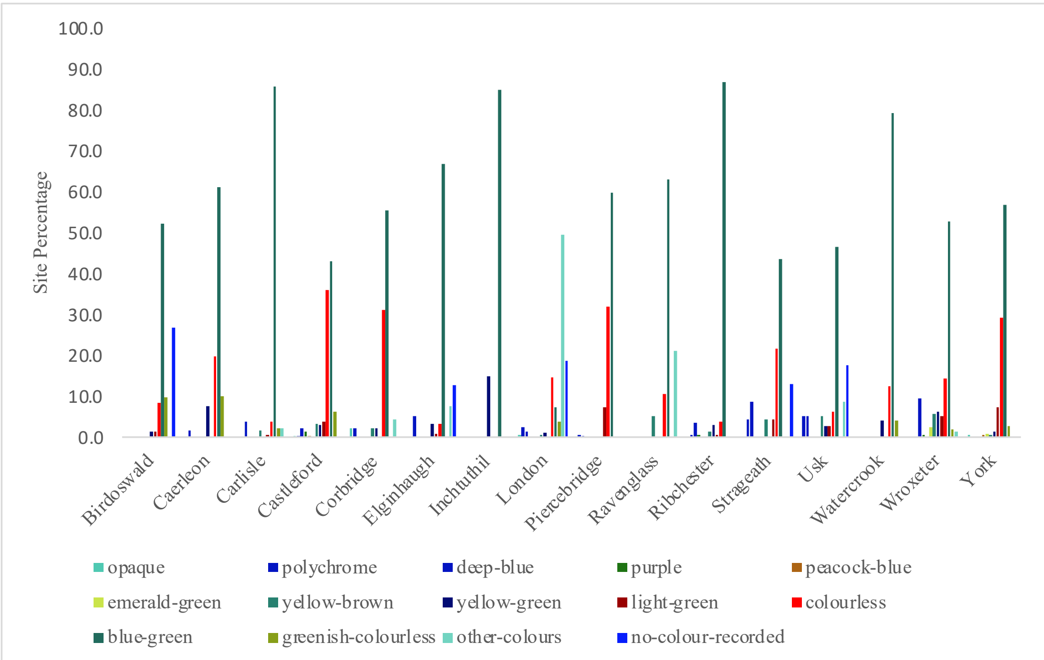


Figure 4.65 Military Sites Colour Percentage Composition Profiles

Table 4.63 Civil Sites Colour Percentage Composition Profiles (1)

Glass Colour	Colchester	Silchester	St Albans	Wroxeter	Catterick	Scotch Corner	Walton le Dale	Wilderspool
opaque	0.1	0.7	0.8	-	-	-	-	-
polychrome	2.0	4.7	0.5	-	0.5	3.3	-	-
deep-blue	1.5	2.0	4.4	-	1.5	9.8	-	-
purple	-	-	0.5	-	-	-	4.0	-
peacock-blue	0.1	-	-	-	-	-	-	-
emerald-green	1.1	0.7	1.6	-	-	1.6	-	-
yellow-brown	3.5	4.7	3.9	1.4	-	1.6	4	6.7
yellow-green	2.3	4.7	6.2	1.4	0.5	1.6	4	-
light-green	4.0	2.0	0.0	4.2	2.6	3.3	4	-
colourless	12.4	7.0	28.5	15.1	24.0	3.3	8	-
blue-green	68.6	59.7	33.7	63.0	61.2	73.8	40	66.7
greenish-colourless	2.7	1.0	15.8	7.4	-	-	-	-
other-colours	1.7	-	3.6	0.4	6.6	-	-	-
no-colour-recorded	-	13.0	0.5	7.0	3.1	1.6	36	26.7
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4.64 Civil Sites Colour Percentage Composition Profiles (2)

Glass Colour	Barton Court Farm	Frocester	Gorhambury	Piercebridge Villa	Gloucester	Stanway	Uley	Skeleton Green
opaque	-	-	-	-	-	5.6	-	-
polychrome	-	3.9	2.2	-	-	-	-	4.8
deep-blue	-	-	3.3	-	-	5.6	-	-
purple	-	-	-	-	-	-	-	9.5
peacock-blue	-	-	-	-	-	-	-	-
emerald-green	-	-	-	-	-	-	-	-
yellow-brown	-	-	7.6	-	-	27.8	-	-
yellow-green	76.9	-	2.2	-	-	-	13.0	4.8
light-green	-	17.6	2.2	-	-	-	8.7	-
colourless	7.7	27.5	29.3	78.6	-	-	34.8	47.6
blue-green	15.4	31.4	46.7	21.4	100.0	33.3	30.4	-
greenish-colourless	-	17.6	6.5	-	-	-	13.0	19.0
other-colours	-	-	-	-	-	27.8	-	4.8
no-colour-recorded	-	2.0	-	-	-	-	-	9.5
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

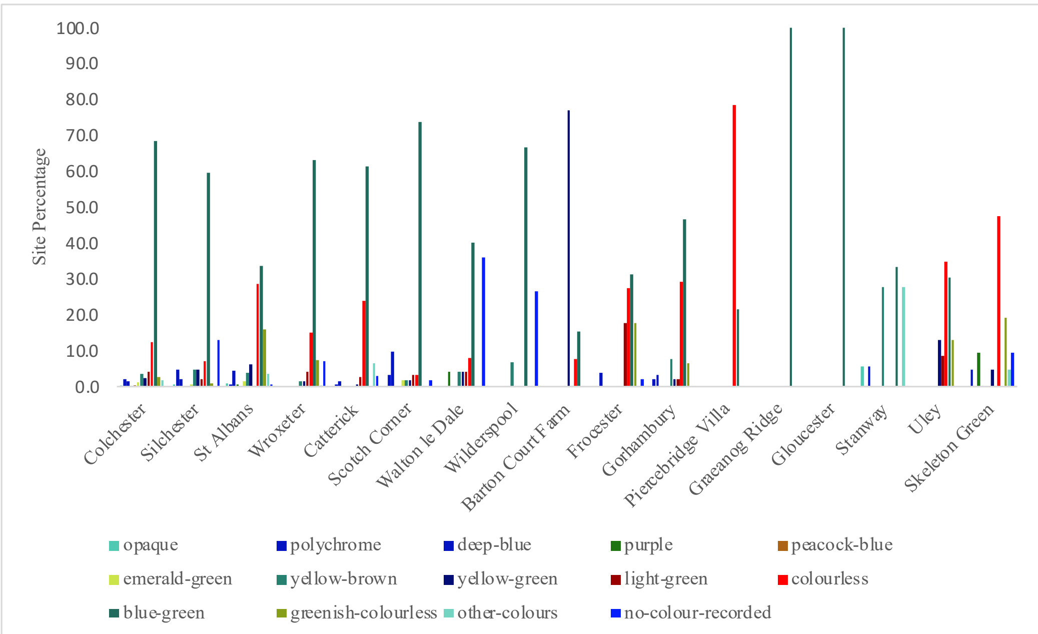


Figure 4.66 Civil Sites Colour Percentage Composition Profiles

The relevance of data reporting for subjective characteristics such as colour that can be affected by the thickness of the glass fragment has been debated by several academics (Cool and Price, 1995, p. 7; Perring and Pitts, 2013, p. 212). For comparison purposes, the glass colour categories used for Colchester were adopted as that site is the largest source of glass assemblages in Roman Britain (Cool and Price, 1995)

The first observation is the dominance of the blue-green, and colourless (including greenish-colourless) glass. The colour profiles of all the sites show a dominance of the natural blue-green for the forts that is typical of the first century CE. Bowls and bottles were common in the 1st century would explain the dominant blue-green colour across all the sites (Price and Cottam, 1998, p. 147). The colour green-blue is also reported in the 'natural glass colour' group for the London Basinghall Street, the Guildhall and the Cripplegate fort excavations without any record of blue-green. By substituting natural blue-green for green-blue, the London profiles are similar to other sites. The London Plantation Place fort excavation records included only blue-green as the 'natural glass colour'. Unfortunately, there is a high incidence of no-colour recorded for the tableware for the London Plantation Place excavation that limits any inference from the proportions.

The main colour for drinking vessels beakers and cups across the sites is colourless including greenish-colourless and light green, with also natural blue-green and deep blue colours reported. There was a higher proportion of colourless vessels for St Albans in proportion to natural blue-green of the Roman Britain corpus that is in contrast to the other sites. This is possibly due to the increased proportion of colourless vessels of beakers and bowls relative to the other large city sites. Colourless vessels were in evidence across a wide range of sites including forts in the north-west of England. The presence of colourless glass is seen even for low sample sizes and remote settlements as at Watercrook as a bowl and two unidentified vessel fragments show.

The profile for Inchtuthil is a snapshot of the late 1st century with no colourless glass as that was introduced from the later part of the 1st century mainly for drinking vessels. The blue-green natural glass colour is dominant at Scotch Corner from the pillar moulded bowls, whereas the proportion of colourless vessels at Catterick in the tableware vessels, does reflect the occupation of the site into the 2nd and 3rd centuries CE when colourless glass became more common (Cool and Price, 1995, pp. 211–220). These examples highlight that the colour of glass vessels could support the dating of those glass vessels based on deposition dating.

The colour emerald-green was reported in the Carlisle assemblage. The composition of emerald-green glasses was investigated by Jackson and Cottam (2015) with a suggestion that glasses of this colour were made with plant-ash rather than the common natron flux. In addition, while the examples were found to be of common vessel shapes and with no special craft distinguishing features, the authors suggested emerald-green glass could be a means to understand trading routes as the glass-working locations would not be common. In this case, the vessel type was not specifically confirmed as it was in the no-class group.

The profile for Frocester with light green as a significant main profile colour was from a bowl fragment and handled jug fragments. The high yellow-green colour percentage for Barton Court Farm was from tubular-rimmed bowl fragments that were significant on that site. These cases illustrate that the characteristic profile depends on several factors such as sample size, specialist reporting and the local material culture could have influenced the types and colours of glass vessels consumed.

In terms of colour, a grouped spectrum of the colour range can simplify the colour associations to glass types as shown in Table 4.65.

Table 4.65 Colour Groups

Strong-colours	**Light-colours**	**Colourless**	**Blue-green**	**Other colours**
opaque	yellow-brown	colourless	blue-green	black
polychrome	yellow-green	greenish-colourless		green
deep-blue	light-green			green-blue
purple				green-yellow
peacock-blue				blue
emerald-green				late-roman-green
				red
				turquoise
				white
				no-colour-recorded

Source: (Cool and Price, 1995)

The strong colours were mainly a 1st and early 2nd century palate of colours for vessels (Cool and Price, 1995, p. 10; Price and Cottam, 1998, p. 15). The light colours and colourless glass became more common from the early 2nd century particularly for drinking vessels, that as a glass type also became more dominant. Blue-green was the most common colour to produce glass vessels in the 1st–3rd centuries (Price and Cottam, 1998, pp. 14–16). Late Roman colours were seen more towards the 4th century that included the light colours of pale yellow-green and pale green shades.

Colour profiles were assessed as indications of the range of glass types for sites. The glass site colour group percentage profiles are shown for the military and civil sites in Figures 4.67 and 4.68. An example of military sites with defined occupation periods that support these chronological general trends include the Usk fortress that was operational 60-66CE and the Elginhaugh fort that was operational 78-88CE. Both sites had low colourless proportions relative to the other colours. However, the Carlisle, Ribchester and Ravenglass forts were operational into the 2nd century and also had low colourless proportions probably as all had high blue-green bottle compositions, a narrow range of glass types and low proportions of drinking vessels. Scotch Corner was an industrial centre that declined operationally in the 2nd century was another example of a low colourless profile but with relatively similar bottle and drinking vessel proportions. In the same area, both Catterick and Piercebridge had site compositions with significantly higher proportions of mainly 2nd and 3rd century colourless glass drinking vessels and tableware.

This complex relationship between colour and chronology is also illustrated with the light colour group, expected to be seen in 2nd century and later sites but seen in the evidence of the relatively short lived 1st century fortress sites of Usk and Wroxeter.

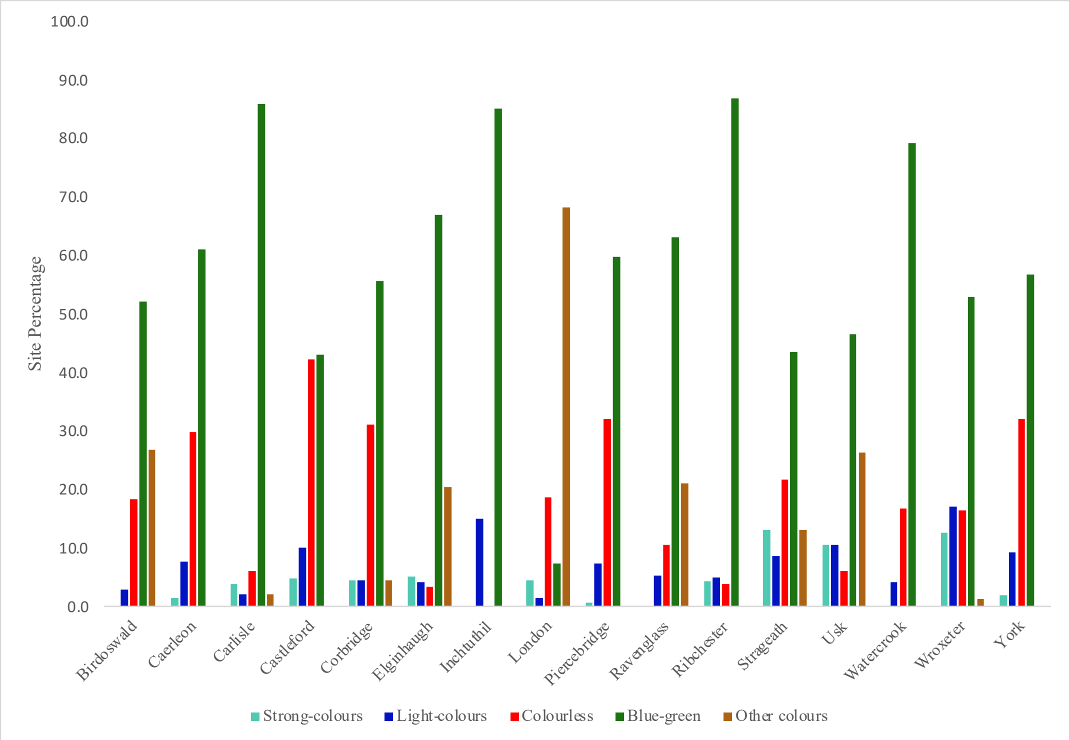


Figure 4.67 Military Sites Vessel Colour Group Percentage Counts

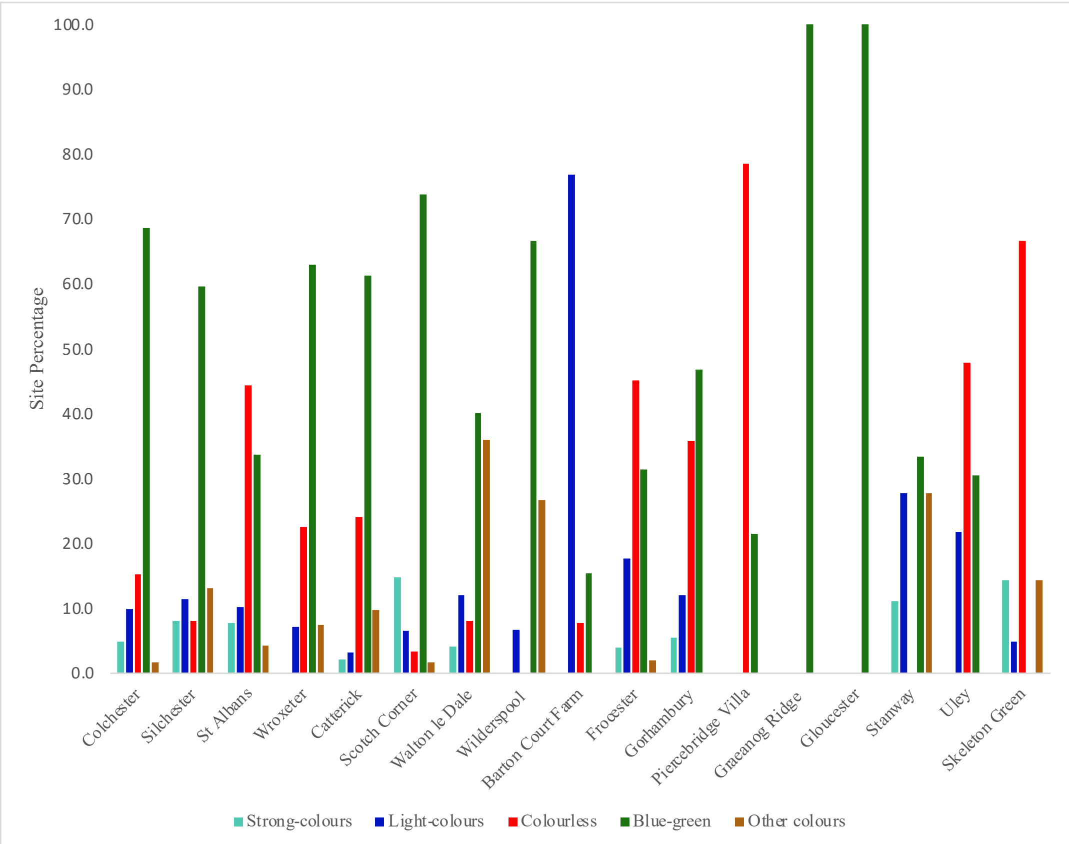


Figure 4.68 Civil Sites Vessel Colour Groups Percentage Counts

Patterns of difference between civil sites include more colourless than blue-green vessels at St Albans that probably are from the high proportion of beakers. This pattern for Castleford was mainly from cups, for Frocester from bowls, and with no single vessel type seemingly the contributing factor. The light colours that included predominantly yellow-green at Barton Court Farm were from a mix of tableware. This last example could reflect a consumer choice presuming choice was available or a local traded supply of a glass batch of vessels. The detailed colour groups percentage counts are presented in Tables 4.66 and 4.67 for the military and civil sites.

Table 4.66 Military Sites Vessel Colour Groups Site Percentages

Glass Colour	Strong-colours	Light-colours	Colourless	Blue-green	Other colours	Total %
Birdoswald	-	2.8	18.3	52.1	26.8	100.0
Caerleon	1.5	7.6	29.8	61.1	0.0	100.0
Carlisle	3.9	2.1	6.0	85.8	2.1	100.0
Castleford	4.8	10.0	42.2	43.0	-	100.0
Corbridge	4.4	4.4	31.1	55.6	4.4	100.0
Elginhaugh	5.1	4.2	3.4	66.9	20.3	100.0
Inchtuthil	-	15.0	-	85.0	-	100.0
London	4.4	1.5	18.6	7.4	68.1	100.0
Piercebridge	0.7	7.2	33.6	58.6	0.0	100.0
Ravenglass	-	5.3	10.5	63.2	21.1	100.0
Ribchester	4.4	4.9	3.9	86.8	-	100.0
Strageath	13.0	8.7	21.7	43.5	13.0	100.0
Usk	10.5	10.5	6.1	46.5	26.3	100.0
Watercrook	-	4.2	16.7	79.2	-	100.0
Wroxeter	12.6	17.0	16.4	52.8	1.3	100.0
York	1.9	9.3	32.1	56.7	-	100.0

Table 4.67 Civil Sites Vessel Colour Groups Site Percentages

Glass Colour	Strong-colours	Light-colours	Colourless	Blue-green	Other colours	Total %
Colchester	4.8	9.9	15.1	68.6	1.7	100.0
Silchester	8.0	11.3	8.0	59.7	13.0	100.0
St Albans	7.8	10.1	44.3	33.7	4.1	100.0
Wroxeter	-	7.0	22.5	63.0	7.4	100.0
Catterick	2.0	3.1	24.0	61.2	9.7	100.0
Scotch Corner	14.8	6.6	3.3	73.8	1.6	100.0
Walton le Dale	4.0	12.0	8.0	40.0	36.0	100.0
Wilderspool	-	6.7	-	66.7	26.7	100.0
Barton Court Farm	-	76.9	7.7	15.4	-	100.0
Frocester	3.9	17.6	45.1	31.4	2.0	100.0
Gorhambury	5.4	12.0	35.9	46.7	-	100.0
Piercebridge Villa	-	-	78.6	21.4	-	100.0
Graeanog Ridge	-	-	-	100.0	-	100.0
Gloucester	-	-	-	100.0	-	100.0
Stanway	11.1	27.8	-	33.3	27.8	100.0
Uley	-	21.7	47.8	30.4	-	100.0
Skeleton Green	14.3	4.8	66.7	-	14.3	100.0

The ‘missing’ strong colours could be expected for the forts Birdoswald, Ravenglass and Watercrook as they were all occupied in the 2nd century . The Inchtuthil fortress was the most northerly site and occupied just for a decade in the 1st century (81-88 CE) before being fully decommissioned. The absence of colourless glass also supports the short duration of the fortress as this option was not common in the 1st century and was associated mainly with drinking vessels – no evidence of drinking vessels was reported for Inchtuthil. A similar observation is made for Wilderspool. No strong coloured glass was reported for the large city Wroxeter that was developed from the end of the 1st century, with such glass found in the preceding fortress.

The glass vessels found in the shrine at Uley and the burial sites at Gloucester, Stanway and Skeleton Green would have represented objects of significance to the religious and burial traditions of the communities local to the area, rather than an indication of trade and consumption. The colour patterns of difference between these sites can all be associated with the vessel types. For example, in the Gloucester cemetery all the vessels were blue-green and were small container unguent bottles commonly seen in burials (Simmonds *et al*., 2008). The Stanway graves presented a more balanced colour profile with the presence of mainly unguent bottles and tableware with some drinking vessels, but no bottles (Crummy *et al.*, 2007). Bottles and jars were commonly used as urns in burials. The Skeleton Green cemetery assemblages included a high percentage of colourless vessels and the high proportion of tableware can be attributed to bowls (Partridge, 1981). The Uley shrine assemblages did not include evidence of unguents and was balanced across bottles, drinking and tableware that reflects the relatively balanced colour profile (Woodward and Leach, 1993).

These observations mean that colour will not be a differentiating indicator of site composition or regional distribution but could be an indication of the chronological lifetimes of settlements and possibly of community preferences, given the examples of St. Albans with a preference for colourless glass beakers and Barton Court Farm for yellow-brown glass.

4.6.3 Sites Vessel Marks and Decorations Profiles

Turning then to the characteristics of glass body base markings, the sites' observed markings are presented as Tables 4.68, 4.69 and Figures 4.69, 4.70 for the military and civil sites. The data represents vessel body and base markings as percentage of total marked vessel counts that is c. 30% of the overall vessel corpus. The main marking types are represented.

Table 4.68 Military Sites Vessel Markings Site Percentage

Glass % Marks	abraded-band	arcaded-band	circular-base-mouldings	engraved-lines	facets	indented	inscription	raised-rings	ribbed	wheel-cut-lines
Birdoswald	7.7	-	-	-	-	-	7.7	30.8	46.2	-
Caerleon	-	-	35.3	-	17.6	-	-	-	29.4	-
Carlisle	34.4	-	-	3.1	3.1	6.3	-	40.6	9.4	-
Castleford	-	-	19.4	-	20.4	3.1	-	-	2.0	55.1
Corbridge	14.3	-	23.8	4.8	9.5	4.8	4.8	-	9.5	23.8
Elginhaugh	-	-	18.2	-	13.6	4.5	-	-	59.1	4.5
Inchtuthil	-	-	14.3	-	-	-	-	-	71.4	14.3
London	-	5.6	-	-	5.6	-	-	-	16.7	44.4
Piercebridge	41.5	-	17.0	-	5.7	3.8	-	-	11.3	17.0
Ravenglass	33.3	-	33.3	-	-	-	-	-	33.3	-
Ribchester	3.5	1.2	16.5	-	7.1	1.2	-	21.2	44.7	3.5
Strageath	-	-	-	-	33.3	-	-	-	33.3	33.3
Usk	13.5	-	-	-	1.9	1.9	1.9	17.3	38.5	17.3
Watercrook	-	-	100.0	-	-	-	-	-	-	-
Wroxeter	2.0	0.7	3.3	-	7.9	1.3	-	-	22.4	10.5
York	15.4	-	8.5	0.9	6.0	3.4	0.9	0.9	27.4	24.8

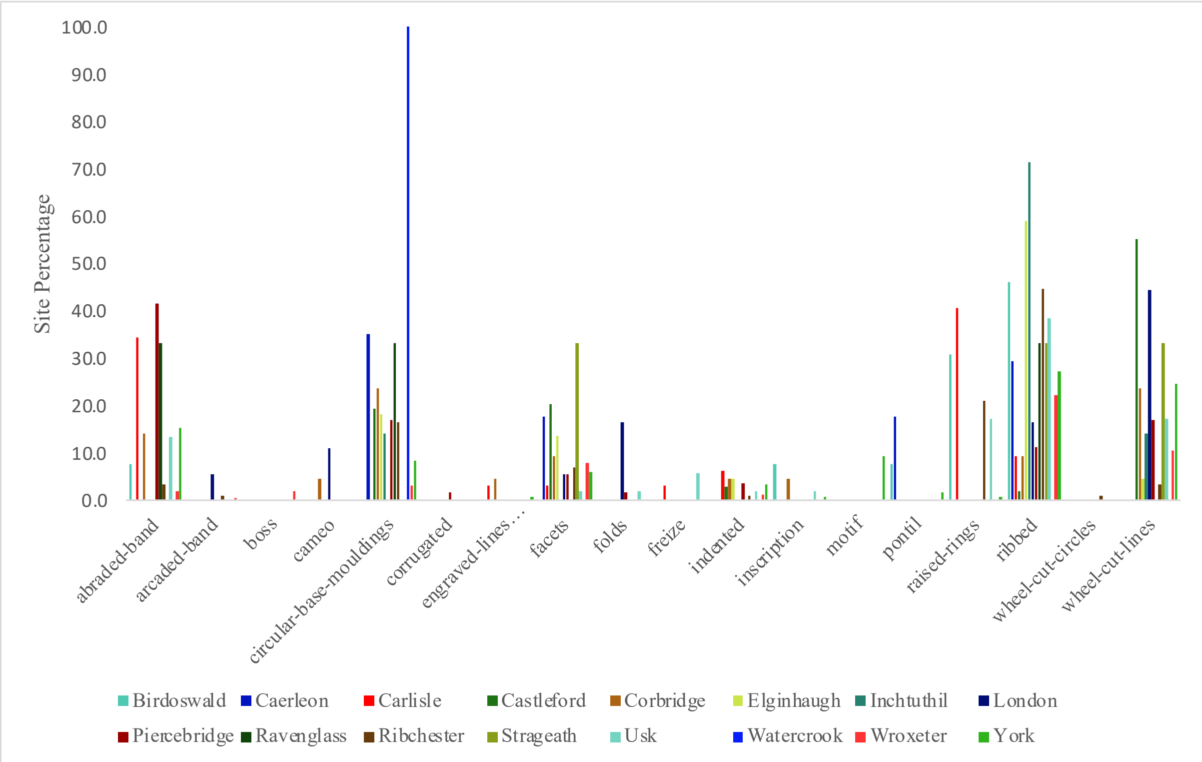


Figure 4.69 Military Sites Vessel Body Base Markings Site Percentage Counts

Table 4.69 Civil Sites Vessel Markings Site Percentage

Glass % Marks	abraded-band	arcaded-band	circular-base-mouldings	engraved-lines	facets	indented	inscription	raised-rings	ribbed	wheel-cut-lines
Colchester	16.8	0.2	12.1	0.2	3.8	4.0	0.9	-	29.1	25.6
Silchester	6.3	-	14.3	-	1.6	1.6	1.6	-	54.0	17.5
St Albans	4.9	-	7.6	0.7	14.6	2.8	3.5	0.7	34.7	27.1
Wroxeter	10.0	-	30.0	-	6.7	3.3	-	-	33.3	13.3
Catterick	25.0	-	40.0	-	7.5	2.5	7.5	-	7.5	10.0
Scotch Corner	33.3	-	-	-	6.7	-	-	-	40.0	20.0
Walton le Dale	-	-	-	-	40.0	40.0	-	-	20.0	-
Wilderspool	-	-	-	-	-	-	-	-	-	-
Barton Court Farm	20.0	-	-	-	20.0	20.0	-	-	20.0	20.0
Frocester	38.1	-	4.8	-	14.3	-	-	-	28.6	14.3
Gorhambury	8.0	-	16.0	-	16.0	-	4.0	-	8.0	12.0
Piercebridge Villa	-	-	-	-	-	-	-	-	-	-
Graeanog Ridge	-	-	-	-	-	-	-	-	-	-
Gloucester	-	-	-	-	-	-	-	-	-	-
Stanway	-	-	-	-	-	-	-	-	-	-
Uley	33.3	-	-	-	-	-	-	-	-	-
Skeleton Green	-	-	22.2	-	11.1	-	-	-	-	66.7

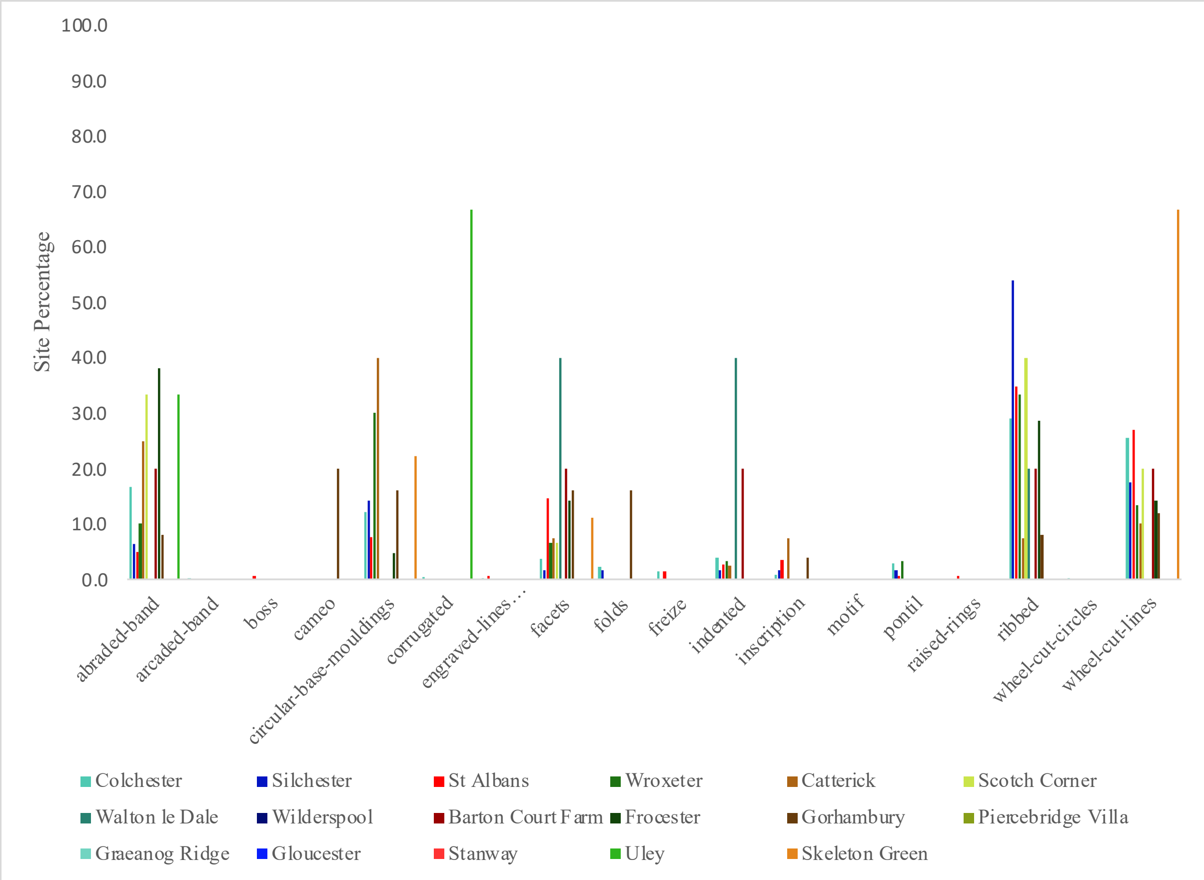


Figure 4.70 Civil Sites Vessel Body Base Markings Site Percentage Counts

The markings patterns are broadly similar for both the civil and military sites with common markings such as circular base-markings, facets, indents and ribbed as features of the design of the vessel and made during the glass-working process when the vessel was hot, usually based on the mould design for glass blown vessels. The sites with high proportional ranges of marked vessels include the Usk and York fortress sites, the Corbridge, Ribchester, Carlisle and Piercebridge forts, all the large cities, Catterick and Gorhambury.

The vessel class and markings associations are shown in Table 4.70 and Figure 4.71. These show circular base marks with bottle type, wheel-cut lines with drinking vessels, and ribbed tableware. The circular base-markings are commonly seen on the base of bottles as manufacturer marks (Price and Cottam, 1998, p. 30). Ribbed vessels are commonly bowls made as cast or blown vessels with also drinking vessels showing signs of ribs. The abraded bands and wheel-cut lines were made after the vessel had been annealed and was cold using cutting and engraving tools (Price and Cottam, 1998, p. 32). The markings are reported for *c.* 28% of the total assemblages and so were relatively common as design features of the vessels. Some would have been attractive visually and perhaps with a functional purpose, such as facets and indents on drinking vessels for users to hold the glass. Base markings on bottles as manufacturing trade marks are in fact still used on modern glass bottles.

Table 4.70 Glass Vessel Class Body Base Markings

Glass Class %	container-large	container-small	drinking	tableware	Romano-British %
abraded-band	1.2	-	9.6	2.3	13.1
circular-mouldings	12.5	-	0.1	0.2	12.8
facets	-	-	7.0	1.0	8.0
folds	-	-	0.1	1.0	1.1
indented	0.1	0.2	1.8	1.0	3.1
inscription	0.8	-	0.1	0.3	1.2
pontil	0.4	0.3	0.6	0.9	2.2
raised-rings	2.9	-	0.1	0.0	3.0
ribbed	1.9	-	2.2	25.7	29.8
wheel-cut-lines	0.5	-	15.0	5.6	21.1
other-body-base-marks	1.4	0.1	2.3	0.8	4.6
	21.7	0.6	38.9	38.9	100.0

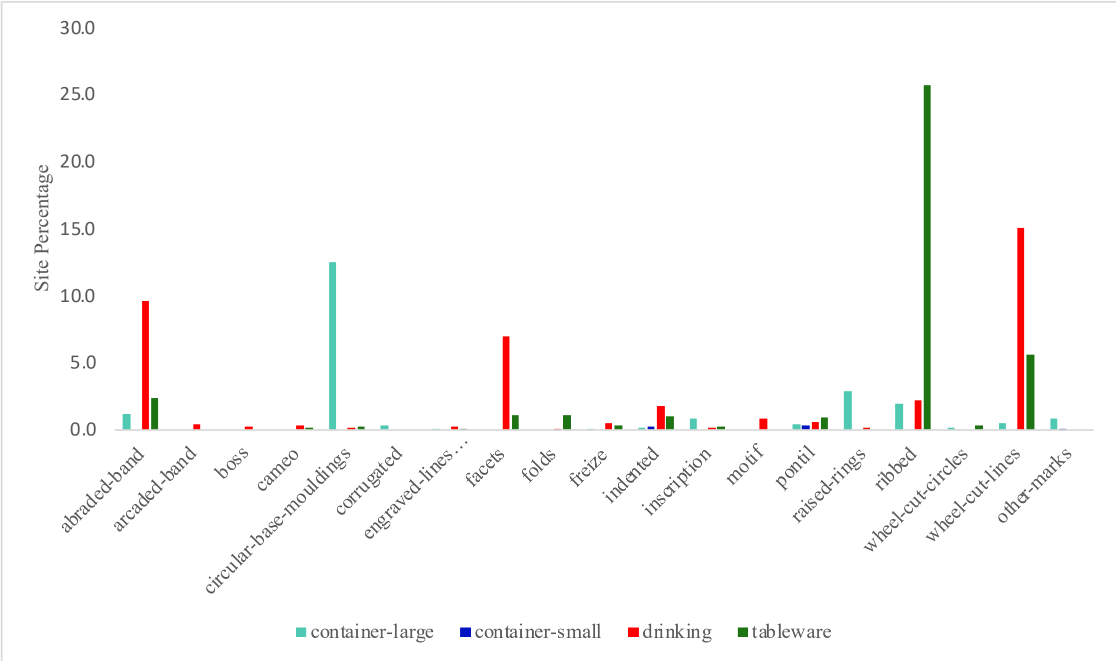


Figure 4.71 Glass Corpus Vessel Class Proportional Markings

The patterns of vessel markings appear to apply across the sites with the association more about vessel types than settlement type. It is unlikely therefore that these features will be an indicator of what vessels were used by the populations in the settlements.

Glass on glass decoration (i.e. trails and coloured streaks) may be an indicator of manufacturing practices that could have added value to vessels. To make such vessels involved additional skilled tasks performed at high temperature during the glass-working process with trailing, including applied trails and marvered trails, and coloured streaks the most common across the Roman Britain corpus.

The decorations as blobs, coloured streaks and trails were applied during either the hot forming or cold stages (Price and Cottam, 1998, pp. 30–37). The sites' decoration profiles are presented as Tables 4.71, 4.72 that have the trailing decorations highlighted and shown in Figures 4.72, 4.73. The glass vessel class decoration profiles are presented in Table 4.73.

Table 4.71 Military Sites Vessel Decorations Corpus Percentage

Glass Decor	applied-blob	applied-chip	applied-rods	applied-trail	col-streaks	marvered-trail	medallion	mosaic	moulding	painted	pinched-out	trailing
Birdoswald	-	-	-	100.0	-	-	-	-	-	-	-	-
Caerleon	-	-	-	-	-	-	-	-	-	-	-	100.0
Carlisle	-	-	-	100.0	-	-	-	-	-	-	-	-
Castleford	-	-	-	-	-	-	-	-	-	-	-	100.0
Corbridge	25.0	-	-	-	-	-	-	-	-	-	-	75.0
Elginhaugh	-	-	-	-	100.0	-	-	-	-	-	-	-
Inchtuthil	-	-	-	-	33.3	-	-	-	-	-	-	66.7
London	-	-	-	-	-	16.7	-	16.7	-	-	-	66.7
Piercebridge	18.4	-	-	73.7	2.6	-	-	-	-	2.6	2.6	-
Ravenglass	-	-	-	-	-	-	-	100.0	-	-	-	-
Ribchester	-	5.3	-	-	84.2	-	-	-	-	-	-	10.5
Strageath	-	-	-	-	-	-	-	-	-	-	-	-
Usk	66.7	-	-	33.3	-	-	-	-	-	-	-	-
Watercrook	-	-	-	-	-	-	-	-	-	-	-	-
Wroxeter	-	-	-	-	22.2	66.7	-	11.1	-	-	-	-
York	-	-	-	-	-	-	-	-	-	-	-	100.0

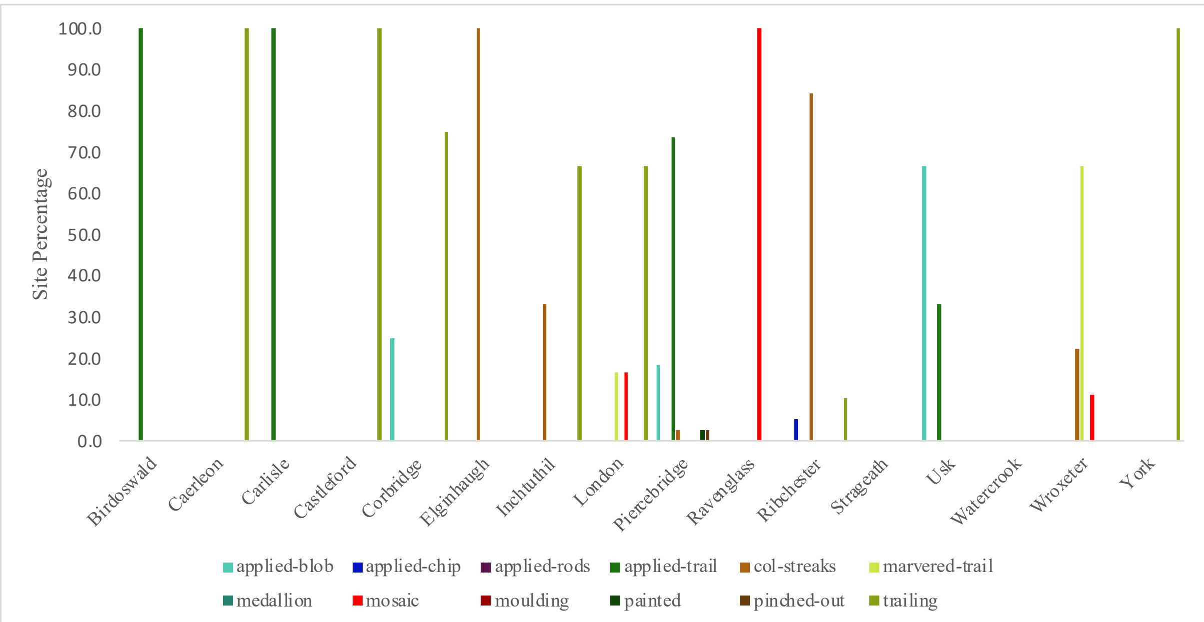


Figure 4.72 Military Sites Vessel Decorations Percentage Counts Profiles

Table 4.72 Civil Sites Vessel Decorations Corpus Percentage

Glass Decor	applied-blob	applied-chip	applied-rods	applied-trail	col-streaks	marvered-trail	medallion	mosaic	moulding	painted	pinched-out	trailing
Colchester	4.2	-	4.2	35.4	-	10.4	4.2	8.3	-	-	14.6	18.8
Silchester	20.0	-	6.7	-	13.3	13.3	-	-	-	-	-	46.7
St Albans	-	-	-	-	4.2	4.2	-	33.3	-	-	-	58.3
Wroxeter	-	-	-	-	-	-	-	-	-	-	-	100.0
Catterick	-	-	-	-	-	-	-	-	-	-	-	100.0
Scotch Corner	-	-	-	-	-	-	-	-	-	-	-	-
Walton le Dale	-	-	-	-	-	-	-	-	-	-	-	100.0
Wilderspool	-	-	-	-	-	-	-	-	-	-	-	-
Barton Court Farm	-	-	-	-	-	-	-	-	-	-	-	100.0
Frocester	14.3	-	-	-	14.3	-	-	14.3	-	-	-	57.1
Gorhambury	-	-	-	-	-	-	-	66.7	-	-	-	33.3
Piercebridge Villa	-	-	-	-	-	-	-	-	-	-	-	-
Graeanog Ridge	-	-	-	-	-	-	-	-	-	-	-	-
Gloucester	-	-	-	-	-	-	-	-	-	-	-	-
Stanway	-	-	-	100.0	-	-	-	-	-	-	-	-
Uley	-	-	-	100.0	-	-	-	-	-	-	-	-
Skeleton Green	-	-	-	-	-	-	-	-	-	-	-	-

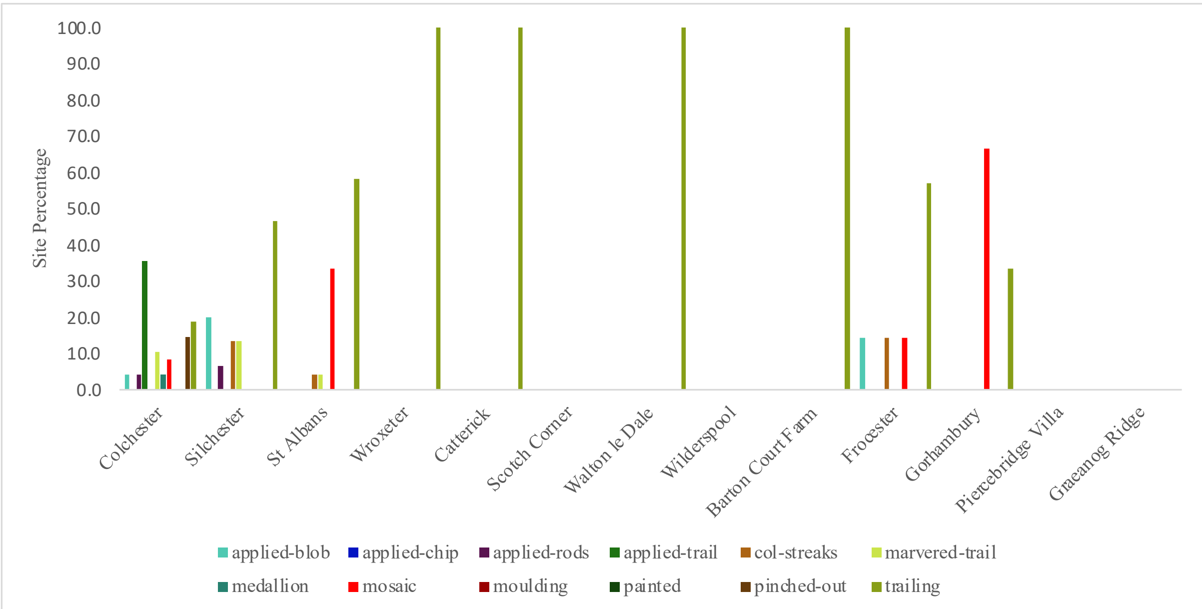


Figure 4.73 Civil Sites Vessel Decorations Percentage Counts Profiles

Table 4.73 Glass Vessel Class Decoration

Glass Class %	container-large	container-small	drinking	tableware	Romano-British %
applied-blob	-	-	3.3	3.3	6.6
applied-chip	-	-	-	0.4	0.4
applied-rods	-	-	-	1.2	1.2
applied-trail	0.4	-	12.9	10.0	23.2
col-streaks	6.2	-	0.4	5.0	11.6
marvered-trail	-	-	-	5.8	5.8
medallion	-	-	-	0.8	0.8
mosaic	0.4	-	-	7.1	7.5
moulding	-	-	-	-	-
painted	-	-	0.4	-	0.4
pinched-out	-	-	2.9	0.4	3.3
trailing	0.8	-	10.8	27.4	39.0
Total % decor counts	7.9	-	30.7	61.4	100.0

The decorations are *c.* 5.6% of the total corpus counts and so are a relatively small proportion of the total assemblage. Decorations may not have been visible on the rim, base or handle fragments and so more vessels might have had decoration than we can observe. The main glass on glass decoration technique from the records was trailing hot glass onto the hot vessel during the vessel forming stage. This type of decoration was 68% of the decorated vessels, mainly on tableware, and found on the majority of the military and civil sites. Horizontal or spiral trails were known on a range of vessels made during the 2nd-4th century CE with many common decorations and some quite elaborate called 'snake-thread' decorations that are considered to have been made in Cologne (Harden *et al.*, 1987, p. 107; Price and Cottam, 1998, p. 32).

Exceptional decorations could have been seen as luxury glass vessels. This includes mosaic and painted decoration that are discussed as follows with examples shown in Figure 4.92.

Mosaic decorated vessels have been registered from several civil sites in this study, including the large cities Colchester, Wroxeter and St Albans, the villas at Frocester and Gorhambury and London Basinghall Street (Frere, 1972, 1984; Neal *et al*, 1990; Cool and Price, 1995; Webster and Chadderton, 2002; Wardle, 2015a). The mosaic finds included an emerald-green cast millefiori bowl at Gorhambury with unusual decoration. The other mosaic vessel at Gorhambury was a colourless cast bowl with opaque yellow marks. The finds at St. Albans included mosaic vessels that were made using the millefiori technique. The mosaic at Frocester was a purplish brown bowl with opaque marks of several colours. A mosaic fragment found at Ravenglass was a dark blue glass fragment, possibly from a polychrome mosaic bowl dating to the early Flavian period (Hunter-Mann, 2015). The other military site with evidence of mosaic glass was the Castleford fort with a polychrome floral bowl found in the *vicus* and dated mid 2nd century (Cool and Philo, 1998).

While the percentage of vessels with decoration is small, painted glass vessels are extremely rare and there is an example found at Caerleon, of a fragment of a painted colourless cup. The only other painted fragments were found at Colchester and Piercebridge, all in the 2nd to 3rd centuries. All these techniques are carried out during glass-working and require time, materials and skill in the glass-working process by the ancient craft workers.

These are examples of vessels made by specialist crafts skills. Polychrome mosaic vessel glass was distributed widely across the Mediterranean central and western regions in the main as convex cast bowls produced by glass-workers of the central region (Cool and Price, 1995, p. 14). The trade of the mosaic glass was influenced by fashion and the popularity of imitations of luxury precious stone tableware (Fleming, 1999, p. 22). It is unlikely that the costs to produce were more than for other similar tableware glass forms given the established glass-working experience established since the mid 1st century BCE. In the mid 1st century CE, the fashion changed to colourless vessels and is an explanation why they are not common in Britain (Cool, 1996; Cottam, 2019, p. 350).

Based on this evidence, it is unlikely that glass decoration is going to be a reliable indicator of consumer choice as decoration styles appear to have been distributed across the regions with no apparent boundary restrictions.

4.7 Glass Vessel Dimensions Data

4.7.1 Context

The recorded dimensions of glass fragments collected from excavations were evaluated for settlement type patterns. The glass material records of dimensions can include the weight of the fragment, and the dimensions of the fragment (present height) with estimated dimensions of the original vessel rim diameter (RD), the body width (BW), the base diameter (BD) and the glass wall thickness (WT). These details, together with the archaeological context of deposition site and the chronology dating of the glass deposition, are usually detailed in the reported excavation catalogue accession lines. The rim diameter and body width dimensions are the basis of the data used in this research.

The reported accession line data of vessel dimensions was not complete for every site accession line. Comparative trend analysis across sites, using moving average or best fit techniques, can have reliability issues with sample data sizes of less than ten, particularly also if the variability of the data is high as the selected sample data sets could have been biased. The analysis principles are set out in the Appendix 4. In summary, for each of the site data set graphs, there is a scatter plot of the sample points, a moving average curve and a best fit line. The moving average curve shown is calculated to show a smoothed line that highlights the possible outliers. The trend line is the best fit linear line that could fit all the data points and in the graphs is highlighted in red. The coefficient of variability is the standard deviation divided by the mean. The standard deviation is represented by the moving average distance range and the mean by the best fit line. It is a measure of the variability of the data in relation to the mean. The coefficients of variation (cv) are noted on each graph with the higher numbers the greater the variability and a cv less than 1.0 is considered to be low variance. More details of this measurement technique are provided in the Appendix 4.

By focussing on the data sets with more than 10 samples, the trend from the variance of the moving average relative to the best fit line is more likely to be representative and so only sites with sufficient rim diameters or body widths data were evaluated as stand-alone sites.

A variance of rim diameters could be expected as the formation of the rim was a manual process carried out by the glass worker for all vessels. The body width dimensions for glass mould-blown vessels would have been to a closer tolerance to the glass workers moulds. A variance for this dimension therefore suggests different moulds and possibly different glass-working centres. The following details are the drinking vessel and tableware dimensions profiles, followed by the containers as bottles and unguent bottles.

4.7.2 Drinking Vessel and Tableware Dimensions

The dimensional analysis of the sites' drinking vessels and tableware is presented and discussed in the next section. The data sets are shown in Tables 4.74 and 4.75.

Table 4.74 Vessel Rim Dimensions Data Showing Best Fit Range and Scatter Range

Vessels	Sites	Rim Diameters (mm)				
		Best Fit Range		Scatter Range		Samples
Beakers	Colchester	60	80	29	110	40
	Wroxeter	78	115	70	130	8
	Corbridge	80	83	70	100	6
	Piercebridge	80	80	65	100	5
	Wroxeter (f)	75	80	70	90	7
	York	50	60	11	130	25
Cups	Catterick	65	100	28	110	13
	Colchester	80	80	33	120	36
	Castleford	80	98	60	120	30
	Piercebridge	70	108	17	140	44
	Wroxeter (f)	72	85	70	88	11
	York	30	60	13	90	14
Bowls	Catterick	85	125	75	127	8
	Colchester	140	160	50	230	95
	Silchester	125	145	110	140	16
	Castleford	150	200	125	225	15
	London	170	180	125	210	7
	Usk	150	170	125	180	10
	Wroxeter (f)	135	150	100	225	12
	York	150	200	150	210	7
Jars	Catterick	78	100	70	120	6
	Colchester	76	100	34	190	88
	Wroxeter	100	117	60	160	11
	Castleford	55	125	40	200	7
	Usk	100	100	80	130	5
	York	80	110	56	260	6
Bottles	Catterick	55	70	42	165	13
	Colchester	45	55	32	100	58
	Silchester					
	Wroxeter	55	60	40	75	8
	Castleford	42	77	35	125	9
	Elginhaugh					
	Ribchester	75	100	40	170	28
	York	45	60	21	105	15

Note: Wroxeter (f) is the fortress site

Table 4.75 Vessel Body Width Dimension Data Showing Best Fit Range and Scatter Range

Vessels	Sites	Body Widths (mm)				
		Best Fit Range		Scatter Range		Samples
Beakers	Colchester	40	40	17	90	30
	Wroxeter					
	Corbridge					
	Piercebridge					
	Wroxeter (f)					
	York	24	27	8	60	17
Cups	Catterick					
	Colchester	28	55	14	115	15
	Castleford					
	Piercebridge					
	Wroxeter (f)					
	York	15	22	9	46	9
Bowls	Catterick					
	Colchester	85	95	39	150	12
	Silchester					
	Castleford					
	London					
	Usk					
	Wroxeter (f)					
	York	80	88	80	90	4
Jars	Catterick					
	Colchester					
	Wroxeter					
	Castleford					
	Usk					
	York					
Bottles	Catterick					
	Colchester	60	90	30	115	16
	Silchester	130	200	80	235	9
	Wroxeter	75	100	40	150	11
	Castleford					
	Elginhaugh	110	150	28	180	16
	Ribchester	50	200	40	260	23
	York	40	95	15	150	14

Note: Wroxeter (f) is the fortress site

The following Figures 4.74 and 4.75 show the sample variations for the beaker rim diameters and Figures 4.76 and 4.77 the body widths for the Colchester city and the York fortress sites.

The other sites sample sizes were less than 20 and are presented as combined graphs in Figures 4.77 and 4.78. Each of the graphs 'site sample number' represents the individual accession line record where the dimensions were recorded and as such the order is not relevant.

Figure 4.74 Colchester Beakers Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv = 0.3)

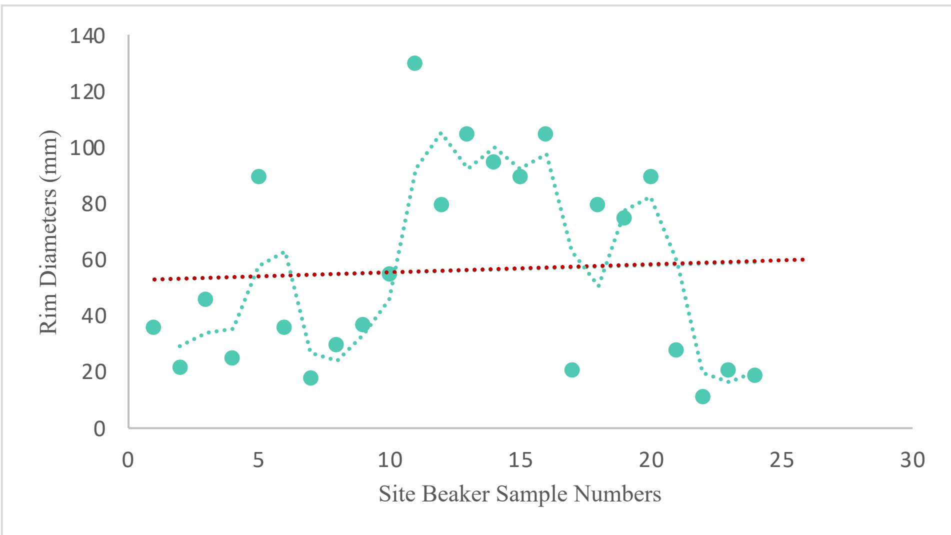


Figure 4.75 York Fortress Beakers Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv = 0.6)

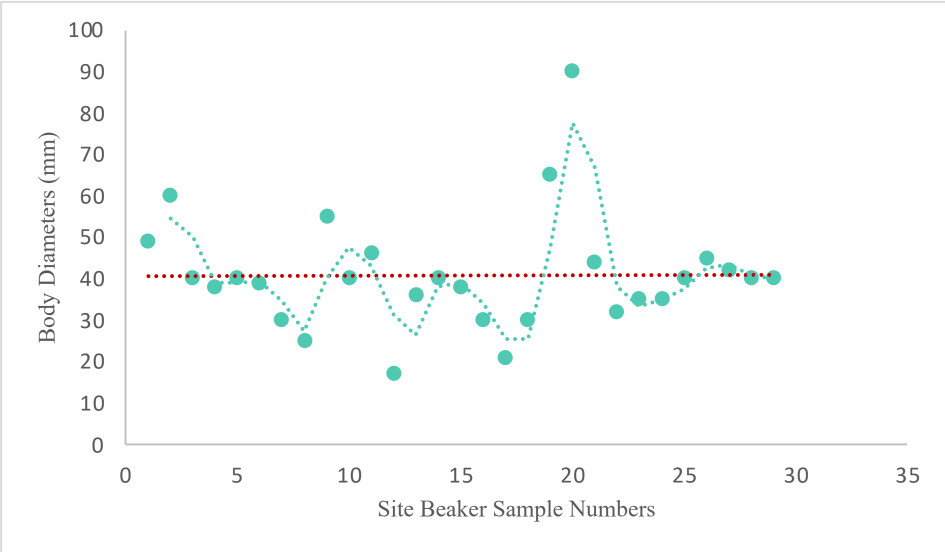


Figure 4.76 Colchester Beakers Body Width Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv = 0.3)

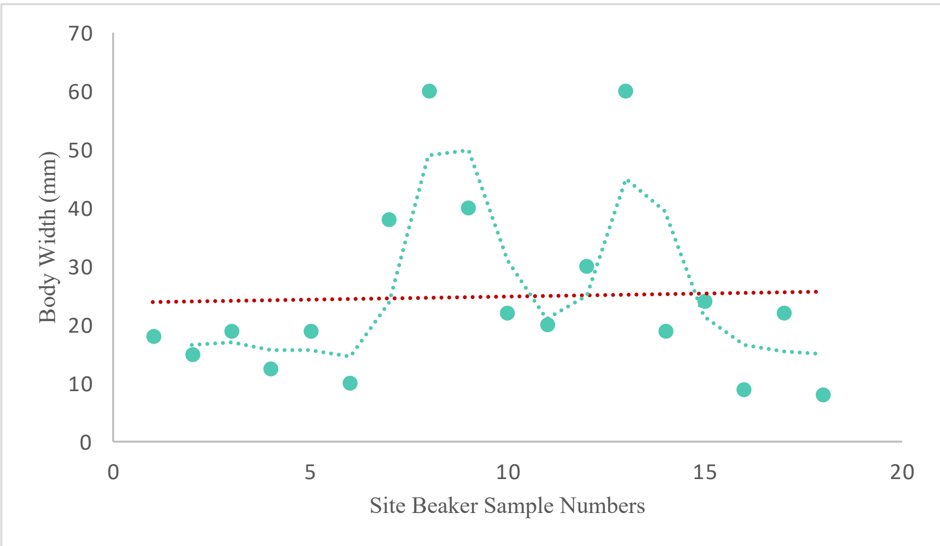


Figure 4.77 York Fortress Beakers Body Width Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv = 0.6)

The indented beaker has a range of rim diameters c 65-90mm (Price and Cottam, 1998, p. 85). There were four samples of indented beakers recovered from Colchester, three samples in the range 70-90mm dated 1^{st}-2^{nd} centuries, and one sample with a rim diameter 40mm dated 61-225CE. The inference from the data for Colchester is that most of the beakers fit the beaker range of dimensions and that again there is no observable change in the production of beakers over two centuries. Images of beakers referred to in this study are shown in Figure 4.78.

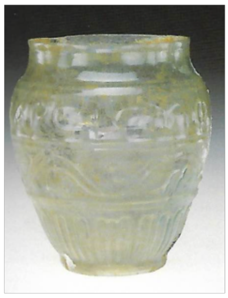
Beaker with foot-ring – 1st-2nd century CE

(Whitehouse 1997, p. 228)

Conical Faceted Beaker, 1st century CE

(Harden 1987, p. 192)

Beaker with inscriptions 1st century CE



(Whitehouse 2001, p. 25)

Beaker (*Calathus*) – 1st-2nd century CE

(Whitehouse 1997, p. 226)

Indented Beaker – 1st century CE

(Whitehouse 1997, p. 111)

Abraded Beaker – 1st – 2nd century CE

(Whitehouse 1997, p. 227)

Figure 4.78 Images of Catalogued Beaker Forms
Sources: (Harden *et al.*, 1987; Whitehouse, 1997, 2001)

The more common fragment vessel parts recovered for drinking vessels are the vessel rims. The best fit line for the beakers from Colchester has a rim diameter range *c.* 60-80mm (Figure 4.74). The sample's variation is shown by the distance of the moving average curve from the best fit line. The moving average distance range for the Colchester rim diameters is c 38-100mm with *c.* 80% of the curve 60-100mm. This is comparable with the range of measurements of catalogued the common conical beakers as *c.* 65-110mm (Price and Cottam, 1998, p. 80). For Colchester, the first 25 samples were dated to the 1st and 2nd centuries CE and the last 15 samples dated to the 3rd and 4th centuries. There is not a noticeable difference in the rim diameter variations between these dated groups for Colchester indicating no observable change in the glass-working products over four centuries in terms of the rim dimensions (Figure 4.74). Assuming this degree of variability of catalogued vessel dimensions means that differences in excavated vessel dimensions outside of these ranges could be an indication of a different vessel form.

The best fit line for the beakers from the York fortress has a rim diameter range c 50-60mm (Figure 4.75). The moving average distance range for the York rim diameters is c 20-100mm with c 80% of the curve 40-100mm for the sample size of 24. There were two samples of indented beakers recovered from York with rim diameters 30 (160-280CE) and 60mm (100-160CE). Given the moving average ranges, these rim diameter results for York suggest the presence of smaller vessels to those from Colchester. The beaker body width graphs for Colchester and York (Figures 4.76, 4.77) show the data representing the glass body parts. These show similar variability to the rim graphs based on similar ranges of the coefficients of variability and with the best fit for York smaller than for Colchester. This needs a larger data sample to be a reliable indication.

By presenting all the sites data in Figures 4.79 and 4.80, the variability of the dimensions for body width and rim diameters can be seen for all the sites data as combined graphs combined graphs including the large and small beaker size types based on the best fit ranges and the catalogued guidance (Price and Cottam, 1998). Based on catalogued vessel rim diameter and body width ranges, the trends show the same variability across all the sites.

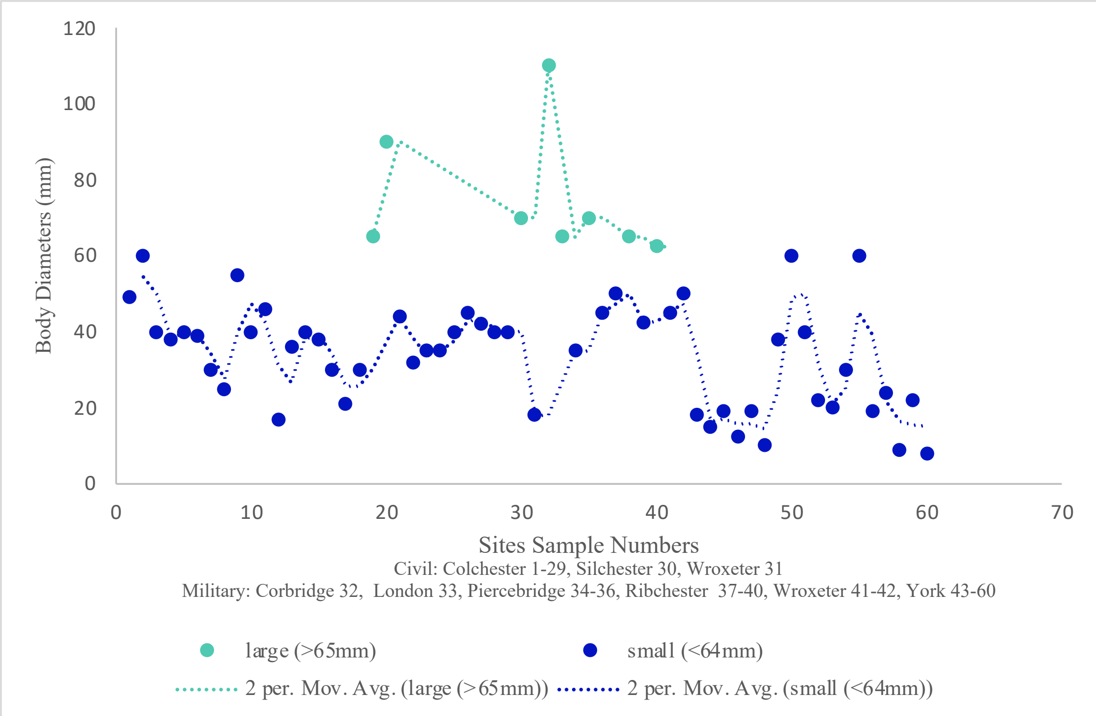


Figure 4.79 Sites Beakers Body Widths for Large (>65mm) and Small (<64mm)

(Graphical Moving Average and Best-Fit Data Trend Shown.)

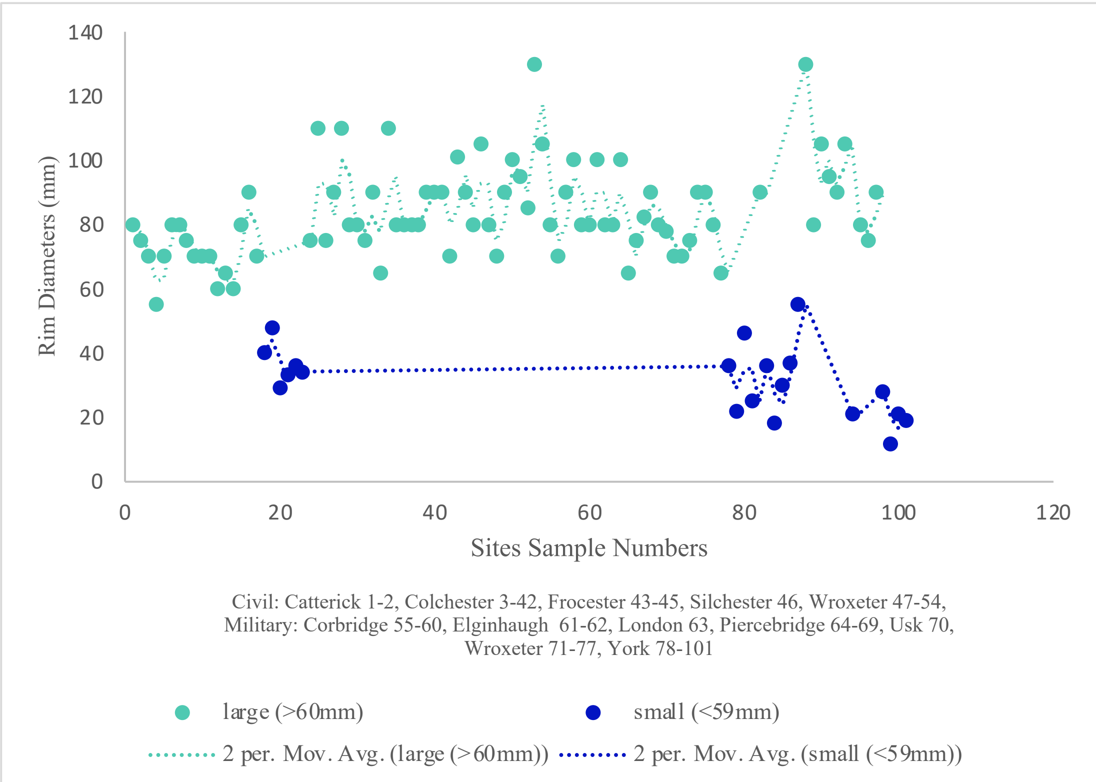


Figure 4.80 Sites Beakers Rim Diameters for Large (>60mm) and Small (<59mm)

(Graphical Moving Average and Best-Fit Data Trend Shown.)

The smaller beaker rim diameter vessels are seen at Colchester (6 from 39 samples) and at the York fortress (14 from 23 samples). This could be an indication of smaller beakers at York and that they were present at Colchester but probably not in any significant numbers. The body width combined measures show similar high variability to the rim measurements but with no significant differences in size of beaker revealed. The rim dimensions for beakers are assumed to be the defining differentiating measure. These beaker vessels would have been made as blown glass vessels.

The following graphs (Figures 4.81, 4.82 and 4.83) show the sample variations for cups rim diameters for Colchester, Castleford and Piercebridge that have site sample sizes above 20.

Figure 4.81 Colchester Cups Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv = 0.2)

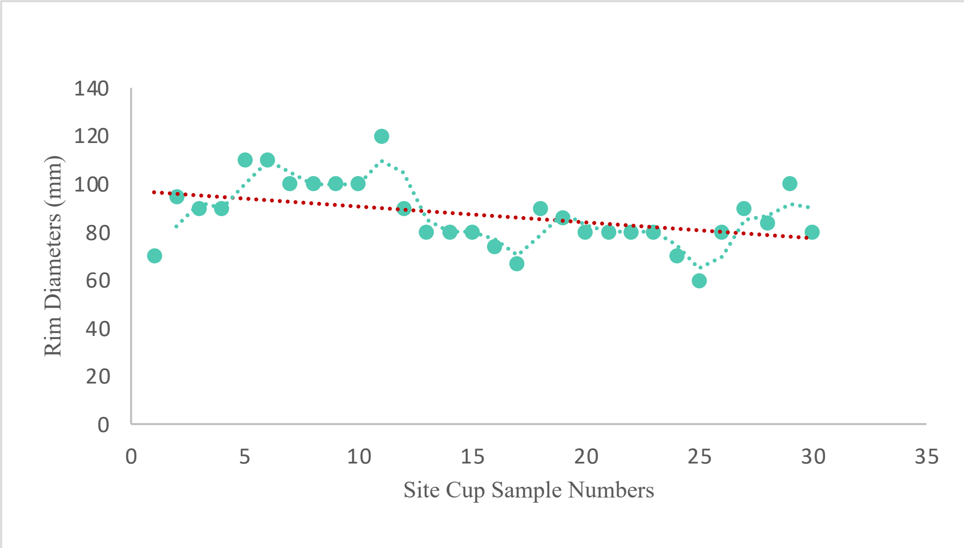


Figure 4.82 Castleford Fort Cups Rim Diameters of each Site Sample Record (Graphical Moving Average and Best-Fit Data Trend Shown). Cv = 0.2)

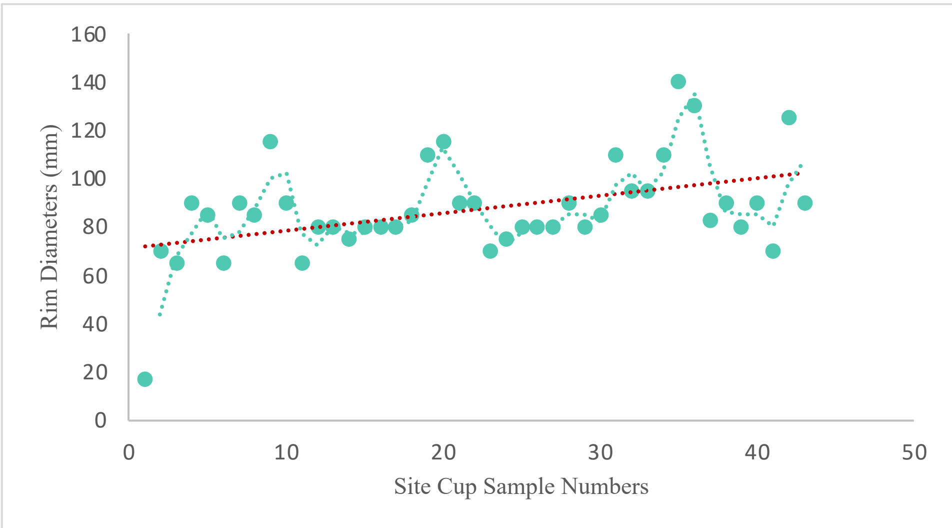


Figure 4.83 Piercebridge Fort Cups Rim Diameters of each Site Sample Record (Graphical Moving Average and Best-Fit Data Trend Shown. Cv = 0.2)

The best fit line for the cups from Colchester has a rim diameter of c 80mm for the 36 samples. The samples' variation is shown by the distance of the moving average curve from the best fit line. The moving average distance range for the Colchester rim diameters is c 33-120mm with c 80% of the curve 70-90mm. These dimensions are compatible with the catalogued range of measurements of the common cylindrical cup c 80-110mm (Price and Cottam, 1998, p. 99). Over 90% of the moving average rim diameter ranges for both the Castleford and Piercebridge forts rim diameters are c 70-110mm which are close to that of Colchester. In contrast, the moving average range for the York fortress is c 20-70mm for a sample size of 14. This is a significantly lower range for cups than for the previous sites.

The dated rim diameter ranges of the common cylindrical cup form for the Colchester and York fortress sites are shown in Table 4.76. Colchester had just cylindrical cups with rim diameters above 65mm, and York with mainly cup rim diameters less than 60mm. The data suggest that there is no observable pattern to the variation in the ranges of rim diameters over four centuries.

Table 4.76 Drinking Vessels: Cylindrical Cups Dated Rim Diameter Ranges

Site	Cylindrical Cups Rim Dia. (mm)	Date Range
Colchester (city)	65-75	1st - 4th century
	80-85	1st - 2nd century
	90	1st - 2nd century
	>100	2nd - 4th century
York (fortress)	18-55	1st - 3rd century
	70-80	2nd - 4th century
	90	2nd - 3rd century

Using the available data for other sites, the combined sites cup rim diameter and body width measurements are shown on Figures 4.84 and 4.85. There is the possibility from these graphs that there are two different cup size types with a smaller cup version with a rim diameter range *c.* 15-35 mm at the York fortress that could have been made and distributed locally.

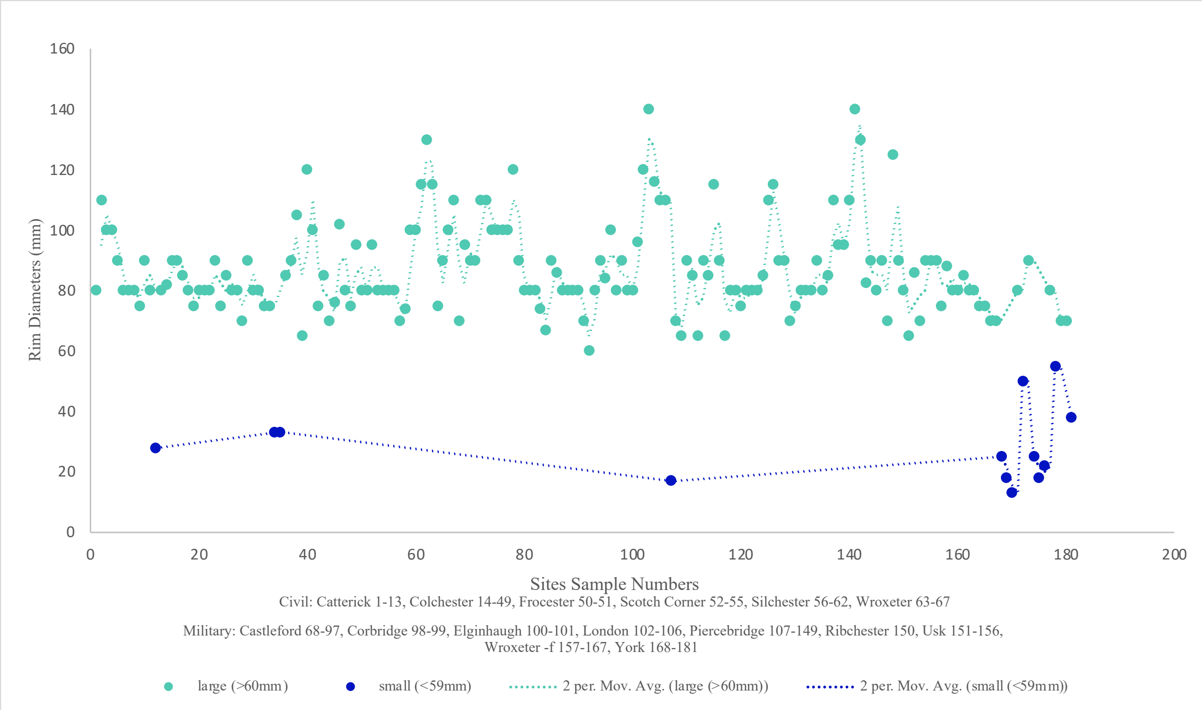


Figure 4.84 Sites Cup Rim Diameters for Large (>60mm) and Small (<59mm)

(Graphical Moving Average Data Trend Shown.

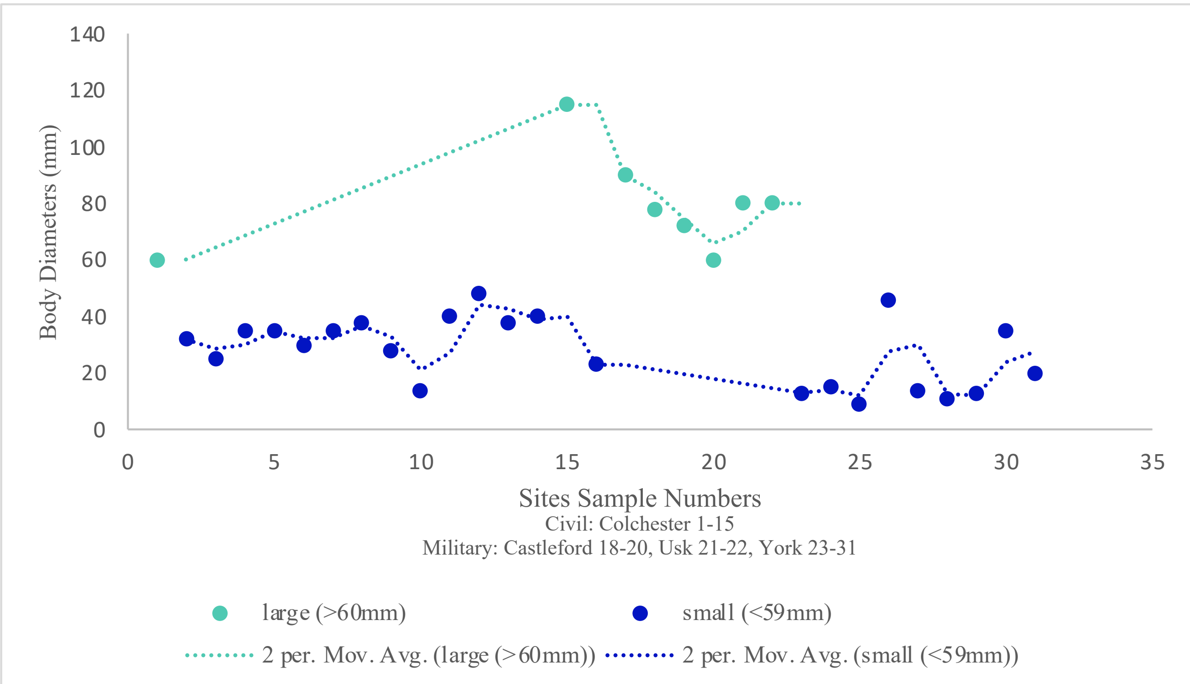


Figure 4.85 Sites Cup Body Widths for Large (>60mm) and Small (<59mm)

(Graphical Moving Average Data Trend Shown.)

Catalogue images of various cup forms are shown in Figure 4.86. The Hofheim cup is a recognised convex cup form with horizontal wheel-cut or abraded lines (Price and Cottam, 1998, p. 71).

Sports cup with gladiators – 1st century CE

(Whitehouse 2001, p. 61)

Modiolus cup, 1st century BCE - 1st century CE

(Whitehouse 1997, p. 230)

Cup with facets 1st century CE

(Harden 1987, p. 194)

Cantharus two-handled cup 1st century CE

(Harden 1987, p. 109)

Hofheim cup, 1st century CE

(Princetown University of Arts)

Conical cup 1st century CE

(Whitehouse 1997, p. 91)

Figure 4.86 Images of Catalogued Cup Forms

Sources: (Harden *et al*., 1987; Whitehouse, 1997; 2001)

The study samples were from Castleford, Colchester, London, Silchester and Wroxeter. The Colchester 16 samples rim diameter range was c 70-90mm and dated mainly to the 1st and 2nd centuries; the Castleford single sample was 70mm dated 150-200CE. These are very consistent measurements and although the data sets are small, they are comparable with the catalogued Hofheim cup rim diameter range of 60-80mm (Price and Cottam, 1998, p. 71).

The trends in drinking vessels' shape and decorations have been noted previously that included the common markings as abraded bands, wheel-cut lines, facets and the change from strong colours to colourless glass on the increase during and after 2nd century CE. The broad consistency of these changes over the centuries and across locations is an indication that people had similar drinking vessel preferences, or that was the available range of products, with the exception of the York fortress noted.

These examples reinforce the hypothesis that drinking vessels, beakers and cups, were made in glass workshops as standard products with variable rim sizes based on glass workers' production variability and traded into the marketplaces of cities and military bases without any supply preferences to regions or consumers. The York exception if reliable could have been of glass-working local to York. There were glass-working residues found at the York fortress including the example described as a "trail with pincer marks at expanded end" that suggests a vessel. There are also examples of glass-working residues found at the Carlisle and Ravenglass forts and the presence of glass-working will be discussed later.

The following graphs (Figures 4.87, 4.88, 4.89 and 4.90) show the sample variations for tableware bowl rim diameters for those sites with sample sizes above 10. The best fit line for the bowls from Colchester has a rim diameter range of c 140-160mm for the 97 samples. The sample's variation is shown by the distance of the moving average curve from the best fit line. The moving average distance range for the Colchester rim diameters is c 50-230mm with c 80% of the curve 100-225mm. This is a wide range of measured rim diameters based on the distance from the best fit line.

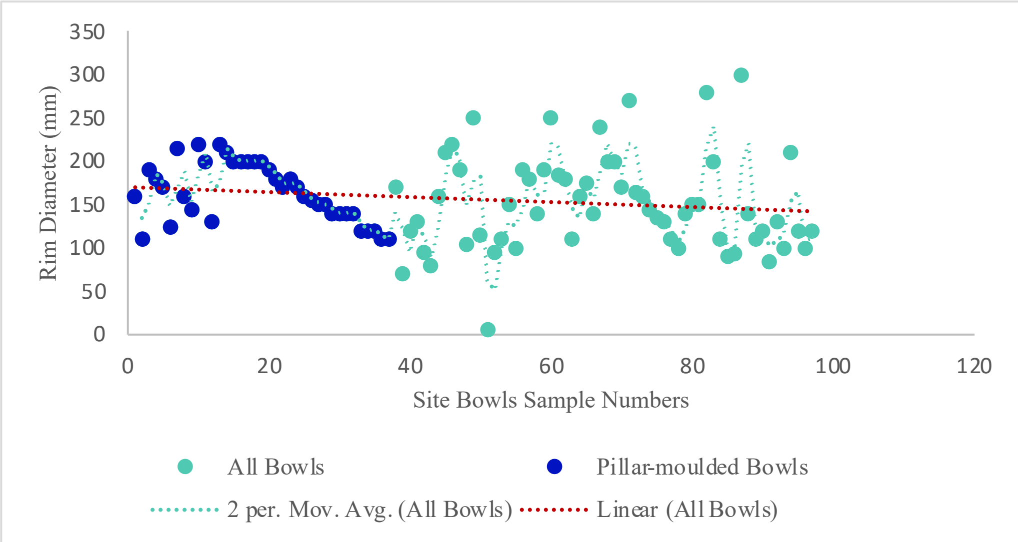


Figure 4.87 Colchester Bowls Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.3. Blue points are pillar-moulded bowls)

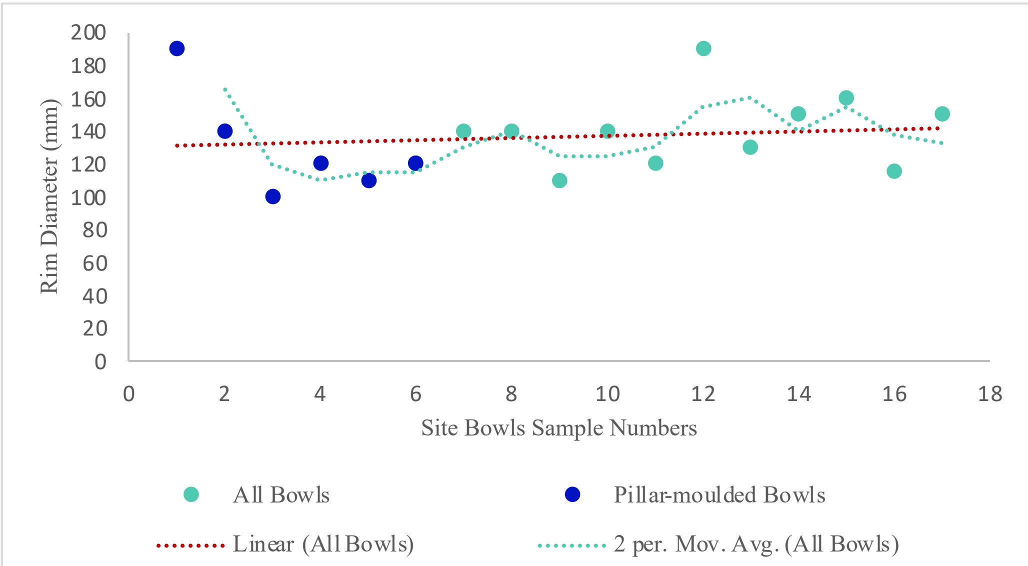


Figure 4.88 Silchester Bowls Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.2. Blue points are pillar-moulded bowls)

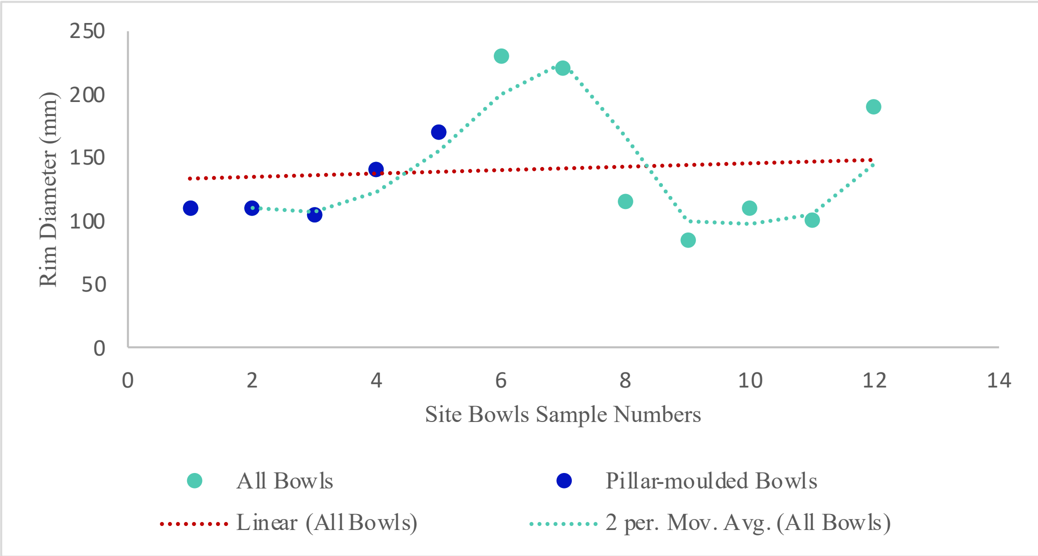


Figure 4.89 Wroxeter Fortress Bowls Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.4. Blue points are pillar-moulded bowls)

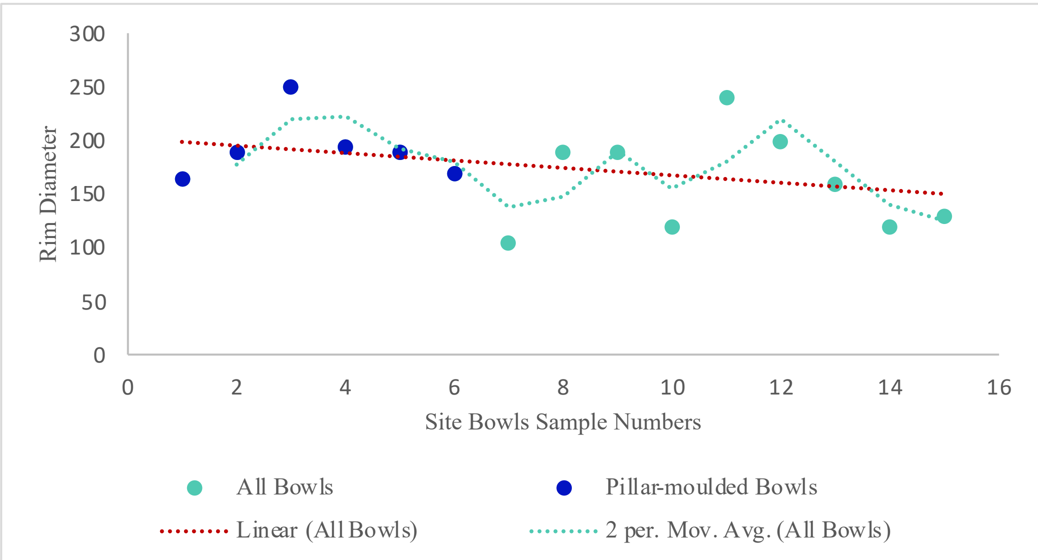


Figure 4.90 Castleford Fort Bowls Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv 0.2. Blue points are pillar-moulded bowls)

The common pillar moulded bowl is recorded as the first 37 samples of Colchester (Figure 4.87). There is no observable difference in the moving average curve between the two bowl type groups. The pillar-moulded bowl was a common cast made bowl in the 1st century with catalogue range of rim diameters c 100-220+mm (Price and Cottam, 1998, p. 44). The study sample measurements match this catalogue range for this glass vessel type. The same pattern variance and trends are seen in the bowl graphs for Silchester, the Castleford fort and the Wroxeter fortress. The pillar-moulded cast bowl was succeeded after the 1st century CE by the blown glass cylindrical, ribbed, and tubular rimmed bowl forms that were of similar rim-range dimensions (Price and Cottam, 1998, pp. 50, 67, 77, 78). The similarity in the patterns of rim diameters across Roman Britain sites without any preferences to regions, civil or military consumers is an indication that the trade was based on a glass industry that produced similar products, with dimensional variations from manual working. As a comparison with Britain, the bowl rim size diameters for Pompeii are similar in range and variation as shown in Figure 4.91 (Cool, 2016). This is both an indication of the consistency in glass-working bowl design and the wide distribution of the bowl product across the Empire: Roman material culture was typically standardised (Fleming, 1999, p. 61).

Figure 4.91 Sites Bowls Rim Diameters – Silchester, Castleford, Usk, and fortress Wroxeter with Pompeii as a Comparison

(Graphical Moving Average and Best-Fit Data Trend Shown. Pompeii bowls shown as blue points)

Catalogued images of period bowls are shown in Figure 4.92.

Ribbed bowl – 1st century CE

(Whitehouse 2001, p. 202)

Bowl, 1st-2nd century CE

(Whitehouse 2003, p. 132)

Deep bowl, 4th century CE

(Harden 1987, p. 113)

Pillar-moulded bowl - 1st century CE

(Harden 1987, p. 52)

Mosaic pillar-moulded bowl - 1st century CE

(Harden 1987, p. 51)

Painted bowl, 1st century CE

(Harden 1987, p. 269)

Figure 4.92 Images of Catalogued Bowl Forms

Sources: (Harden *et al*., 1987; Whitehouse, 2001; 2003)

Another tableware type was the glass jar. These were similar vessels to the pottery jars that would have been used for cooking, except that the function of the glass jar was probably for storage as the glass would not have survived the heating process. They have been catalogued as several glass forms with a range of rim diameter sizes that for the most common forms of the convex jar are of sizes: *c.* 55-90mm, 80-130mm and the larger 140-200mm (Price and Cottam, 1998, pp. 137, 140, 143). The jar rim diameter graphs for Colchester and Wroxeter are shown as Figures 4.93 and 4.94.

Both sites show mainly jars with the smaller range of rim diameters. The shapes of 24% of the study jars had the characteristics of a convex jar with a collar rim and a rim diameter range of c 80-130mm (Price and Cottam, 1998, p. 137).

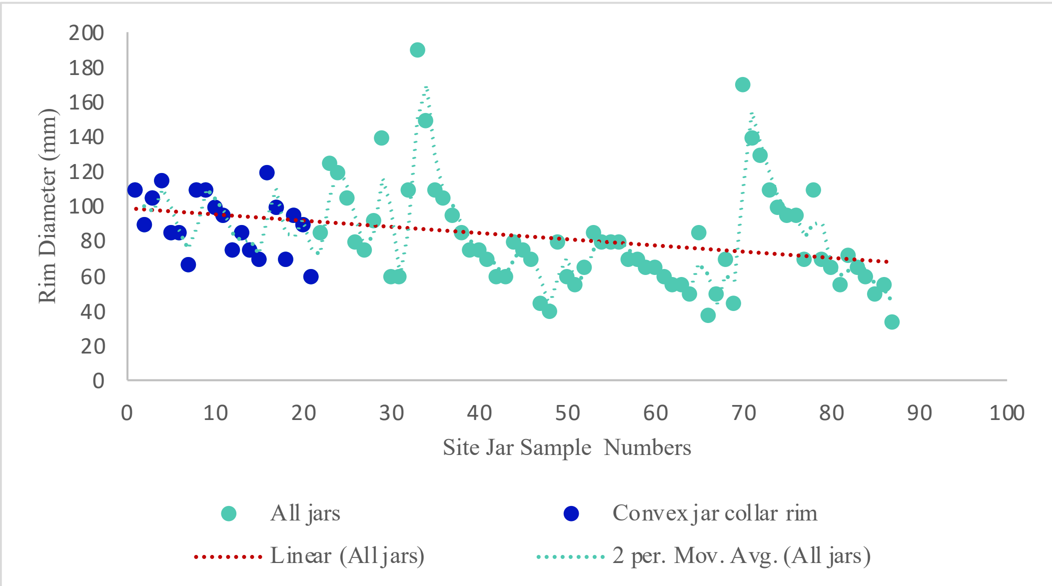


Figure 4.93 Colchester Jars Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.3. Blue points are convex collar rim jars)

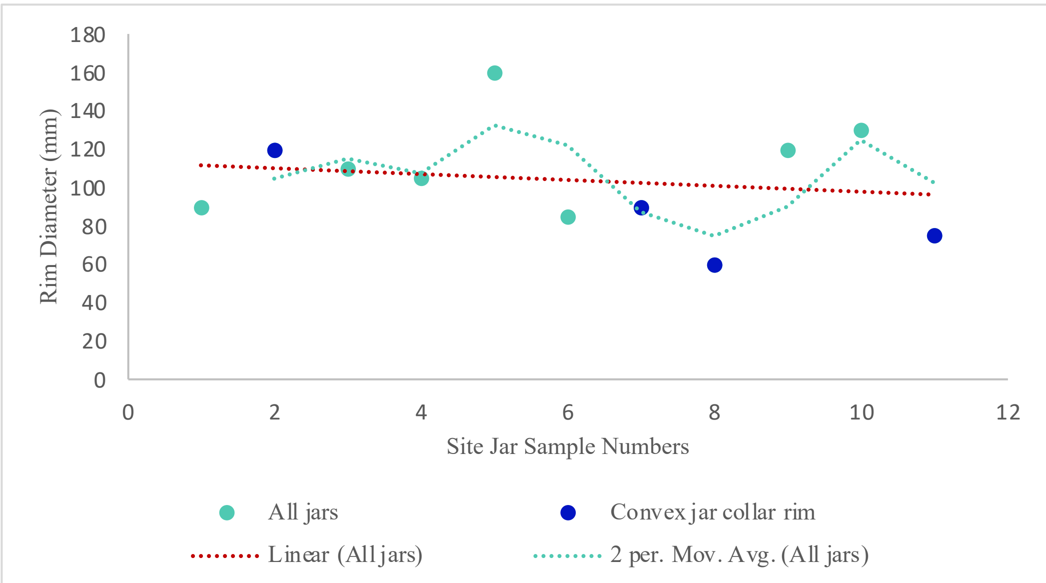


Figure 4.94 Wroxeter City Jars Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.3. Blue points are convex collar rim jars)

A combined graph of jar rim diameters from smaller sample sites that includes the small sample with rim measurements from Pompeii in Figure 4.95.

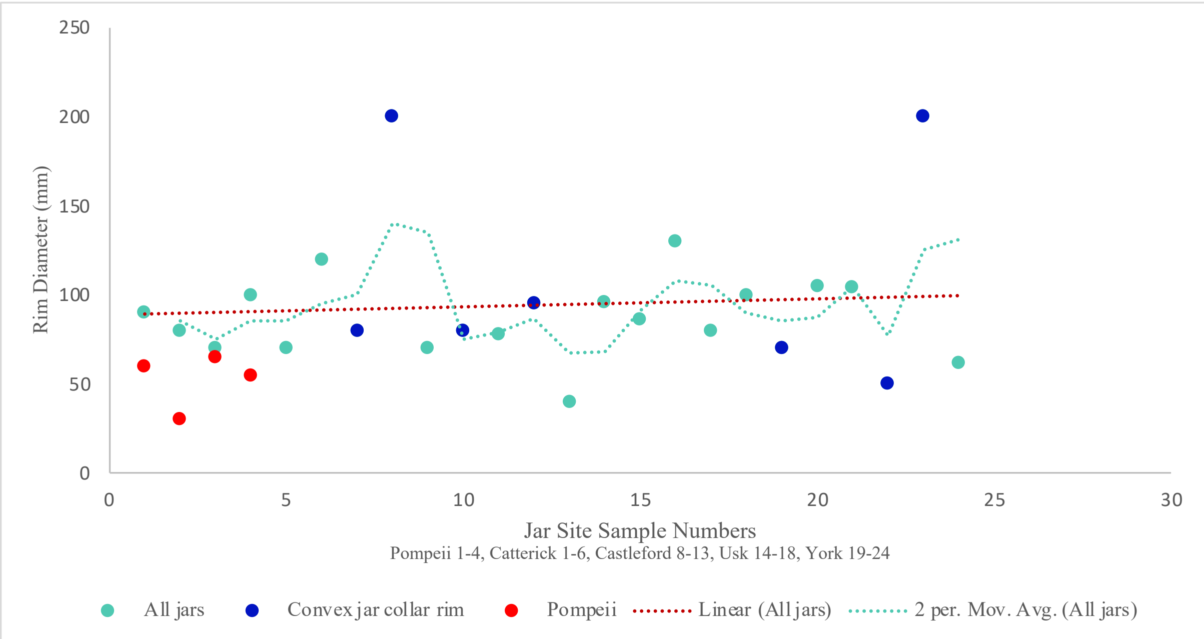


Figure 4.95 Jars Rim Diameters (Catterick, Castleford, Usk, York with Pompeii)

(Graphical Moving Average and Best-Fit Data Trend Shown. Convex collar rim jars as blue points)

These show the same broad range of rim diameters as the larger Romano-British sites. The combined graph of sites jars rim diameters are shown in Figure 4.96 that display the different sizes of rim diameters with very large (>130mm), large (80-130mmmm), and small (<79mm).

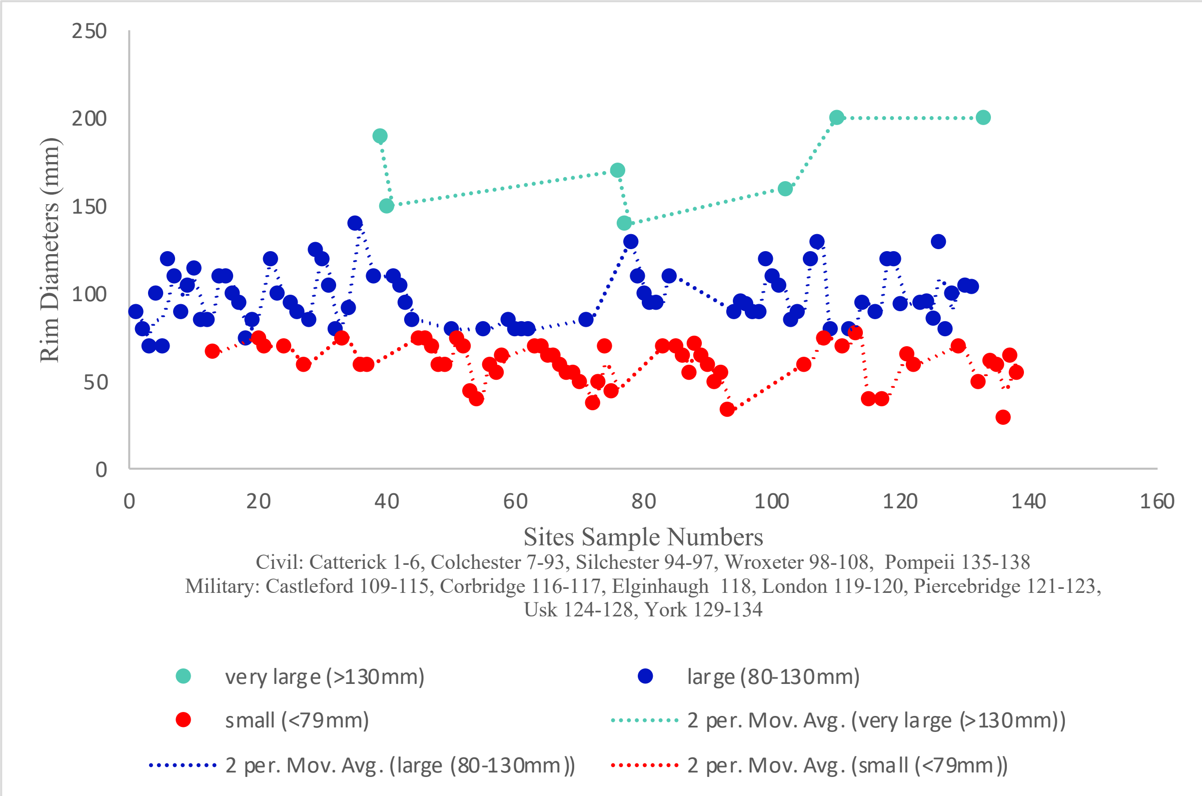


Figure 4.96 Sites Jars Rim Diameters for Very Large (>130mm), Large (80-130mm), and Small (<79mm)

(Graphical Moving Average and Best-Fit Data Trend Shown)

The similarity in the patterns of jar rim diameters and vessel size dimensions across these Roman city sites again suggests that the glass industry produced products similar sizes of jars. Catalogue images of jar vessel types are illustrated in Figure 4.97.

Globular Jar– 2nd – 3rd century CE

(Whitehouse 1997, p. 166)

Jar– 4th – 5th century CE

(Whitehouse 1997, p. 164)

Jar – 3rd - 4th century CE

(Whitehouse 1997, p. 166)

Jar – 3rd – 4th century CE

(Whitehouse 2001, p. 119)

Jar – 3rd – 4th century CE

(Whitehouse 2001, p. 159)

Globular (lopsided) jar – 3rd - 4th century CE

(Whitehouse 1997, p. 164)

Figure 4.97 Images of Catalogued Jar Forms

Source: (Whitehouse, 1997; 2001)

The final tableware vessel is the jug type. The jug data are presented in Figure 4.98 below as a combined sites' graph as the site data sample sizes were not sufficient as individual graphs and only the rim diameter dimensions were sufficient in number. There are catalogued jug forms in the rim diameter range 20-40mm (Price and Cottam, 1998, pp. 150, 152, 155, 165, 167) and in the range 40-70mm (Price and Cottam, 1998, pp. 147, 161, 163). These are consistent across the sites. The jug body heights would probably have been a more differentiating dimension, but no data was available.

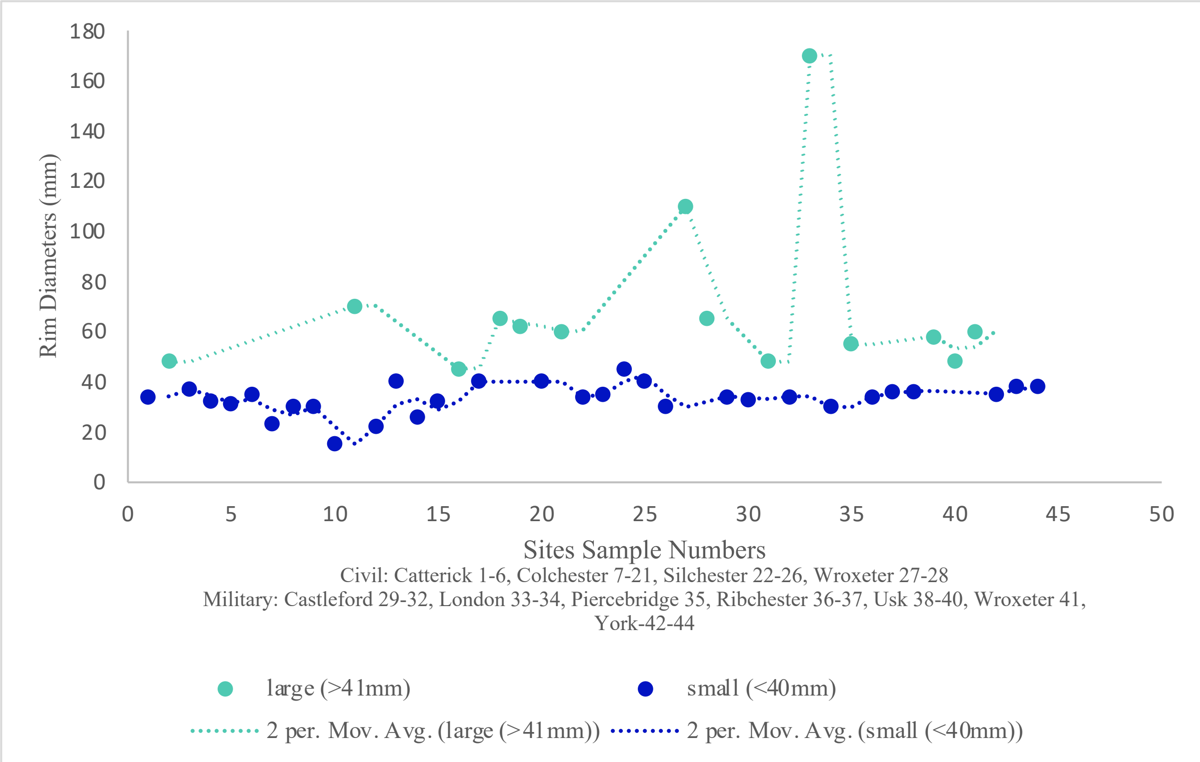


Figure 4.98 Jugs Rim Diameters (Catterick, Colchester, Silchester, Castleford, London, Piercebridge, Ribchester, Usk, Wroxeter-f and York)

(Graphical Moving Average Data Trend Shown)

Catalogue images of jug forms referenced in this study are shown in Figure 4.99.

Long necked jug– 1st century CE

(Harden 1987, p. 140)

Flagon jug– 4th century CE

(Whitehouse 1997, p. 260)

Amphorisk jug– 1st century CE

(Whitehouse 2001, p. 44)

Bell-shaped jug– 1st century CE

(Harden 1987, p. 141)

Ribbed jug– 3rd -4th century CE

(Harden 1987, p. 143)

Faceted jug– 1st century CE

(Harden 1987, p. 193)

Figure 4.99 Images of Catalogued Jug Forms

Sources: (Harden *et al.*, 1987; Whitehouse, 1997, 2001)

4.7.3 Containers

The large container bottle rim diameter graphs are presented in Figures 4.100, 4.101and 4.102 for Colchester, Ribchester and York; with the bottle body width dimensions presented in Figures 4.103, 4.104, 4.105, 4.106 and 4.107 for Colchester, Castleford, Elginhaugh, Ribchester, and York.

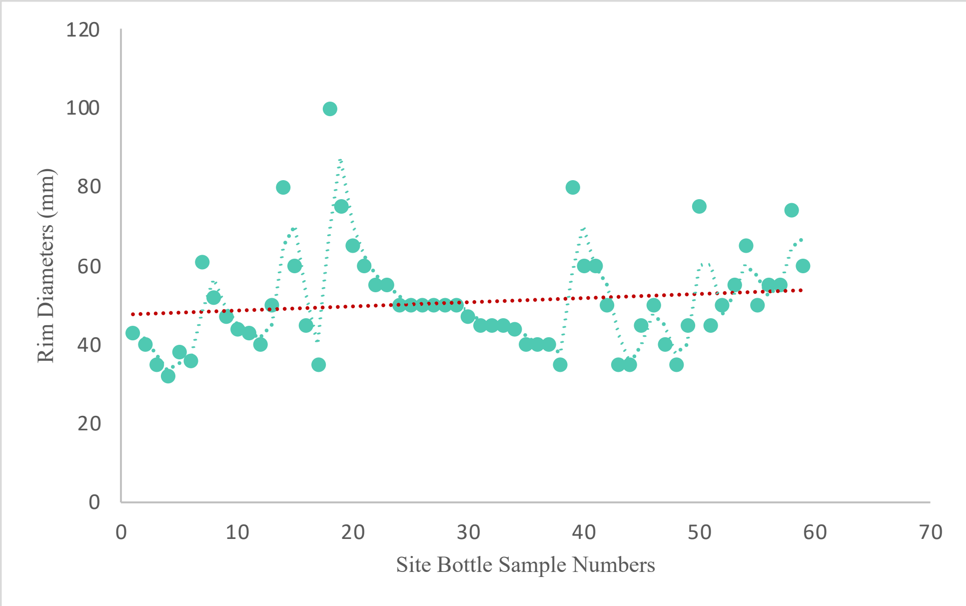


Figure 4.100 Colchester Bottles Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.3)

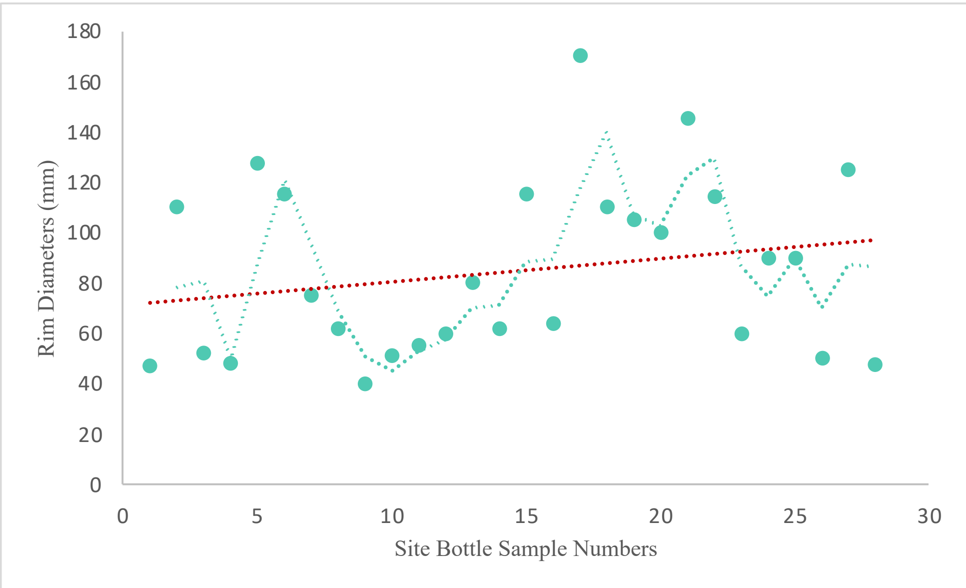


Figure 4.101 Ribchester Fort Bottles Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.4)

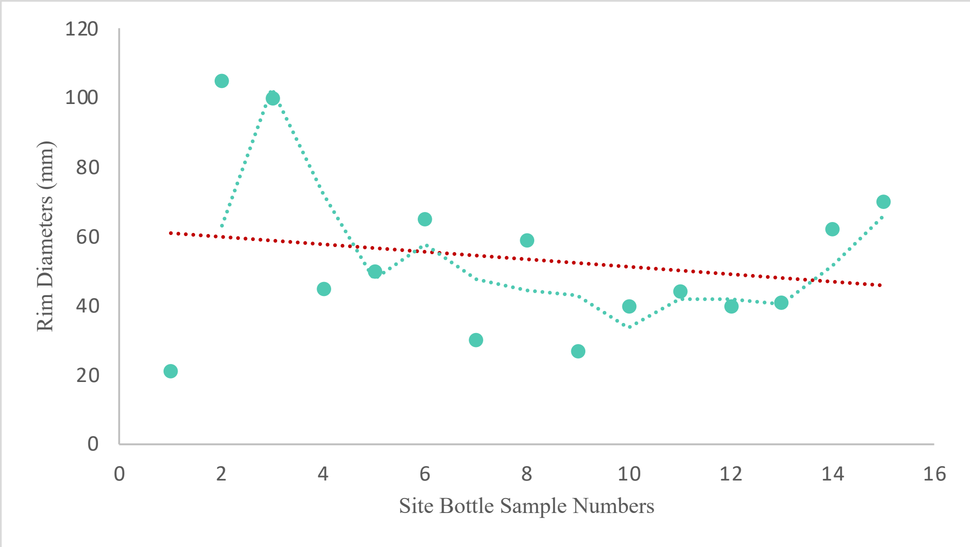


Figure 4.102 York Fortress Bottles Rim Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.5)

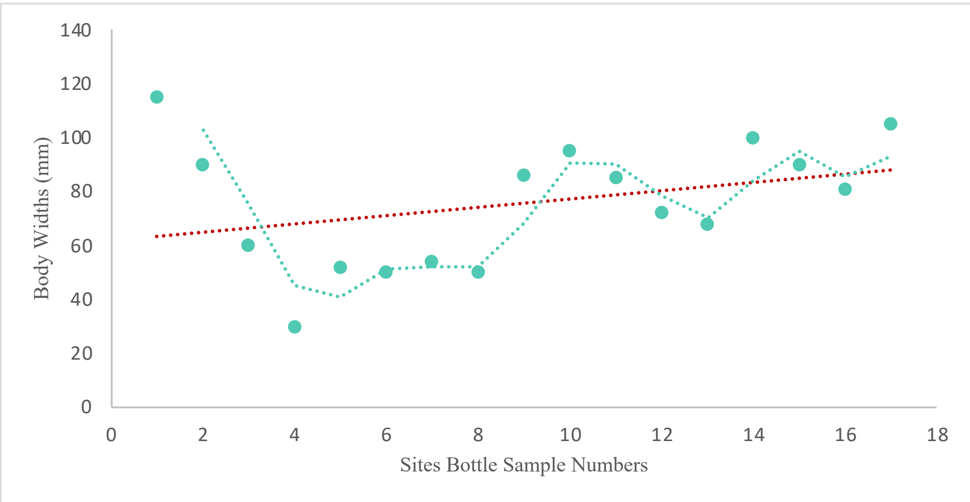


Figure 4.103 Colchester Bottles Body Width Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.3)

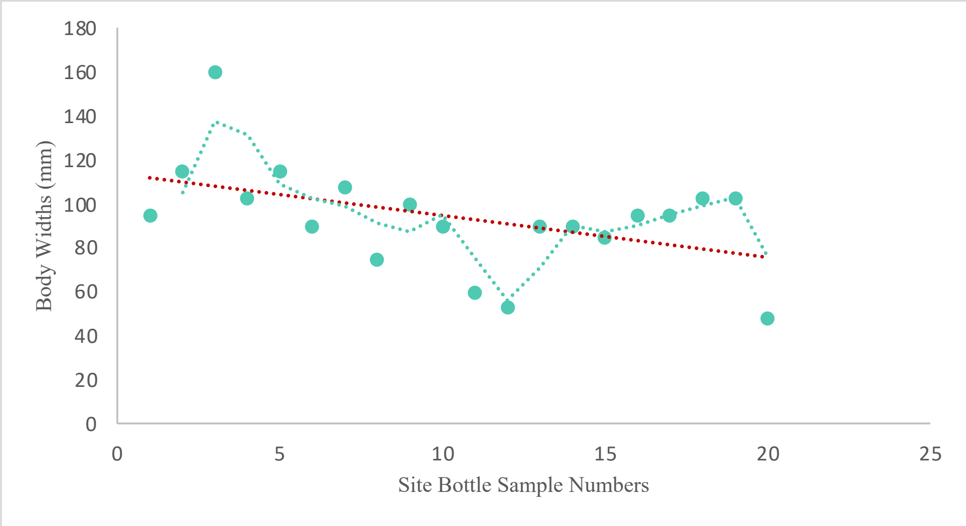


Figure 4.104 Castleford Fort Bottles Body Width Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.3)

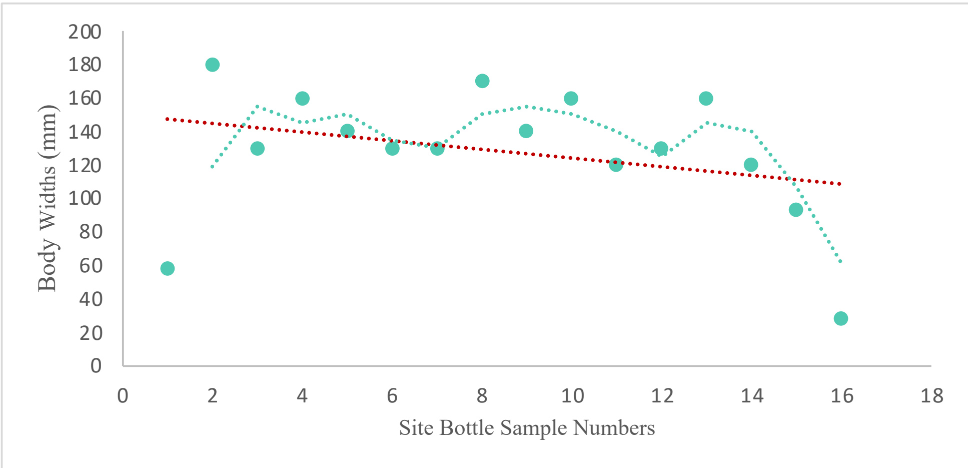


Figure 4.105 Elginhaugh Fort Bottles Body Width Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.3)

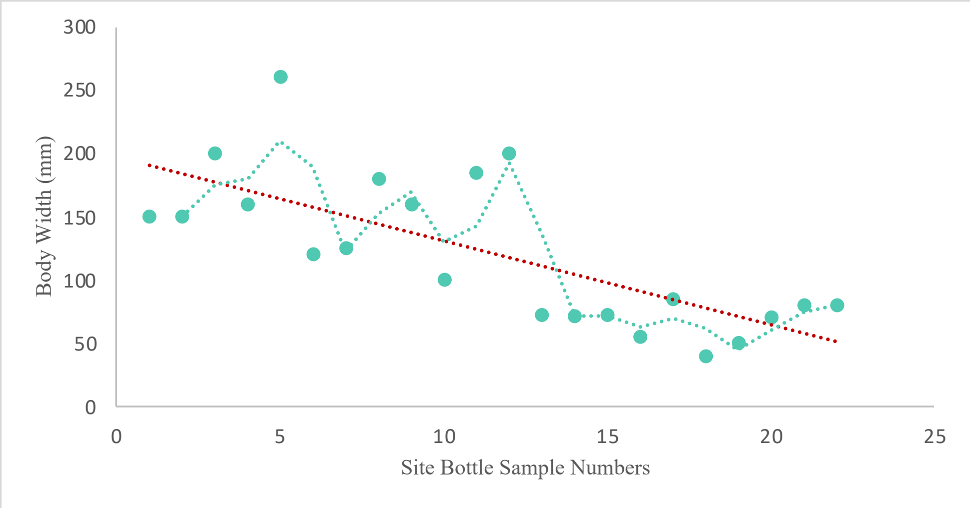


Figure 4.106 Ribchester Fort Bottles Body Width Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.5)

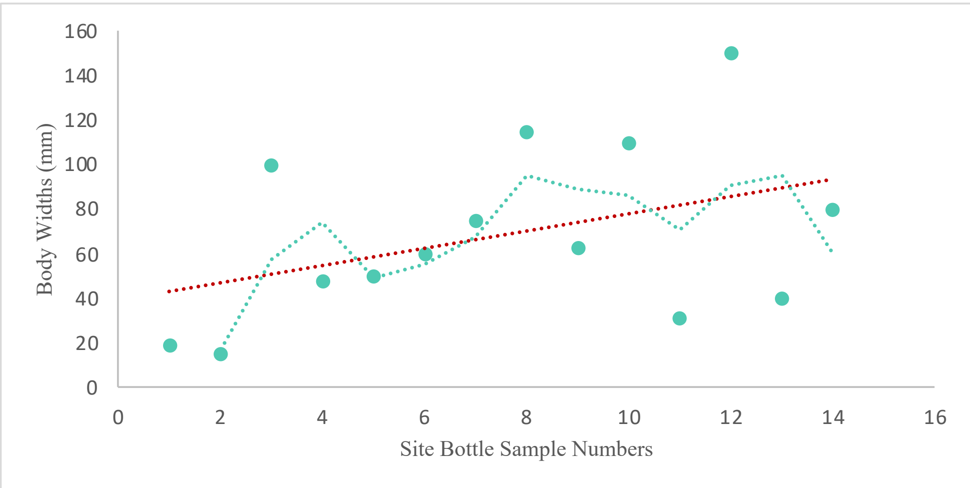


Figure 4.107 York Fortress Bottles Body Width Diameters of each Site Sample Record

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.6)

All the individual sites' graphs of bottle body widths and rim diameters illustrate wide ranges of variation. The body width data for all sites is shown in a single graph (4.108) that shows the breadth of the range across both the civil and military sites and reduces the impact of bias from individual sites. The measured variation across the civil and military sites is very similar that suggests that bottles were made and distributed with contents across all of the sites without any differentiation to any of the sites. The variation is however very broad.

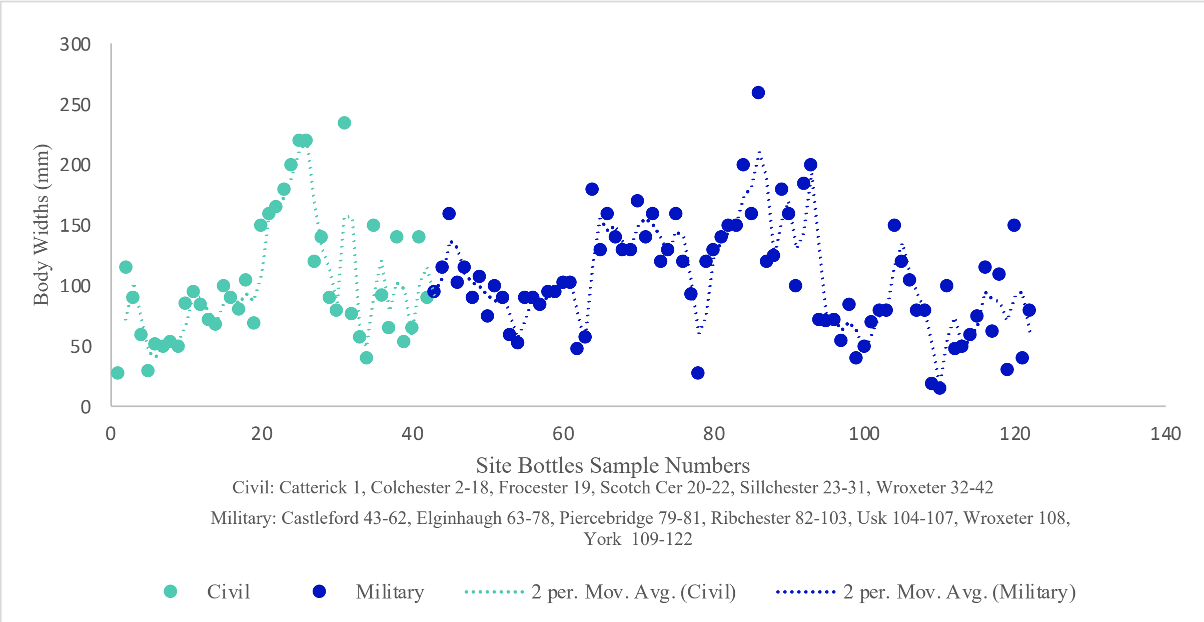


Figure 4.108 Site Types Bottles Body Width Diameters (mm)

(Graphical Moving Average and Best-Fit Data Trend Shown. Cv =0.5. Civil 38.5%, Military 68.5%)

A small-large bottle division was highlighted in the Colchester square bottle assemblage (Cool 1995: 181). This source further suggested that there was a further subdivision of the small bottle group into tall-narrow and small (squat) bottles. There are indications of groups of small bottles with widths less than or equal to 120mm, and a larger group of bottles with widths greater than 120mm. These body width groups of small bottles and large bottles are presented graphically together with a further group of tall-narrow bottles with widths of less than 60mm that are of similar dimensions to the small flasks (e.g. bath-flasks) as described in Price and Cottam (1998, p. 188).

These dimensional groups are presented in Figure 4.109 where each of the site bottle sample numbers represents the individual accession line record where the dimensions were recorded. The order relates to the sites data and with more sites, it is expected that this pattern would continue. The graph shows that all the three groups have relatively low variability across the civil and military landscapes.

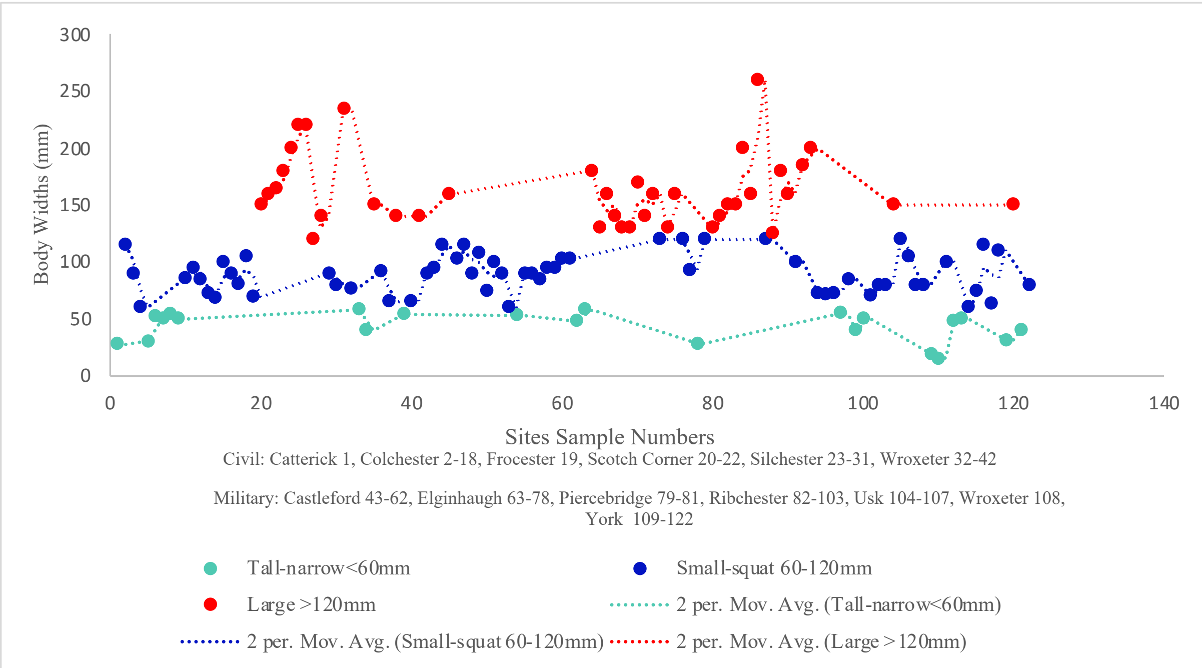


Figure 4.109 Corpus Bottles Body Width Diameters (mm)

(Graphical Moving Average Shown. Tall Cv =0.3. Small Cv =0.2, Large Cv =0.2)

All three groups are present on both the civil and military sites with the following observations. Colchester has evidence of just the tall-narrow and small-squat bottles recorded, whereas Silchester and Scotch Corner only have signs of large and small-squat bottles; however, more dimensional sample data would be needed to confirm these patterns. The tall-narrow bottles are seen across most of the civil and military sites. While more dimensional data from sites would support this general distribution association, these patterns will be analysed for associations between glass forms and locations in Chapter 6.

Catalogue images of bottle forms are presented in Figure 4.110.

Cylindrical bottle– 1st – 2nd century CE

(Whitehouse 1997, p. 187)

Square bottle– 1st – 2nd century CE

(Whitehouse 2003, p. 162)

Mercury bottle – 2nd – 3rd century CE

(Whitehouse 2001, p. 85)

Square bottle with woven cover– 3rd century CE

(Whitehouse 1997, p. 183)

Amphora – 4th – 5th century CE

(Whitehouse 2001, p. 185)

Frontinus bottle – 3rd century CE

(Whitehouse 2001, p. 97)

Figure 4.110 Images of Catalogued Bottle Forms

Sources: (Whitehouse, 1997, 2001, 2003)

The dimensions data for the small unguent type containers is shown in Figures 4.111, 4.112 for the rim diameters and body widths. Images of unguent containers are illustrated in Figure 4.113.

Figure 4.111 Corpus Unguent Bottles Rim Diameters (mm)

(Graphical Moving Average Shown. Military Cv =0.4, Civil Cv =0.3 Average =23)

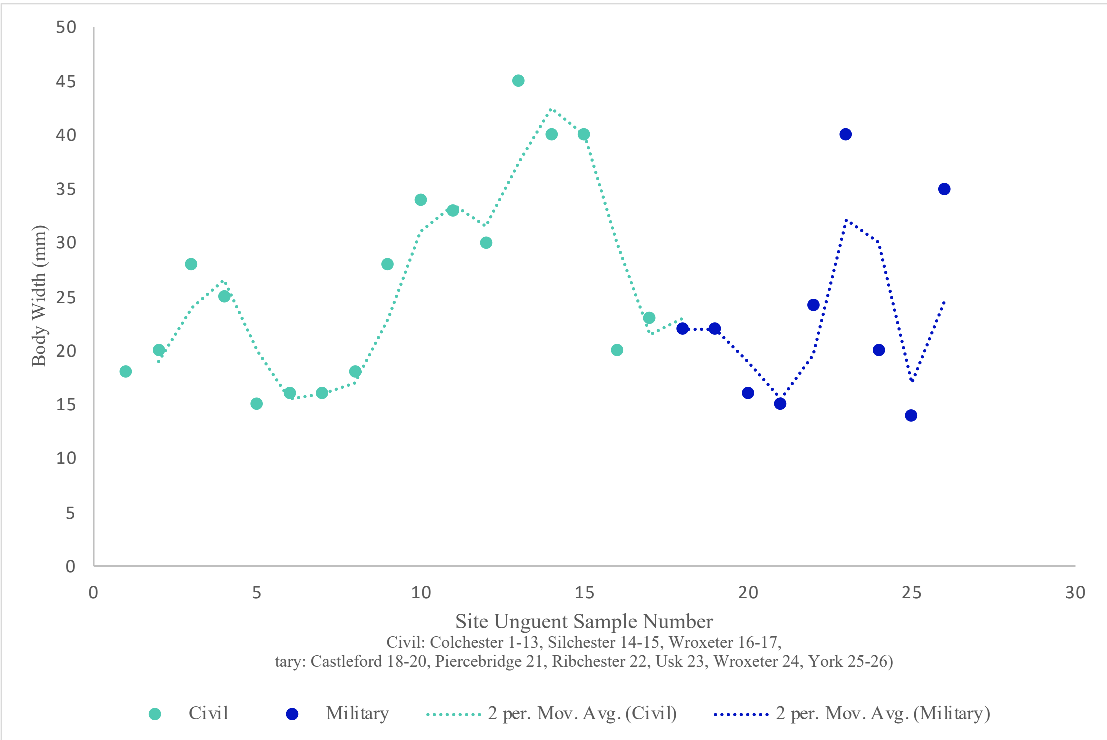


Figure 4.112 Corpus Unguent Bottles Body Width (mm)

(Graphical Moving Average Shown. Military Cv =0.4, Civil Cv =0.4 Average =25)

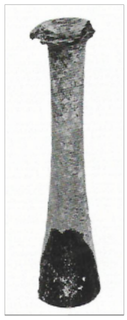
Unguent bottle– 1st – 2nd century CE	Unguent bottle– 1st – 3rd century CE	Unguent bottle– 2nd -3rd century CE
		
(Whitehouse 1997, p. 132)	(Whitehouse 1997, p. 148)	(Whitehouse 1997, p. 134)

Figure 4.113 Catalogue Glass Unguent Bottle Images
Source: (Whitehouse, 1997)

The shapes of these unguent bottles changed little in the period to 500CE as small, tall and narrow glass containers. Over 66% of the corpus unguent bottles were dated to the end of the 2nd century. The range of sizes varied considerably with rim diameters 10-46mm (average 23mm) and body width 14-45mm (average 25mm). These are probably the tall-narrow bottles previously described and although they were not reported as unguent bottles, they would have fulfilled the same purpose as personal small containers that could be carried as accessories.

4.8 The Romano-British Sites Corpus

4.8.1 Roman Britain Distribution

The overall glass corpus data is from the 33 archaeological sites that includes 13 settlement sites, 16 military sites and four shrines as set out in Tables 4.1, 4.2 and 4.3. This body of data can also be viewed as a proportional distribution across Roman Britain as corpus class counts and illustrated in Table 4.77.

Table 4.77 Vessel Class Counts and Corpus Percentage Counts

Class Counts	container-large	container-small	drinking	tableware	no-class	Totals
Large Cities	626	72	402	1336	86	2522
Towns	118	4	50	117	8	297
Rural	24	1	38	96	12	171
Shrines	6	15	10	26	10	67
Military	904	64	451	688	162	2269
Total Counts	1678	156	951	2263	278	5326
Large Cities	11.8	1.4	7.5	25.1	1.6	47.4
Towns	2.2	0.1	0.9	2.2	0.2	5.6
Rural	0.5	0.0	0.7	1.8	0.2	3.2
Shrines	0.1	0.3	0.2	0.5	0.2	1.3
Military	17.0	1.2	8.5	12.9	3.0	42.6
Total % Counts	31.5	2.9	17.9	42.5	5.2	100.0

The corpus distribution is based on the same base counts but with a view that looks at the distribution of the vessel finds data across the entire corpus. The presentation of the vessel distribution across the corpus then gives a geographic spread of the individual vessel finds that allows cross regional views. Any vessel bias on a site is now seen in comparison with the overall distribution of the glass across the regions' sites. The following sections present the corpus vessel data with the sites as a network of nodes in Roman Britain. The corpus distribution patterns across Roman Britain are presented in Tables 4.78 and 4.79.

Table 4.78 Civil Sites Vessel Class Corpus Percentage Accession Counts

Civil Sites Corpus %	container-large	container-small	drinking	tableware	vessel no-class	Totals
			Large Cities			
Colchester	6.3	0.8	4.8	16.2	1.0	29.1
Silchester	2.7	0.2	0.5	1.9	0.4	5.6
St Albans	1.1	0.2	1.1	4.7	0.2	7.2
Wroxeter	1.7	0.2	1.1	2.3	0.1	5.3
			Town - Industrial Settlements			
Catterick	1.6	-	0.6	1.4	0.1	3.7
Scotch Corner	0.3	-	0.3	0.5	-	1.1
Walton le Dale	0.1	-	0.1	0.2	-	0.5
Wilderspool	0.2	-	-	0.1	-	0.3
			Rural Settlements			
Barton Court Farm	0.0	-	-	0.1	0.1	0.2
Frocester	0.2	-	0.2	0.4	0.2	1.0
Gorhambury	0.2	-	0.3	1.2	-	1.7
Piercebridge Villa	0.1	-	0.2	-	-	0.3
Graeanog Ridge	-	-	-	-	-	0.0
			Shrines & Burial Sites			
Gloucester	-	0.1	-	-	-	0.1
Stanway	-	0.2	-	0.1	-	0.3
Uley	0.1	-	0.1	0.2	0.1	0.4
Skeleton Green	0.0	-	0.1	0.2	0.1	0.4

Table 4.79 Military Sites and Total Corpus Vessel Class Percentage Accession Counts

Sites Corpus %	**container-large**	**container-small**	**drinking**	**tableware**	**vessel no-class**	**Totals**
			Fortresses & Forts			
Birdoswald	0.6	-	0.2	0.4	0.1	1.3
Caerleon	0.7	0.2	0.2	1.0	0.5	2.5
Carlisle	3.6	-	0.2	0.6	-	4.4
Castleford	1.0	0.1	1.7	1.9	0.3	5.1
Corbridge	0.1	-	0.3	0.4	0.1	0.8
Elginhaugh	1.6	-	0.2	0.4	-	2.2
Inchtuthil	0.2	-	-	0.2	0.1	0.4
London	0.4	0.1	0.7	2.2	0.5	3.8
Piercebridge	4.0	0.2	2.4	1.1	0.1	7.8
Ravenglass	0.2	-	-	0.1	-	0.4
Ribchester	2.6	0.1	0.2	0.9	0.1	3.8
Strageath	0.1	-	0.1	0.2	-	0.4
Usk	0.3	0.2	0.3	1.1	0.2	2.1
Watercrook	0.3	-	-	0.1	0.1	0.5
Wroxeter	0.3	0.2	0.9	1.5	0.1	3.0
York	0.8	0.1	1.1	1.1	0.9	4.0
Military Sites	17.0	1.2	8.5	12.9	3.0	42.6
Civil Sites	14.5	1.7	9.4	29.6	2.2	57.4
Overall Total	31.5	2.9	17.9	42.5	5.2	100.0

The tables disaggregate the corpus percentage counts in Table 4.77 for each of the sites arranged as civil sites including the shrines and burial sites, and each of the military sites that include the fortresses and forts. The percentage distribution across the corpus differs from the individual site composition views.

The tables show the bias towards the large cities and the military sites that represent respectively 47.4% and 42.9% of the corpus counts. The sites with proportions above 4% of the corpus include the large cities Colchester, Silchester, St Albans and Wroxeter, the forts Carlisle, Castleford, Piercebridge, and the York fortress that together account for *c.* 70% of the corpus. These are shown in Figure 4.114 that also shows the bands of sites with less than 1.5% and between 4% and 1.5% of the corpus distribution. The middle band range of <4.0% and >1.5% includes the other three fortress sites, and Elginhaugh, London, Ribchester, and the industrial centre at Catterick. Taken together, these 15 of the 33 corpus sites account for 93% of the total corpus counts.

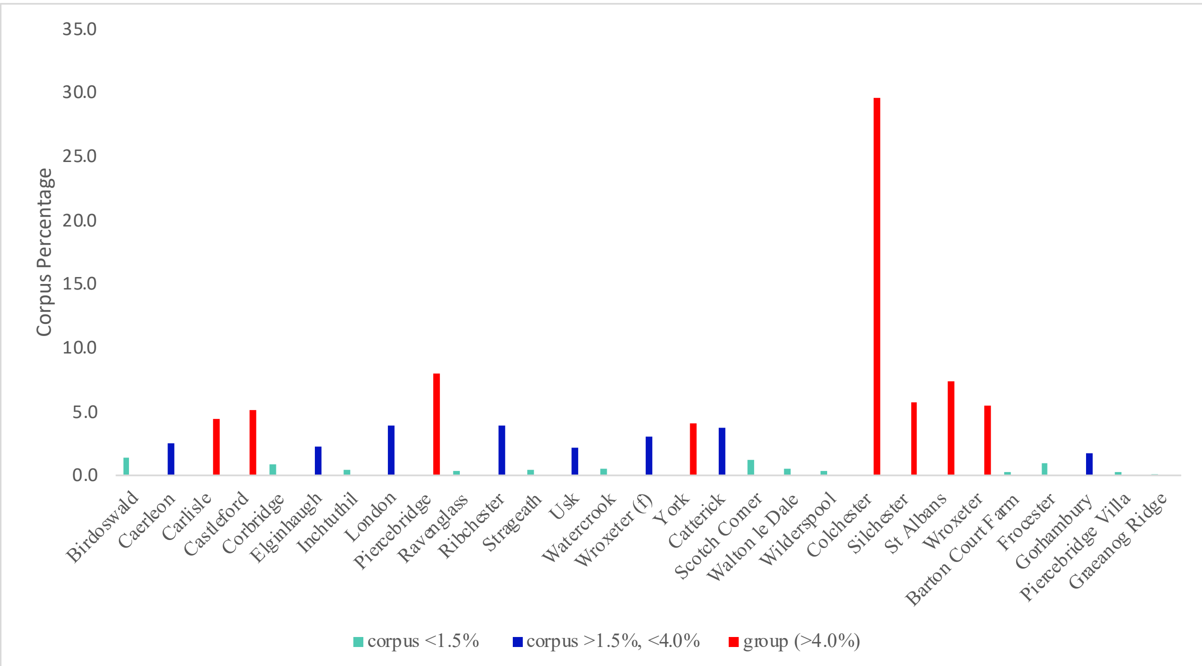


Figure 4.114 Glass Corpus Distribution of Percentage Counts –Civil and Military Sites

The vessel class % corpus counts are shown graphically in Figures 4.115 and 4.116 for the military and civil sites. These show the significance of the large containers across all the military sites, where they dominate the profiles except for Castleford, London and the fortress sites. The unusually high percentage bottle sites of Carlisle, Piercebridge and Ribchester have been discussed earlier in this chapter with contextual explanations for these individual sites.

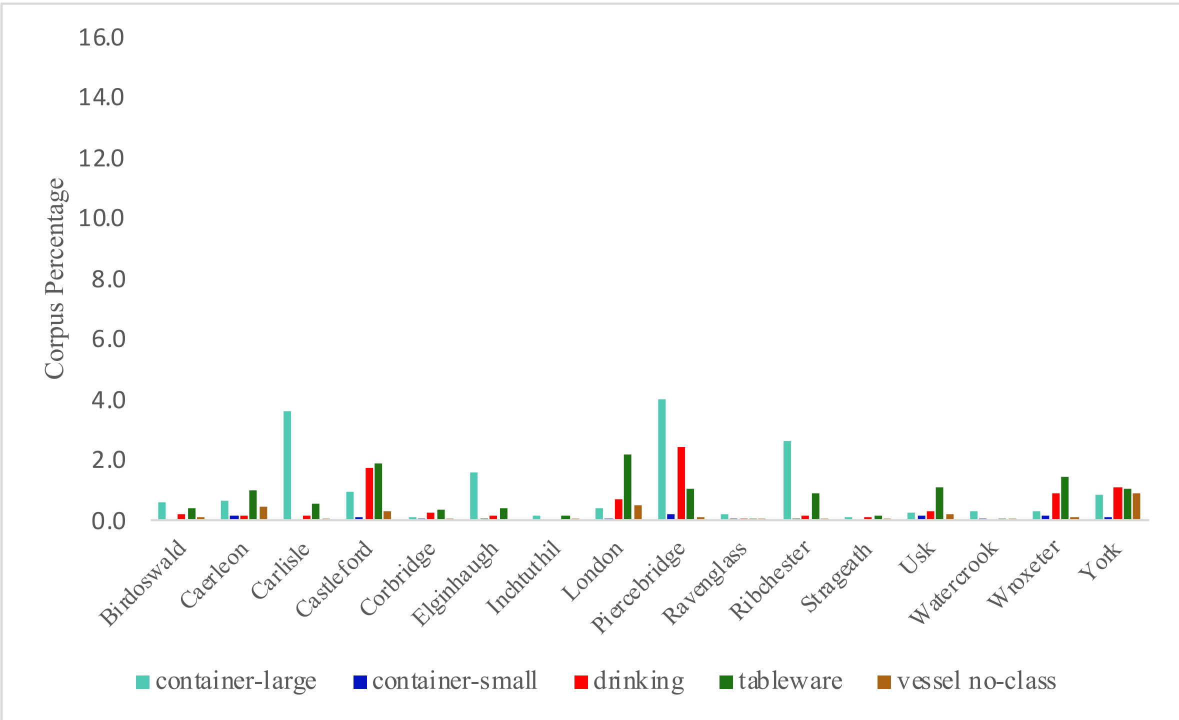


Figure 4.115 Military Sites Vessel Class Corpus Percentage Counts

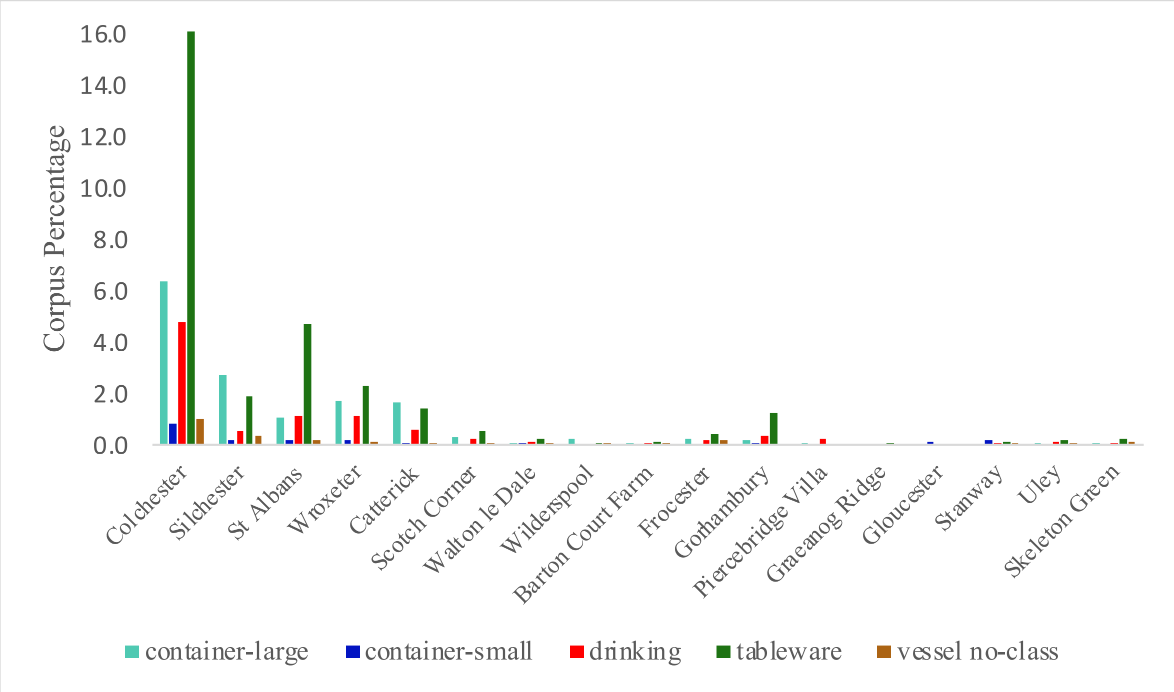


Figure 4.116 Civil Sites Vessel Class Corpus Percentage Counts

These observations will be central to the detailed distribution and transport analysis in Chapter 6 that will consider all the sites as nodes in the distribution network.

4.8.2 Romano-British Glass Types

The lower-level data of glass types are presented in the following Figures 4.117 to 4.120.

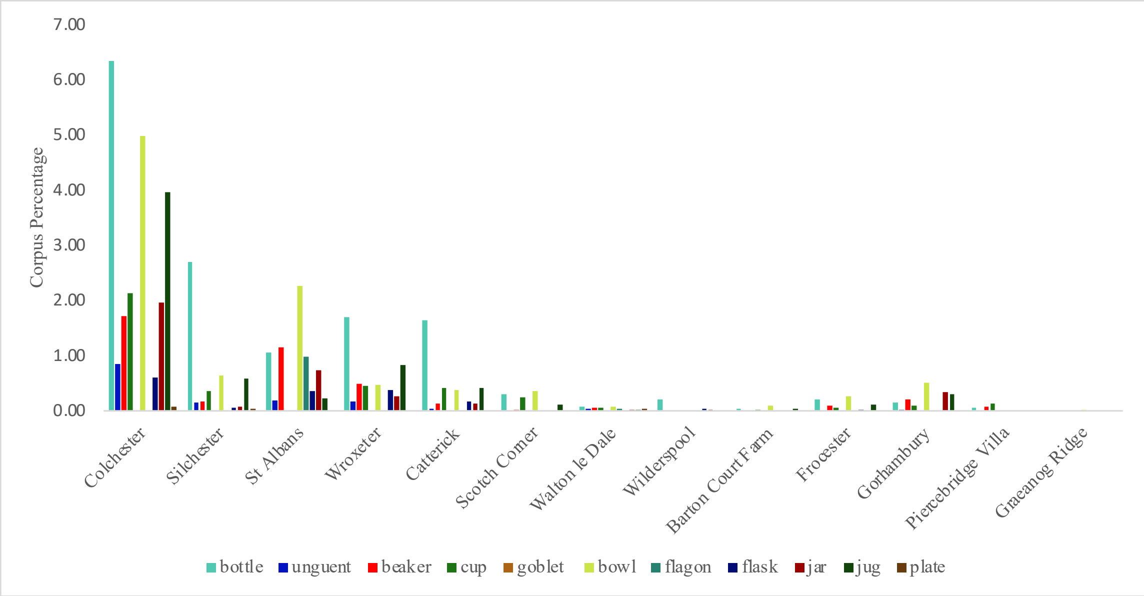


Figure 4.117 Civil Sites Vessel Type Corpus Percentage Counts (1)

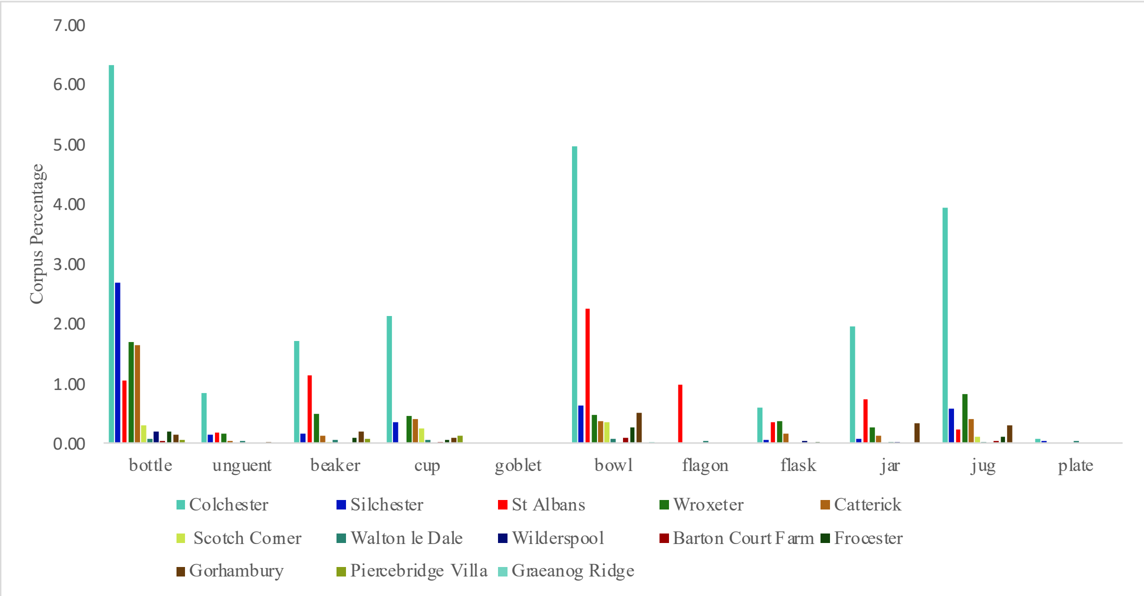


Figure 4.118 Civil Sites Vessel Type Corpus Percentage Counts (2)

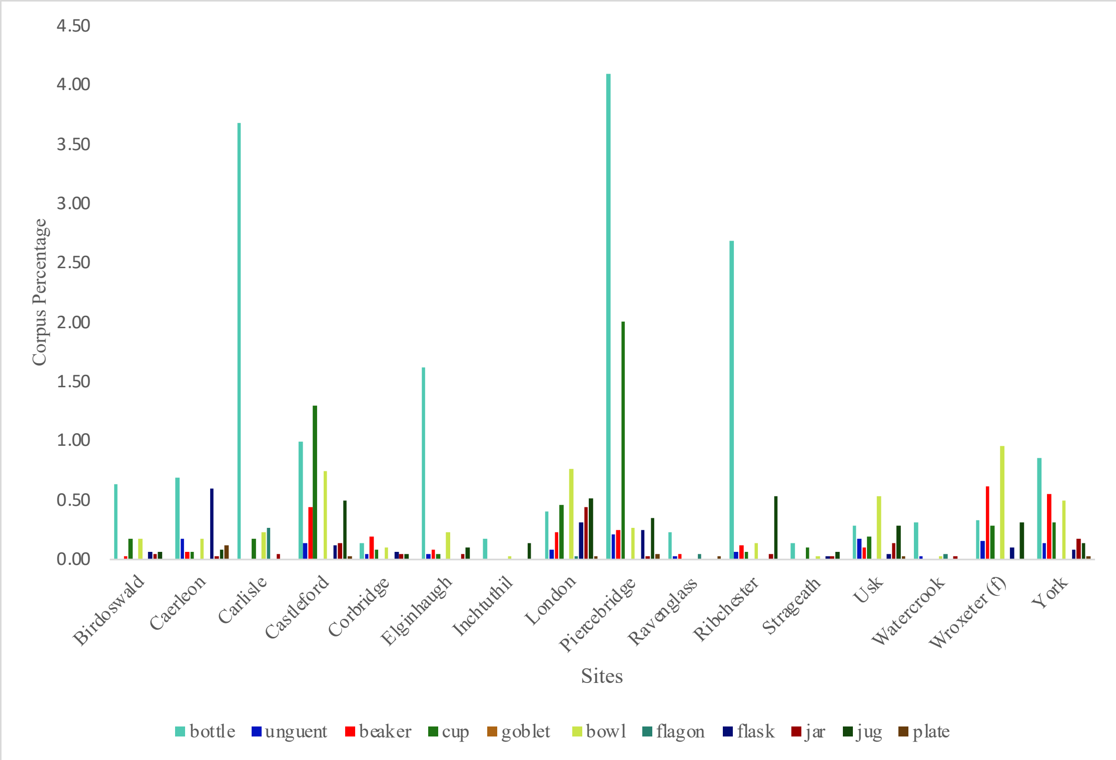


Figure 4.119 Military Sites Vessel Type Corpus Percentage Counts (1)

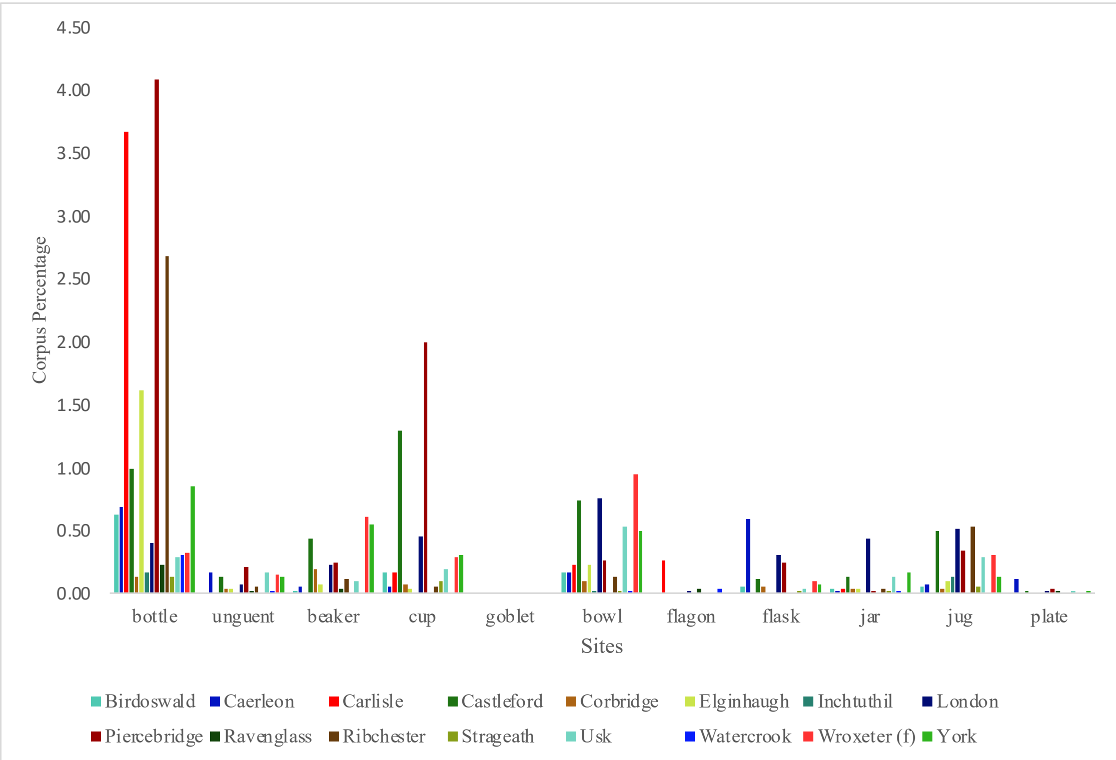


Figure 4.120 Military Sites Vessel Type Corpus Percentage Counts (2)

The graphs show the clusters of types on sites and the sites associated with particular glass type (e.g. bottles, beaker, bowl, etc.). The large proportions of bottles on the Caerleon, Carlisle, Elginhaugh, Piercebridge, and Ribchester sites are seen as the main contributors to the bottle proportional distribution across Roman Britain. This will be picked up in Chapter 6.

Glass forms are vessel types with particular features as set out in Section 3.2.1 Typology and Table 3.1. Glass forms are referenced as catalogued vessel types and detailed in guides to glass vessels finds (Isings, 1957; Price and Cottam, 1998). The corpus records have *c.* 29% of the vessel types counts reported as forms that have been used to compare the sites' glass profiles and the distribution of glass across Roman Britain. The sites with significant proportions of types have similar proportions of forms. These are the large cities Colchester, Silchester, St Albans and Wroxeter, with Catterick and the military fortress sites Caerleon, Usk, Wroxeter, York and Castleford, Piercebridge, London and Ribchester. These are all sites with sample counts greater than 2.1% of the corpus. As forms are recognisable glass types, it may be possible to use the glasswork centres origins of forms where they are known to provide insights into the trading routes, particularly for the imported vessels into Britain in the early decades following the invasion. This could be possible for the bottles that would have been early imports of the contents of oil, wine or other products, to the military following supply routes. The other forms that could be relevant to trade would be the complex manufactured vessel forms with a presence recognised on the Continent.

4.9 Summary

This chapter has reviewed the quality and quantity of the assemblage data through reviewing unusual sites' proportional variations and using the comparisons with the Romano-British corpus proportions to validate the sites' profiles. The data has also been reviewed using a systematic process to match types and shapes with the original accession line detail to eliminate as many missing data and errors as possible. The reviews have confirmed that the fragmentary data could be analysed as being representative of the material records and of the presence of vessels in the original populations of glass for the deposition dated periods.

The reviews of the characteristics of the glass, as colour, markings, and decorations as features do not appear to be associated with particular sites or regions. The presentation of the data has shown that other than for bottles, drinking vessels and bowls, the glass industry tended to make very similar shaped vessels albeit with broad ranges of size variability. In contrast, the dimensional analyses of drinking vessels, beakers and cups, has revealed possible patterns of smaller drinking vessels at St Albans and York than for the other sites which is reinforced with data of distinct recognisable vessel forms. These patterns will be further analysed as sites' profiles in Chapter 5. The distribution of large bottles has revealed patterns of broad consistent ranges of dimensions across all sites, with possible groups of bottle sizes identified from the data. These bottle size groups have revealed distribution patterns that will be further analysed in Chapter 6. These analyses will be based on the site type proportional counts data presented in Tables 4.6, 4.7 for the military sites and 4.8, 4.9 for the civil sites and for the site form proportional counts in Tables 4.10, 4.11, 4.12 for military sites and 4.13, 4.14, 4.15 for the military sites.

These patterns of difference and similarity are at the lower levels of detail needed for analyses. The association of types and forms at a site will give a richer view of the use and movement of glass in the ancient world. All of these points will be carried forward into the analysis of the glass vessels on sites and the distribution of vessels across Roman Britain.

5 CHARACTERISTICS OF SITE GLASS PROFILES

5.1 Introduction

This chapter includes the analysis of the site profiles to determine whether there were characteristic profiles of settlement types which could distinguish between military and civil settlements consumers. The analysis of the sites examined if the differences in the site profiles could be associated with the types of settlements as large cities, industrial centres, rural settlements, and Roman army bases. The research also explored the differences with the use of glass on sites and whether there were any associations with the settlements' material cultures and communities.

The analysis techniques used were 1) comparative proportional analysis, with the site assemblages converted into percentages of the reported glass vessel types for each of the sites, and 2) correspondence analysis that assessed the associations between the glass and location (Cool and Baxter, 1999; Perring and Pitts, 2013; Carlson, 2017; Broadley, 2020). In addition, a qualitative site scoring model was developed in this study that was based on the presence of the glass types and forms at sites. These three techniques were used to analyse and assess the patterns of glass data on the sites.

The Colchester settlement site represented 29.1% of the overall database and was the largest single settlement sample as shown in Table 4.1. This large site comprised several individual sites at the same location. Given the data from these individual sites were from the same archaeological excavation project, the assumption was that similar sampling biases would have applied across all these individual sites and therefore the comparative analyses could be used as a comparison with other civil and military sites. A chronological analysis was carried out for Colchester for the periods before and after the Boudican revolt in 60/1 CE that revealed the changes in the glass type profiles from the 1st century CE to 500 CE. This was possible because of the large sample size for Colchester. Site profile analyses were then carried out across all the other sites for the study period.

This chapter presents the results of the analyses of the reported glass finds from the selected archaeological sites in Roman Britain. It is set out in three main sections: 1) the site profiles defined by the site type (e.g. large city, town, rural settlement, or military site); 2) the site scoring model results discussion; 3) considerations on whether the site profiles can provide insights of the material cultures of the ancient communities living in the settlements, and 4) a commentary on the use of glass as ritual and votive offerings based on the evidence from the shrines.

5.2 Site Glass Profiles

5.2.1 Colchester Sites

Colchester was an early Roman administration centre for the region. The early town was built on the site of the fortress occupied by *Legio XX* that moved to the fortress at Usk in 58 CE. The early fort was not operational after *c*. 49 CE, and the early layout of the settlement was taken from the fortress plan as can be seen in Figure 5.1.

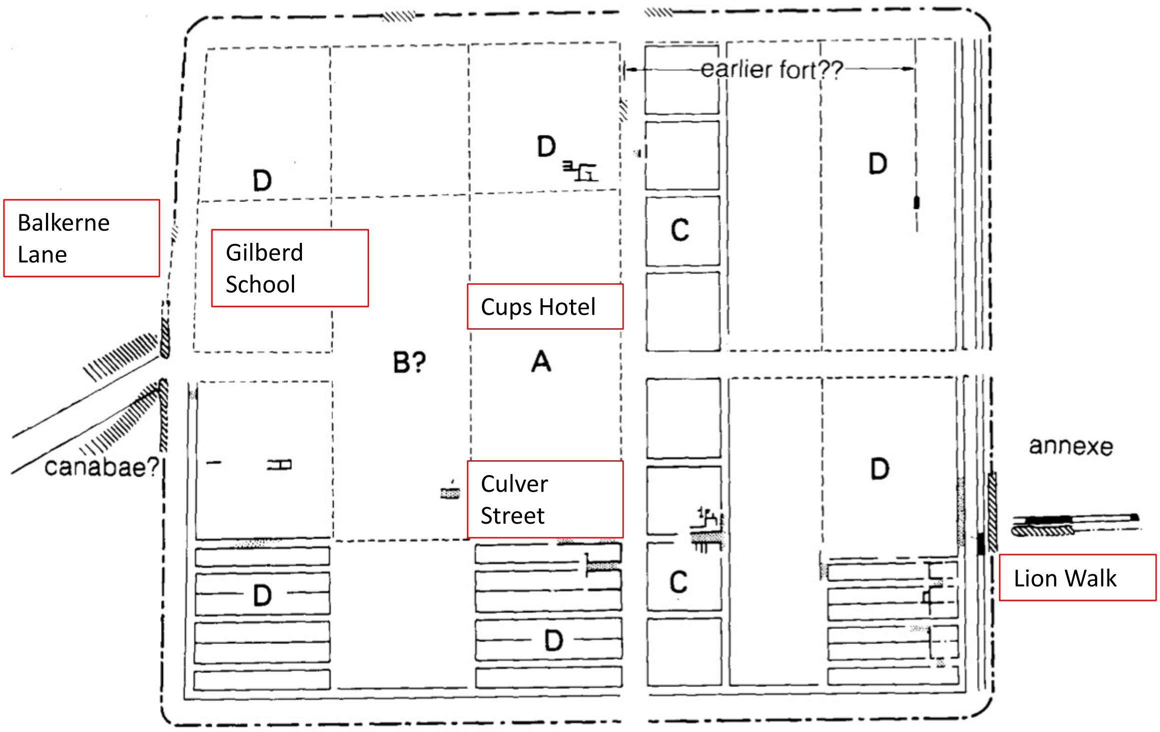


Figure 5.1 Plan of the Fortress (Colchester Period I)

A-principia, B-praetorium, C-tribunes houses, D-barracks and the Archaeological Sites with Glass Highlighted

Source: (Crummy, 1984, p. 6 Fig. 5 with additions)

The plan shows the standard fortress layout with the main excavation sites considered here where glass was found, namely Balkerne Lane, Culver Street and Lion Walk. Many of the original fortress structures were re-used by the original colony, including the buildings at the Culver Street site that were military structures and the tribunes' houses. These structures together with the fortress *principia* on the *via principalis* were identified during the excavations 1971-9 (Crummy, 1983, p. 5). The Balkerne Lane site was at the main gate to the fortress. There was evidence of iron working that was also seen at the Lion Walk site to the east of the fortress in the annexe. The annexe also included the Long Wyre Street site adjacent to Lion Walk. This annexe area included a temple and theatre as shown in Figure 5.2 that shows the settlement in the period 60/1 CE-*c.*80 CE and 80-100/25 CE. These plans show Colchester in the periods following the destruction in 60/1 CE of parts of the city during the Boudican revolt that then were rebuilt and extended to the north and east of the original site.

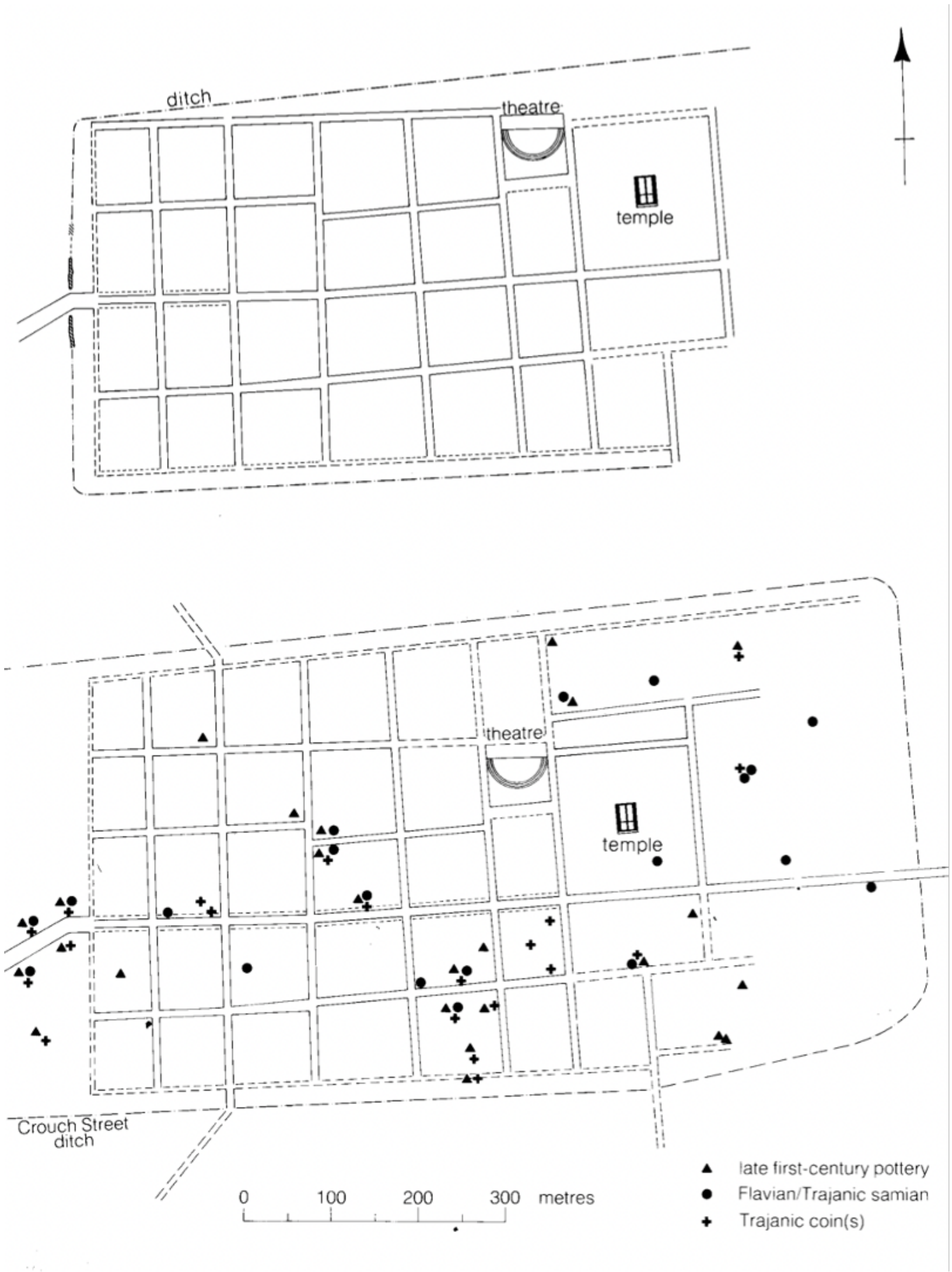


Figure 5.2 Colchester 60/1-c.80 CE; below, Colchester 80-100/25 CE

Source: (Crummy, 1984, p. 12 Fig. 7)

The archaeological material records allowed chronological comparisons of Colchester before and after the Boudican revolt, and to present the impact of the destruction on sites with the renewal of the city over time. The city was extended in the 2nd century CE, retaining the original fortress areas, and demolishing the defences to provide space for the theatre, temple and an extended area to the north, all of which was enclosed by the city wall as shown in Figure 5.2 (Crummy, 1984, pp. 8–9). In the 2nd century CE, together with urban developments at Middleborough and Balkerne Gate, a rampart associated with the city wall was constructed in stages (Crummy, 1984, pp. 15–16). Then early in the 3rd century, the buildings at Middleborough and Balkerne Lane were demolished as part of a decline to the suburbs in these areas. This included closure of the Balkerne Gate in the late 3rd /early 4th centuries CE. Colchester in the late 3rd–4th century CE is shown in Figure 5.3 and this layout continued until the mid 5th century CE.

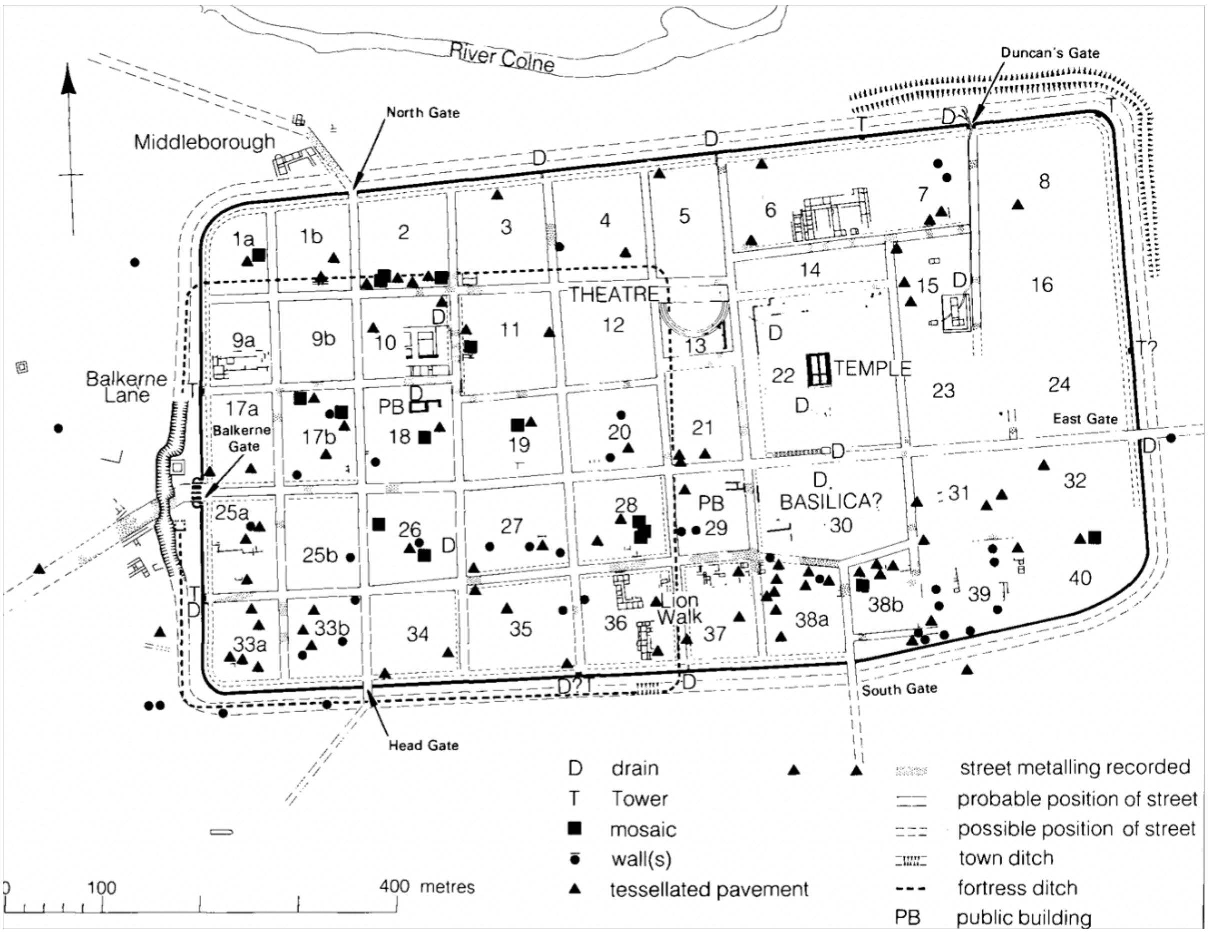


Figure 5.3 Colchester in the late 3rd–4th Century CE

Source: (Crummy, 1984, p. 16 Fig. 9)

Understanding the history and archaeology of the sites provides the context for the glass finds and helps to build a chronological profile of the Colchester sites. These chronological periods for each of the main city sites define the main events in the life of the Roman city. The glass sample sizes for the main sites were considered sufficiently large enough to represent the original populations of glass. The Colchester sites with reported glass finds referred to in this study are shown in Figure 5.4 with the main excavation sites Balkerne Lane near the main gate, Culver Street that was associated with the tribune houses, the Gilberd School barracks, the Lion Walk with evidence of iron working and Long Wyre Street in the annexe.

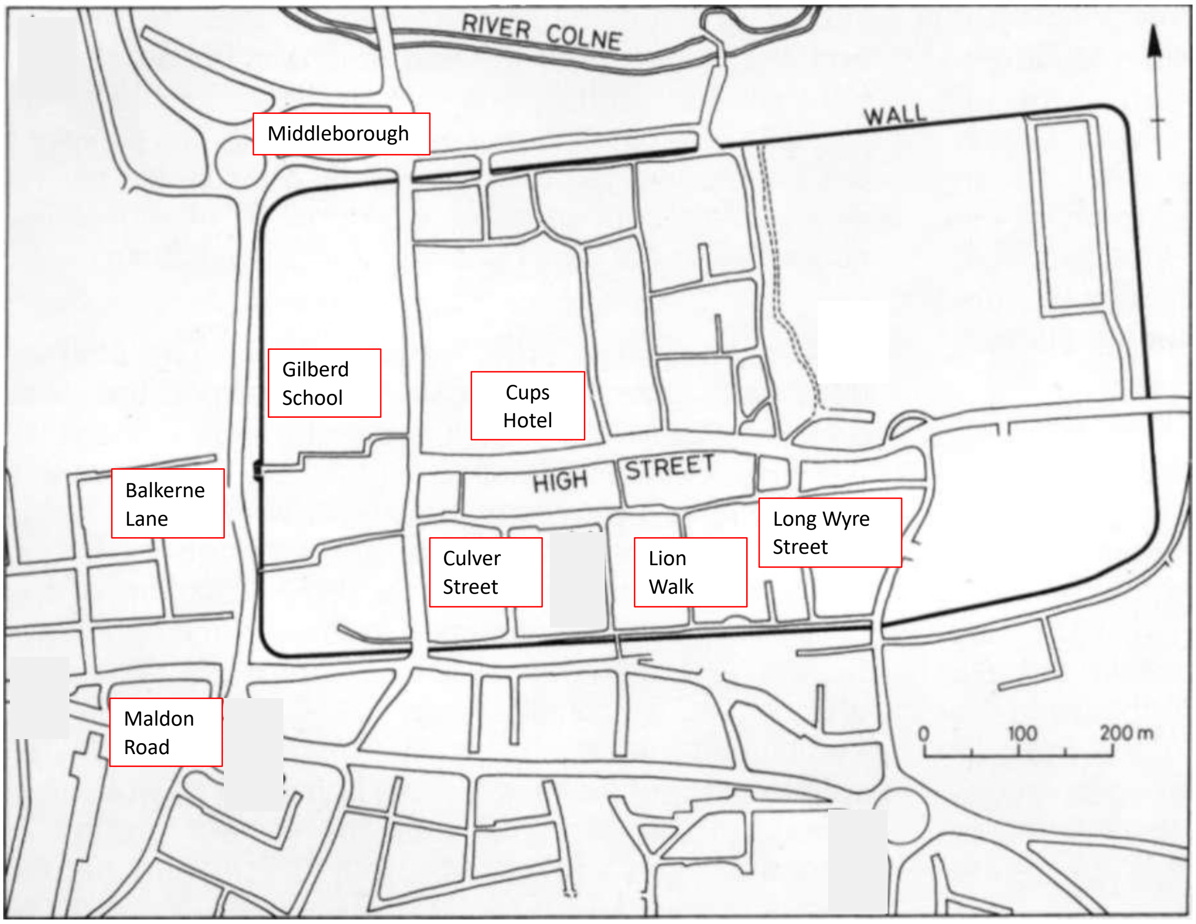


Figure 5.4 The Colchester Sites with Evidence of Glass as Catalogued by Cool and Price

Source: (Cool and Price, 1995, p. 2 Fig. 1.1)

The vessel class counts are presented in Table 5.1 that shows the cumulative glass as accession line counts from 43 to 500 CE. The excavation and reporting of the glass from Colchester were very comprehensive with 1552 accession line assemblages of glass vessels for the time periods from 50 BCE to 500 CE (Cool and Price, 1995). This is the largest part of the study corpus of 5326 accession line assemblages for all the selected sites.

Table 5.1 Colchester Sites Vessel Class Counts for Period to 500 CE

Glass Class	container-large	container-small	drinking	tableware	no-class	Total
Balkerne Lane	108	11	59	309	22	509
Butt Road	15		13	42	2	72
Culver Street	104	22	91	247	16	480
Inner Relief C	1					1
Lion Walk	63	6	42	154	6	271
Long Wyre St	1		1	3		5
Maldon		1		4		5
Middleborough	7		7	7	2	23
St Helenas				1		1
Cups Hotel	8	1	10	14	1	34
Gilberd School	30	4	31	83	3	151
Colchester	337	45	254	864	52	1552

The sites with higher counts included Culver Street that consisted of the fortress barracks and the tribune houses and had high occupancy throughout the life of the city. Balkerne Lane was just outside of the fortress and city wall, and originally was the main access point into the fort and city until the late 3rd century with buildings, temples and metal-working, which could account for the high volume of glass (Crummy, 1984) . The Gilberd School site with high glass counts included barracks immediately inside the city wall at Balkerne Gate. The Cups Hotel site was an excavated cellar originally located in the centre of the fortress on the via *Principalis*. The sites with counts of less than ten were all outside of the city walls except for the Long Wyre

Street site. This site was adjacent to the Lion Walk site that had a significant sample size, and both sites were in the annexe area of the original fort. Long Wyre Street was further east and was in the proximity of the *basilica*. The functional distribution of glass vessels across these Colchester sites is shown in Table 5.2.

Table 5.2 Colchester Sites Vessel Functional Distribution for Period to 500 CE

Glass Class	container-large	container-small	drinking	tableware	no-class	Total
Balkerne Lane	32.0	24.4	23.2	35.8	42.3	32.8
Butt Road	4.5	-	5.1	4.9	3.8	4.6
Culver Street	30.9	48.9	35.8	28.6	30.8	30.9
Inner Relief C	0.3	-	-	-	-	0.1
Lion Walk	18.7	13.3	16.5	17.8	11.5	17.5
Long Wyre St	0.3	-	0.4	0.3	-	0.3
Maldon	0.0	2.2	-	0.5	-	0.3
Middleborough	2.1	-	2.8	0.8	3.8	1.5
St Helenas	-	-	-	0.1	-	0.1
Cups Hotel	2.4	2.2	3.9	1.6	1.9	2.2
Gilberd School	8.9	8.9	12.2	9.6	5.8	9.7
Colchester	100.0	100.0	100.0	100.0	100.0	100.0

The distribution of each vessel class shows the bias towards the sites inside or close to the city walls (the main gate or annexe) with over 90% of the glass recovered from five of the eleven sites. The glass percentage site profile compositions for each of the sites are in Table 5.3

showing the five high sample size city sites. The proportions for these sites are very similar to the Colchester combined sites composition which is also in the table.

Table 5.3 Colchester Sites Vessel Distributions for Period 43 to 500 CE

Glass Class	container-large	container-small	drinking	tableware	no-class	Total
Balkerne Lane	21.2	2.2	11.6	60.7	4.3	100.0
Butt Road	20.8	0.0	18.1	58.3	2.8	100.0
Culver Street	21.7	4.6	19.0	51.5	3.3	100.0
Inner Relief C	100.0	-	-	-	-	100.0
Lion Walk	23.2	2.2	15.5	56.8	2.2	100.0
Long Wyre St	20.0	-	20.0	60.0	-	100.0
Maldon	-	20.0	-	80.0	-	100.0
Middleborough	30.4	-	30.4	30.4	8.7	100.0
St Helenas	-	-	-	100.0	-	100.0
Cups Hotel	23.5	2.9	29.4	41.2	2.9	100.0
Gilberd School	19.9	2.6	20.5	55.0	2.0	100.0
Colchester	21.7	2.9	16.4	55.7	3.4	100.0

The glass vessel types of composition make-up are presented in Tables 5.4, 5.5 as counts and as the percentage composition.

Table 5.4 Colchester Sites Vessel Types Counts for Period to 500 CE

Glass Type	Balkerne Lane	Culver Street	Lion Walk	Middleborough	Cups Hotel	Gilberd School	Colchester
bottle	108	104	63	7	8	30	337
unguent	11	22	6	-	1	4	45
beaker	23	26	20	5	2	11	91
cup	25	50	14	2	4	14	113
goblet	-	-	-	-	-	-	0
bowl	80	80	53	3	7	31	264
flagon	-	-	-	-	-	-	0
flask	12	10	4	-	-	2	32
jar	33	33	17	2	1	13	104
jug	83	53	34	-	1	20	210
plate	1	1	2	-	-	-	4
drinking-misc	11	15	8	-	4	6	50
tableware-misc	100	70	44	2	5	17	250
vessel-no-class	22	16	6	2	1	3	52
Total	509	480	271	23	34	151	1552

Table 5.5 Colchester Sites Vessel Types by Percentage for Period to 500 CE

Glass Type	Balkerne Lane	Culver Street	Lion Walk	Middleborough	Cups Hotel	Gilberd School	Colchester
bottle	21.2	21.7	23.2	30.4	23.5	19.9	21.7
unguent	2.2	4.6	2.2	-	2.9	2.6	2.9
beaker	4.5	5.4	7.4	21.7	5.9	7.3	5.9
cup	4.9	10.4	5.2	8.7	11.8	9.3	7.3
bowl	15.7	16.7	19.6	13.0	20.6	20.5	17.0
flask	2.4	2.1	1.5	-	-	1.3	2.1
jar	6.5	6.9	6.3	8.7	2.9	8.6	6.7
jug	16.3	11.0	12.5	-	2.9	13.2	13.5
plate	0.2	0.2	0.7	-	-	-	0.3
drinking-misc	2.2	3.1	3.0	-	11.8	4.0	3.2
tableware-misc	19.6	14.6	16.2	8.7	14.7	11.3	16.1
vessel-no-class	4.3	3.3	2.2	8.7	2.9	2.0	3.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The Colchester individual sites with similar bottle, beaker, and jar proportions are presented in Figure 5.5.

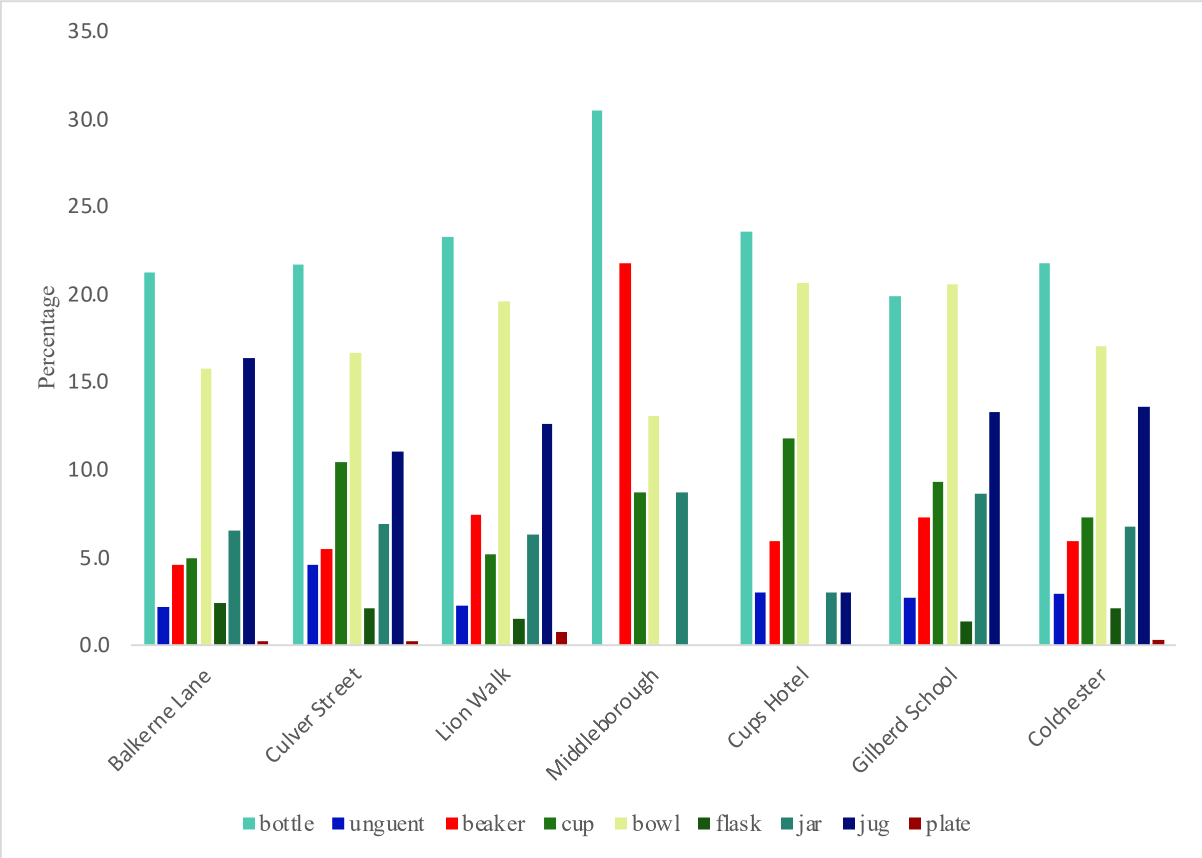


Figure 5.5 Colchester Sites Glass Types by Percentage (to 500 CE)

It shows that Middleborough was different to the broadly comparable Balkerne Lane, Culver Street, Cups Hotel, and Gilberd School sites and with the overall Colchester glass type proportions. Figure 5.6 presents the profile for Middleborough in comparison with the Romano-British corpus.

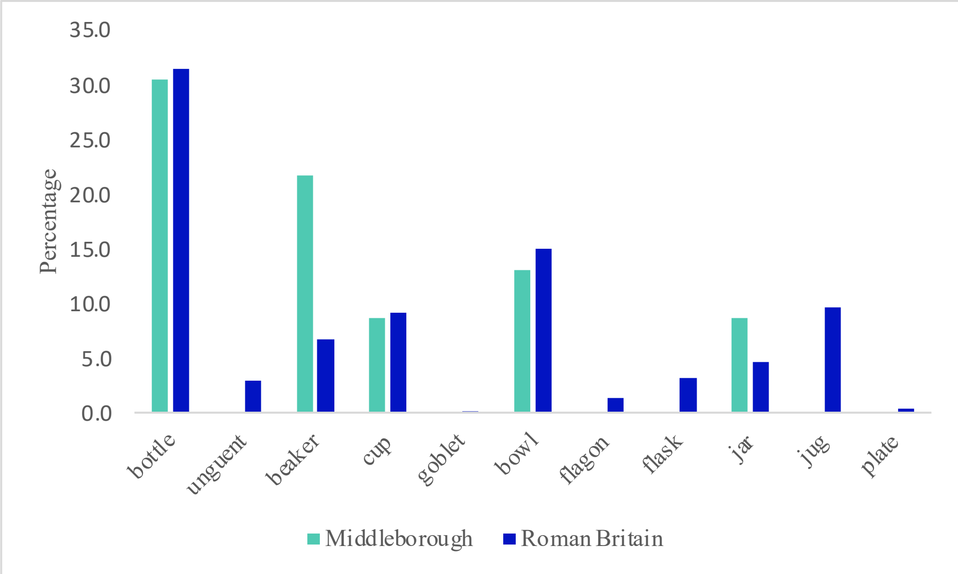


Figure 5.6 Colchester Middleborough Site Glass Types by Percentage (to 500 CE)

The Middleborough site has a different pattern from the inner-city sites with higher bottle and beaker proportions, and no jugs. This site was outside the city walls and was really a 'town house' outside the city walls (Crummy, 1984, p. 155; Cool and Price, 1995, p. 5). The different vessel proportions suggest different drinking and dining activities with the use of bottles as containers for foodstuffs or liquids rather than the use of jugs as serving vessels.

The correspondence analysis shown in Figure 5.7 indicates the association between Middleborough and the beaker as a separate vessel-site association that reinforces the different use of glass at Middleborough.

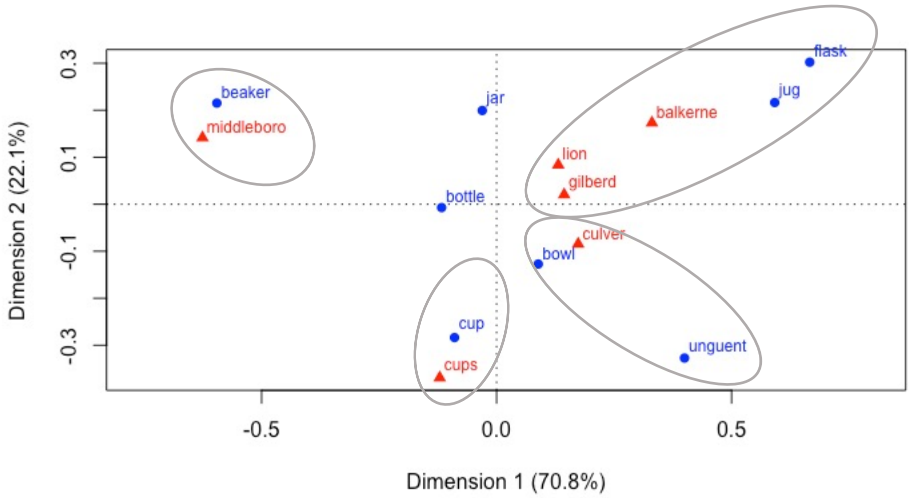


Figure 5.7 Correspondence Analysis of Colchester Sites Glass Types Percentage Compositions (to 500 CE)

The following summary presents a chronological perspective of the changes to the Colchester layout following the departure of the military c. 55 CE (Crummy, 1984). The city perimeter Balkerne Lane site was on the fortress *via sagularis* that was retained when the defences were levelled and the new *colonia* street system laid out c. 54 CE (Crummy, 1984, p. 9).

Balkerne Lane site included buildings and *canabae* until the end of the 3rd century when the city defences were rebuilt, the city gate moved and the buildings demolished. The Gilberd School site was inside the city next to the main city gate with military occupation until c.60/1 CE and thereafter civil buildings and rubbish pits (Cool and Price, 1995, p. 4). The Lion Walk site was in the fortress annexe and the buildings were originally barracks rebuilt in the new city layout c. 54 CE as public buildings, presumed opposite the Temple of Claudius (Crummy, 1984, p. 9). These sites are all associated with flask and jug vessels as can be seen by the alignment in the quadrant (Figure 5.7). These areas would have been teeming thoroughfares for people. Similarly, the Culver Street site included originally tribune dwellings that were replaced by new public buildings in the new development (Crummy, 1984, p. 8). Culver Street is in another quadrant and an association with unguents and bowls also suggests public thoroughfares. The Cups Hotel site was in a separate quadrant with an association with cups. This site was in the central city area near the presumed forum. The bottle: cup ratios for these sites are lower than the other inner-city sites (average 1.6:2.8). These could be indications of different material cultures for the sites. particularly for the Culver Street site which had high status tribune dwellings, and the Cups Hotel site was in the central city area near the forum.

The glass forms for the main Colchester city sites are shown in Table 5.6 and Figure 5.8. Both table and figure data indicate that the glass forms for the inner city sites have the same patterns with the broad range of forms represented, in contrast to the Middleborough site with just pillar-moulded bowls and square bottles. The Cups Hotel site also stands out with a small range of forms that included the ribbed cup. However, the Cups Hotel site sample size with a small range and few forms probably influenced the profile and so is not considered significant.

Table 5.6 Colchester Main Sites Forms Percentage of Vessels for Period to 500 CE

Glass Form	Balkerne Lane	Culver Street	Lion Walk	Middleborough	Cups Hotel	Gilberd School	Colchester
amphorisk	0.8	1.6	1.6	-	-	-	1.0
arcaded-beaker	-	-	-	-	-	-	0.3
bath-flask	3.2	3.2	1.6	-	-	2.0	2.8
cantharos	0.8	0.8	1.6	-	-	-	0.8
conical-jug	7.1	4.8	1.6	-	-	7.8	5.2
cup-base-ring	0.8	8.1	3.1	-	-	2.0	3.6
cylindrical-cup-fire-rim	1.6	2.4	-	-	-	-	1.3
cylindrical-bottle	9.5	4.8	14.1	-	-	2.0	7.3
cylindrical-bowl	2.4	1.6	3.1	-	-	2.0	2.1
frontinus-bottle	0.8	-	1.6	-	-	-	1.0
hofheim-cup	9.5	12.1	12.5	-	-	19.6	11.7
indented-beaker	1.6	1.6	3.1	-	-	5.9	2.3
mercury-flask	0.8	-	-	-	-	-	0.3
pillar-moulded-bowl	35.7	46.8	40.6	66.7	42.9	35.3	40.4
ribbed-bowl	0.8	1.6	1.6	-	-	2.0	1.3
ribbed-cup	-	-	-	-	-	-	0.0
sports-cup	2.4	1.6	-	-	-	2.0	1.6
square-bottle	11.1	4.8	7.8	33.3	42.9	9.8	9.1
tubular-rimed-bowl	11.1	4.0	6.3	-	14.3	9.8	8.0
Total % Forms	100.0	100.0	100.0	100.0	100.0	100.0	100.0

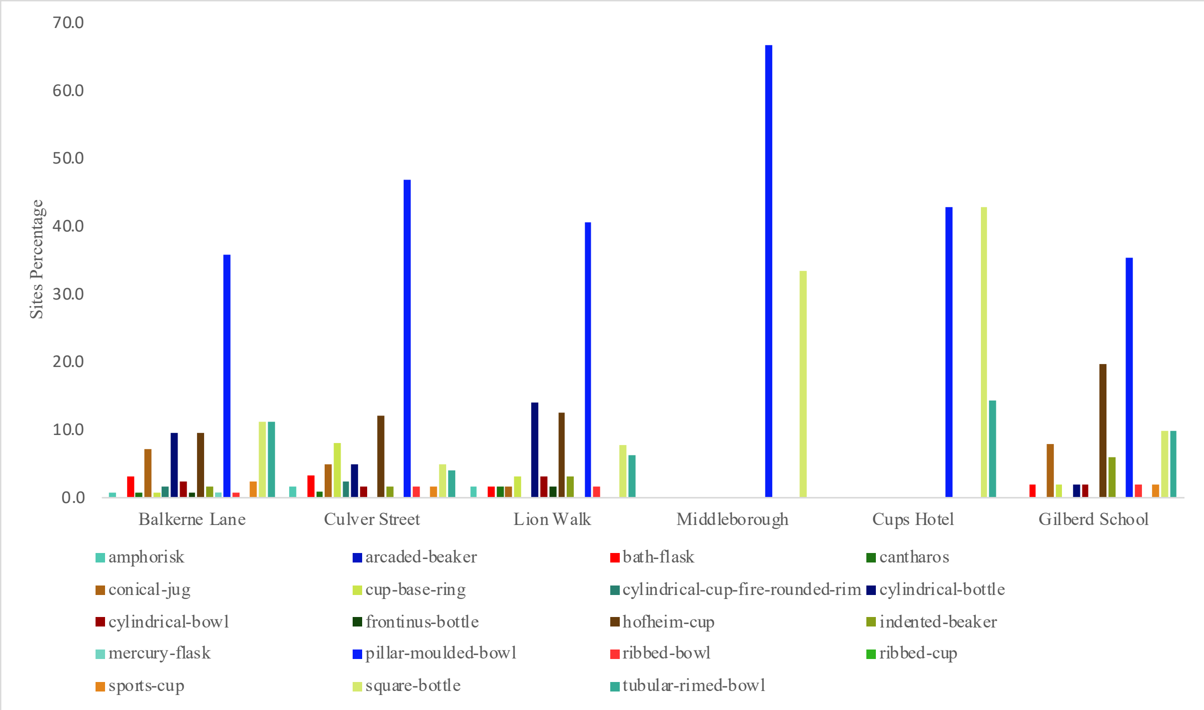


Figure 5.8 Colchester Sites Forms Percentage of Vessels for Period to 500 CE

The graphical and correspondence data plots of the glass types and forms are all consistent in the findings in that 1) tableware is present on all the sites, 2) the sites where people traffic would have been expected have a broad range of containers, drinking vessels and tableware, and 3) the rural suburb site is represented by utilitarian bowls and bottles.

The Colchester settlement glass forms are compared to the other large city glass forms in Table 5.7 and Figure 5.9.

Table 5.7 Large City Glass Forms Percentage of Vessels Comparisons

Glass form	St Albans	Wroxeter	Colchester	Silchester
cylindrical bottle	0.8	5.3	1.8	7.3
frontinus-bottle	-	1.1	0.3	-
square-bottle	9.3	5.3	2.3	12.0
arcaded-beaker	-	-	0.1	-
cantharos cup	-	-	0.2	-
cup-base-ring	-	2.8	0.9	1.0
cylindrical-cup	-	1.1	0.3	0.3
hofheim-cup	-	3.5	2.9	0.3
indented-beaker	0.8	0.4	0.6	0.7
ribbed-cup	-	-	-	0.7
sports-cup	-	-	0.4	-
amphorisk jug	-	-	0.3	1.0
bath-flask	0.3	2.5	0.7	-
conical-jug	-	1.8	1.3	1.3
cylindrical-bowl	3.6	-	0.5	0.7
mercury-flask	-	-	0.1	0.3
pillar-moulded-bowl	4.1	4.9	10.1	5.3
ribbed-bowl	3.1	0.7	0.3	0.7
tubular-rimed-bowl	8.3	2.5	2.0	0.3

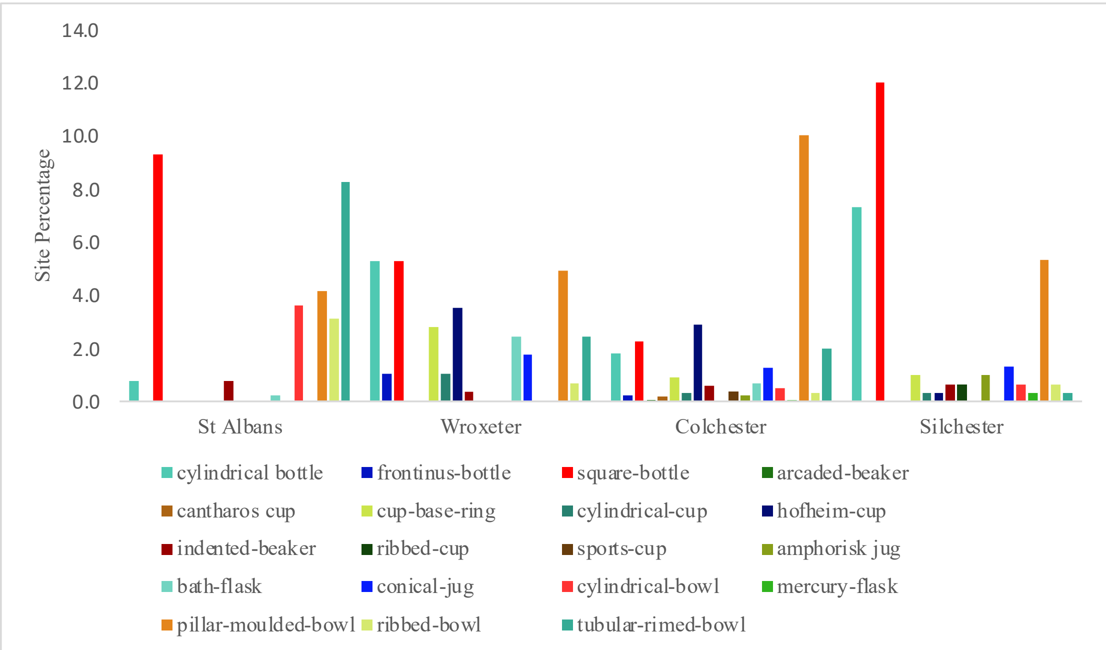


Figure 5.9 Colchester, Silchester, St Albans and Wroxeter City Sites Forms Percentage of Vessels for Period to 500 CE

The proportional glass form compositions for Colchester and Wroxeter have similar patterns with the same broad range of forms that are also comparable with the Colchester inner-city sites of Balkerne Lane, Culver Street and Lion Walk. While glass forms are a sub-set of glass types, these similarities suggest similar material cultures.

Silchester had a higher proportion of cylindrical and square bottles and an absence of bath-flasks. St Albans had a reduced range of forms with a predominance of bowls (St Albans 15.5% vs 8.9% group mean) that included the ribbed and tubular-rimmed bowl glass forms. These differences all contribute to building comparative patterns and descriptions of the sites' profiles that will be further discussed later in this chapter (Section 5.4).

The chronological profiles for Colchester were analysed and are presented in the next section.

5.2.2 Colchester Chronological Profiles

The Boudican revolt in 60/1 CE razed the city to the ground and so the archaeological excavation sites revealed a mid 1st century time capsule followed by three centuries of glass consumption. The Colchester vessel type percentage counts are shown in Table 5.8 and Figure 5.10 for the periods to 43-61 CE, 61-96 CE, 100-200 CE and 200-400 CE.

Table 5.8 Colchester Vessel Types Percentage Counts (Periods 43-400 CE) Based on the Catalogue Glass Data in Cool and Price (1995)

Glass Type %	Colchester 43-61	Colchester 61-96	Colchester 100-200	Colchester 200-400	Colchester 43-500
bottle	10.2	15.5	18.9	25.9	21.7
unguent	4.8	2.8	2.7	2.3	2.9
beaker	5.4	8.5	12.2	6.5	5.9
cup	9.0	4.2	5.4	9.5	7.3
goblet	-	-	-	-	0.0
bowl	32.5	19.7	10.8	9.9	17.0
flagon	-	-	-	-	0.0
flask	-	1.4	4.1	2.7	2.1
jar	2.4	7.0	9.5	5.7	6.7
jug	15.7	26.8	9.5	11.8	13.5
plate	-	1.4	-	-	0.3
drinking-misc	4.8	2.8	4.1	4.9	3.2
table-misc	12.0	8.5	18.9	16.7	16.1
no-class	3.0	1.4	4.1	4.2	3.4
Total %	100.0	100.0	100.0	100.0	100.0

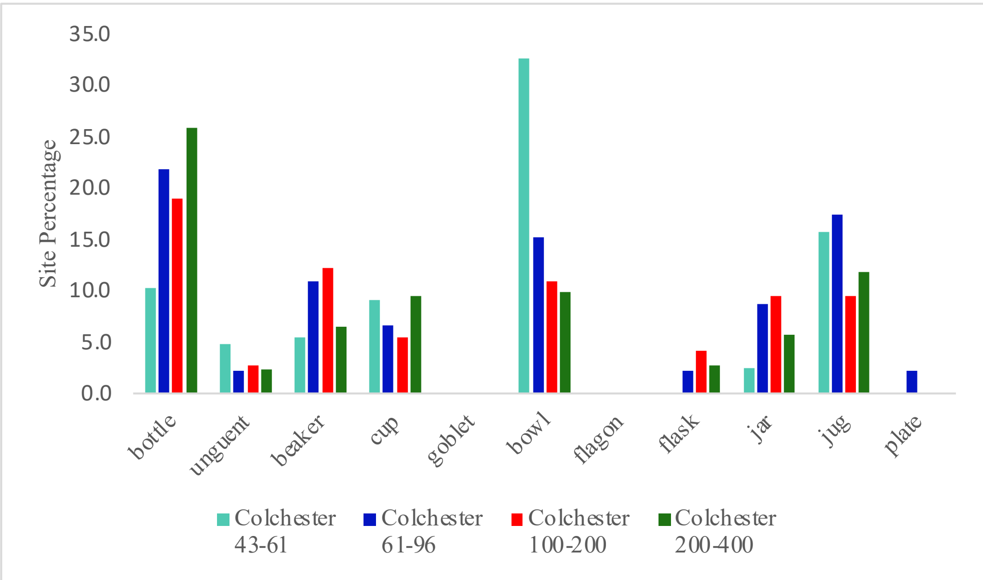


Figure 5.10 Colchester Vessel Types Percentage for Period 43 to 400 CE

This analysis of the data shows a dramatic change for the second part of the 1st century with fewer glass assemblages, and changed proportions of glass types, particularly bowls, and increased proportions of bottles. The Colchester glass vessel colours are compared for the periods 43-61, 61-96, 100-200 and 200-400 CE in Figure 5.11.

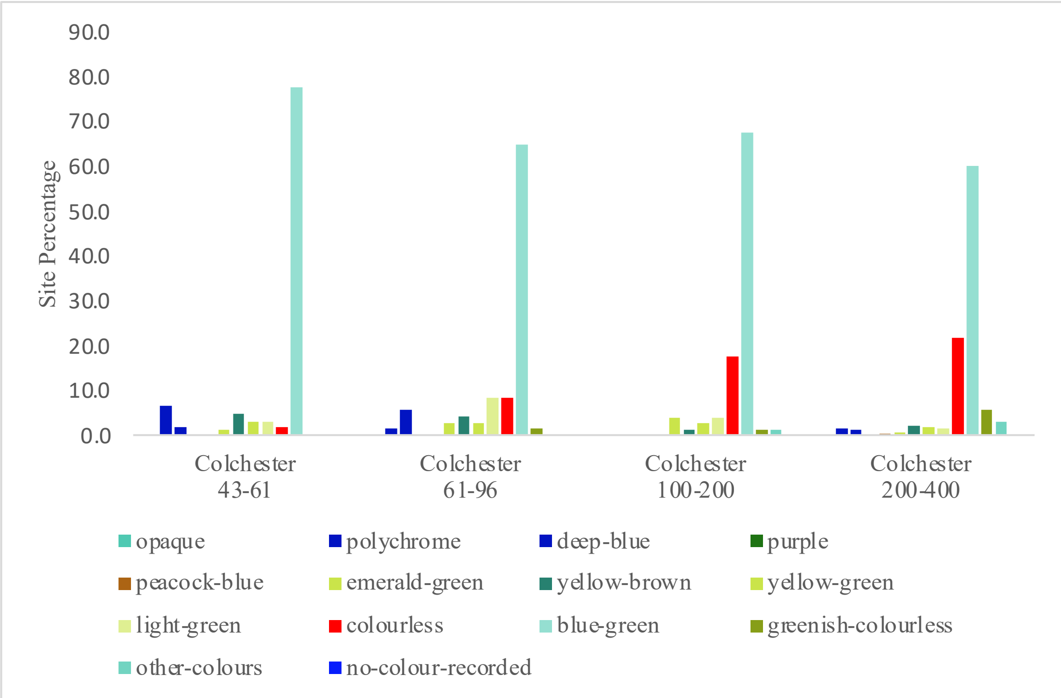


Figure 5.11 Colchester Percentage Vessel Colours for the Periods 61 to 400 CE

The relationship was recognised in Chapter 4 between colours and vessel types. Chronologically, bowls were generally of strong colours in the 1st century CE and drinking vessels tended to be colourless from the 2nd century CE.

This chronological pattern is illustrated in the correspondence analysis of the time periods in the 1st and 2nd centuries in Figure 5.12. This shows the association of vessels with the site changing from bowls to jugs and then to beakers for the periods 43-61, 61-96 and 100-200 CE respectively. These are confirmations from the statistical probabilities of associations of vessel types of the changes to the data over the period phases.

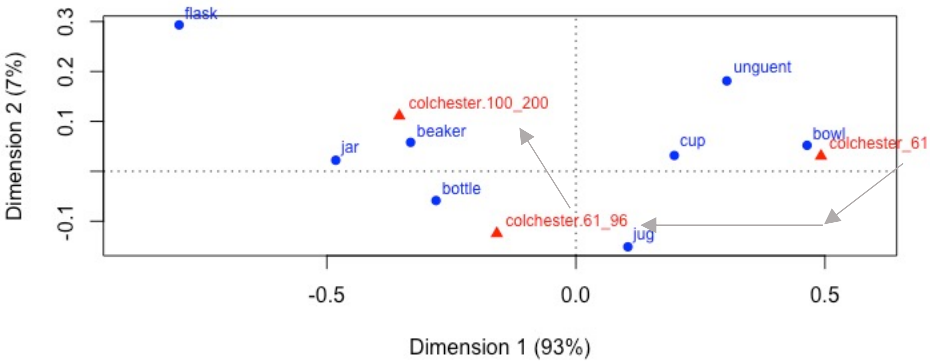


Figure 5.12 Correspondence Analysis of Colchester Glass Types Percentage Counts 60 CE, 61/96 CE and 2nd Century Periods

The proportional vessel forms as a percentage of the site vessels are set out in Table 5.9 and Figure 5.13. These changes of the glass forms from 43 to 61 CE, the next period 61-96 CE following the Boudican revolt and the cumulative inventory of forms by 500 CE correspond with the trend from the glass types. The following analysis discusses each period.

Table 5.9 Colchester Vessel Forms as % of the Site Vessels (c.61 CE, 61-96 and c.500 CE)

Colchester Forms	Form % 43-61CE	Form % 61-96CE	Form % 43-500CE
amphorisk	1.2	-	0.3
arcaded-beaker	-	-	0.1
bath-flask	-	-	0.7
cantharos	0.6	-	0.2
conical-jug	1.8	4.2	1.3
cup-base-ring	-	-	0.9
cylindrical-cup-fire-rounded-rim	-	-	0.3
cylindrical-bottle	2.4	1.4	1.8
cylindrical-bowl	-	-	0.5
frontinus-bottle	-	-	0.3
hofheim-cup	7.8	2.8	2.9
indented-beaker	0.6	-	0.6
mercury-flask	-	-	0.3
pillar-moulded-bowl	25.9	12.7	10.1
ribbed-bowl	-	-	0.3
ribbed-cup	-	-	-
sports-cup	-	1.4	0.4
square-bottle	1.8	1.4	2.3
tubular-rimed-bowl	3.0	2.8	2.0
Total % of Site Vessels	45.2	26.8	25.1

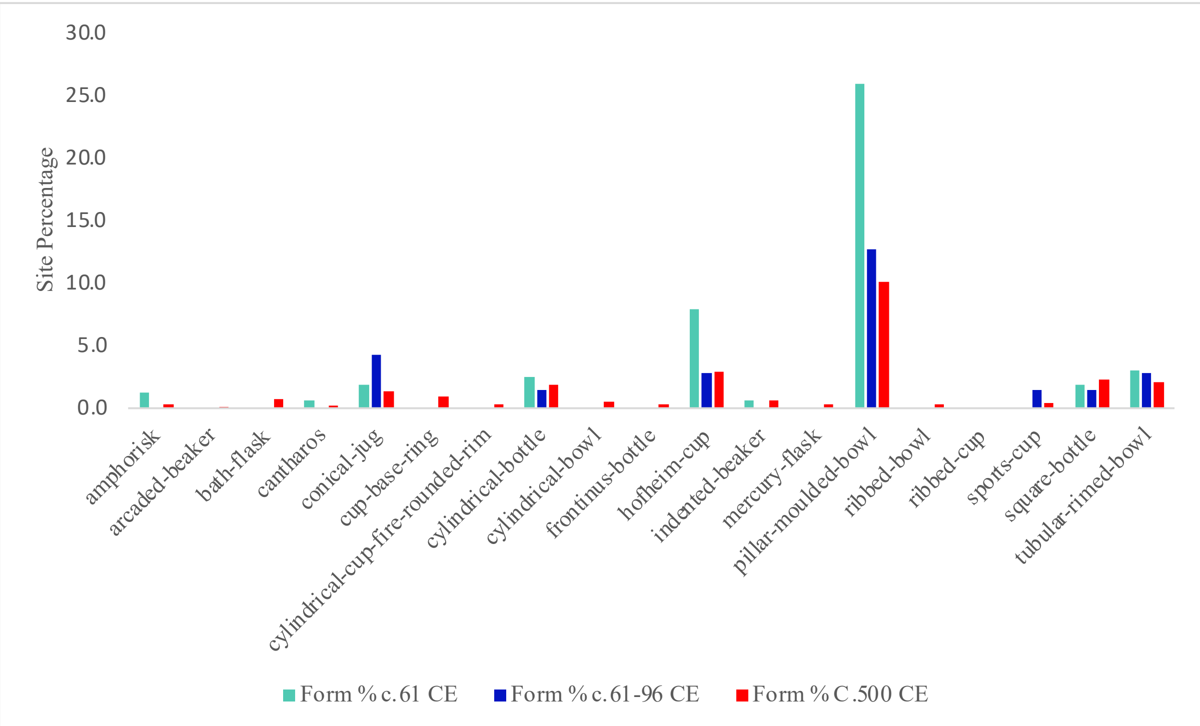


Figure 5.13 Colchester Glass Forms as % of Site Vessels for c. 61, c. 61-96 and to c.500 CE

In *c.* 61 CE, the drinking vessel forms are indications of a community that valued decorated drinking vessels with evidence of the cantharus cup, the Hofheim cup and the indented beaker (Figs. 4.76, 4.84). Pottery small bowls and cups were also popular at this time in Roman Gaul (Luley, 2018). The tableware forms included the pillar-moulded bowl and the tubular-rimmed bowl. The most common glass vessel forms in the mid 1st century were cast pillar moulded bowls and these were *c.* 25% of the site vessels in the 61 CE assemblages. The Colchester fragments were mostly made from blue-green glass, with other fragments made from yellow-brown, light green and polychrome glass. Tubular-rimmed bowls were made as blown vessels and there were two recognised forms, the deep and less common shallow bowl forms (Price and Cottam, 1998, pp. 77, 78). Both had a similar rim size and were made from strong glass colours with polychrome and natural blue-green examples. At least one of the Colchester fragments was of the less common shallow tubular-rimmed bowl and made in emerald-green glass that is even more unusual (Jackson and Cottam, 2015). These examples reinforce the image of a community that valued 'special' glass forms and used them for dining and drinking activities.

The next development of Colchester is the remaining period in the 1st century, 61-96 CE. The proportions of large containers (bottles) and drinking vessels increase significantly by factors of *c.* 2.5 times and *c.* 2 times respectively, with tableware decreasing by 25% (Table 5.8). One should be cautious about interpreting any trends for drinking vessels, jars or jugs, given the assemblage counts for the 61-96 CE period is less than for the other periods, and the vessels able to be identified decreased as indicated by the higher miscellaneous and no-class categorised fragments. Nevertheless, the rise in vessel types and forms seems to indicate that the trade in glass in Roman Colchester was back to the pre-Boudican levels but with a different profile of glass vessel types.

The destruction of the city during the 61 CE revolt was a significant change to Colchester and the 61-96 CE assemblages reflect that with the increase in bottles and decrease in bowls. The bottles could be indications of a renewed trade in oil and wine. The changes to the proportion of pillar-moulded bowls are evidence of an old glass technology bowl being replaced with blown glass bowls as glassblowing became the preferred glass-working process (Prior 2015). The subtleties in shape and colour changes might also illustrate consumer appreciation for new tableware forms.

The individual Colchester sites data offer further detailed insights as to the changes during these periods. The glass type percentage distributions for the Balkerne, Culver and Lion sites are shown in Tables 5.10, 5.11, 5.12 and 5.13 for the period phases to *c.*61, 61-96, 100-200 and 200-400 CE with additional individual sites included with sufficient sample sizes.

Table 5.10 Colchester Sites Vessel Percentage Profiles 43-61 CE

Glass Type %	Balkerne 43-61	Culver 43-61	Gilberd 43-61	Lion 43-61	Colchester 43-61
bottle	4.5	4.9	17.9	14.3	10.2
unguent	-	9.8	7.7	2.4	4.8
beaker	2.3	2.4	10.3	7.1	5.4
cup	13.6	7.3	7.7	7.1	9.0
goblet	-	-	-	-	-
bowl	40.9	36.6	17.9	33.3	32.5
flagon	-	-	-	-	-
flask	-	-	-	-	-
jar	2.3	4.9	2.6	-	2.4
jug	15.9	14.6	12.8	19.0	15.7
plate	-	-	-	-	-
drinking-misc	-	9.8	7.7	2.4	4.8
table-misc	15.9	7.3	12.8	11.9	12.0
no-class	4.5	2.4	2.6	2.4	3.0
Total %	100.0	100.0	100.0	100.0	100.0
Counts	44	41	39	42	166

Table 5.11 Colchester Sites Vessel Percentage Profiles for 61-96 CE

Glass Type %	Balkerne 61-96	Culver 61-96	Wyre 61-96	Lion 61-96	Colchester 61-96
bottle	11.8	66.7	-	18.8	15.5
unguent	3.9	-	-	-	2.8
beaker	3.9	-	-	25.0	8.5
cup	5.9	-	-	-	4.2
goblet	-	-	-	-	-
bowl	21.6	-	-	18.8	19.7
flagon	-	-	-	-	-
flask	2.0	-	-	-	1.4
jar	3.9	-	-	18.8	7.0
jug	29.4	33.3	100.0	12.5	26.8
plate	2.0	-	-	-	1.4
drinking-misc	3.9	-	-	-	2.8
table-misc	9.8	-	-	6.3	8.5
no-class	2.0	-	-	-	1.4
Total %	100.0	100.0	100.0	100.0	100.0
Counts	51	3	1	16	71

Table 5.12 Colchester Sites Vessel Percentage Profiles for 100-200 CE

Glass Type %	Balkerne 100-200	Culver 100-200	Middle+ 100-200	Lion 100-200	Colchester 100-200
bottle	50.0	28.6	10.0	16.7	18.9
unguent	-	7.1	-	2.1	2.7
beaker	-	7.1	30.0	10.4	12.2
cup	-	-	-	8.3	5.4
goblet	-	-	-	-	-
bowl	-	14.3	10.0	10.4	10.8
flagon	-	-	-	-	-
flask	-	-	10.0	4.2	4.1
jar	-	21.4	10.0	6.3	9.5
jug	50.0	-	20.0	8.3	9.5
plate	-	-	-	-	-
drinking-misc	-	7.1	-	4.2	4.1
table-misc	-	14.3	-	25.0	18.9
no-class	-	-	10.0	4.2	4.1
Total %	100.0	100.0	100.0	100.0	100.0
Counts	2	3	10	48	74

Table 5.13 Colchester Sites Vessel Percentage Profiles for 200-400 CE

Glass Type %	Balkerne 200-400	Culver 200-400	Cups+ 200-400	Lion 200-400	Colchester 200-400
bottle	26.9	21.5	18.2	44.0	25.3
unguent	0.0	2.8	6.1	4.0	2.2
beaker	6.7	5.6	6.1	8.0	6.3
cup	2.9	15.0	12.1	8.0	9.3
goblet	-	-	-	-	-
bowl	7.7	8.4	18.2	12.0	9.7
flagon	-	-	-	-	-
flask	2.9	2.8	3.0	-	2.6
jar	3.8	8.4	3.0	4.0	5.6
jug	14.4	11.2	3.0	12.0	11.5
plate	0.0	-	-	-	-
drinking-misc	4.8	3.7	12.1	-	4.8
table-misc	25.0	15.0	15.2	8.0	18.2
no-class	4.8	5.6	3.0	-	4.5
Total %	100.0	100.0	100.0	100.0	100.0
Counts	104	107	33	25	269

These tables show that the broad range of vessel types for 43-61 CE reduced in the period 61-96 CE following the Boudican revolt for all the inner city sites except for the Balkerne Lane site that was next to the main gate. The Balkerne Lane city gate was demolished in the late 3rd century and earlier changes could be reflected in the reduced range in the 2nd century CE. The other inner-city sites show similar trends of reduced ranges and recovery back to the *c.* 61 CE situation by the 3rd century CE.

The graph of the glass percentage counts to 61CE for the individual Colchester sites is shown as Figure 5.14. This was compared with the correspondence analysis plot of the data in Figure 5.15.

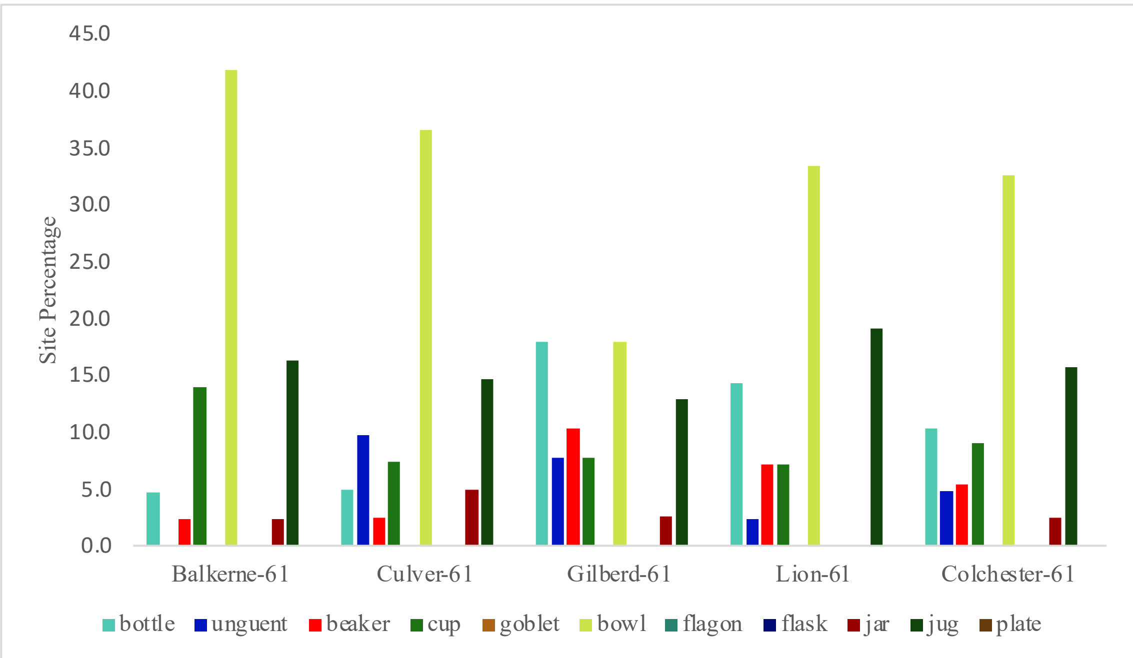


Figure 5.14 Colchester Sites Percentage Compositions for the Period 43-61 CE

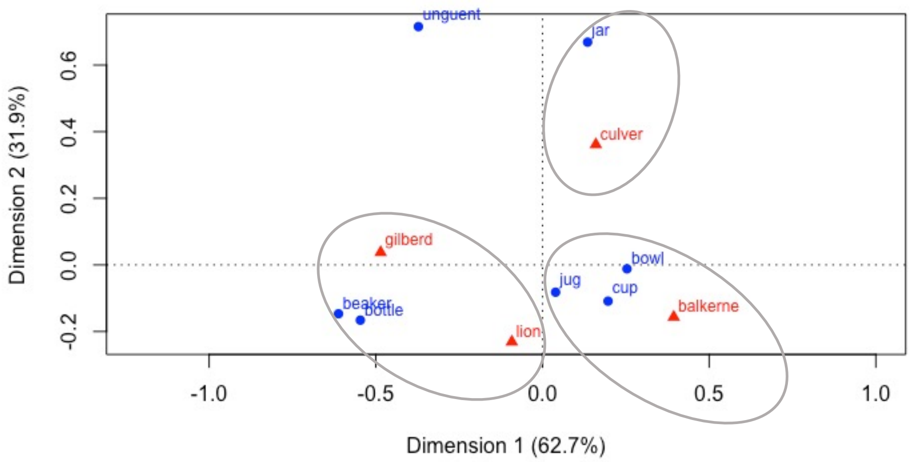


Figure 5.15 Colchester Sites Showing Glass Type Associations (c 49-60/1 CE

The archaeological site detail represented in both figures is necessary to provide the context for the glass assemblages. The Culver Street tribunes' houses have an association with the glass jar. Jars are small capacity glass vessels similar in size to cups (*c.* 80mm rim dia.). It is known that wide-rimmed pottery jars were used for cooking and serving (Cool, 2006, p. 54). The tribunes in Culver Street could have been drinking from Lyon colour-coated pottery fine ware that were present in also Balkerne Lane and Lion Walk from c. 55-125 CE (Symonds and Wade, 1999, p. 227). The Colchester glass jars could have been used as storage vessels or possibly small drinking vessels, but as glass vessels these would not have been used for cooking (Heat resistant glass being a 20th century invention). The Lion Walk and Gilberd School sites both had barracks buildings and the association with beaker and bottle does suggest drinking in contrast to the Culver Street site of jar (possible use of cup) based on the material culture patterns between the tribunes' houses and barracks. The Balkerne Lane site was the main gate to the city and an association with the various vessels bowl, cup and jug could be an indication of other social groups.

These pre-Boudican profiles can be compared to the next period of 61-96 CE in Figure 5.16.

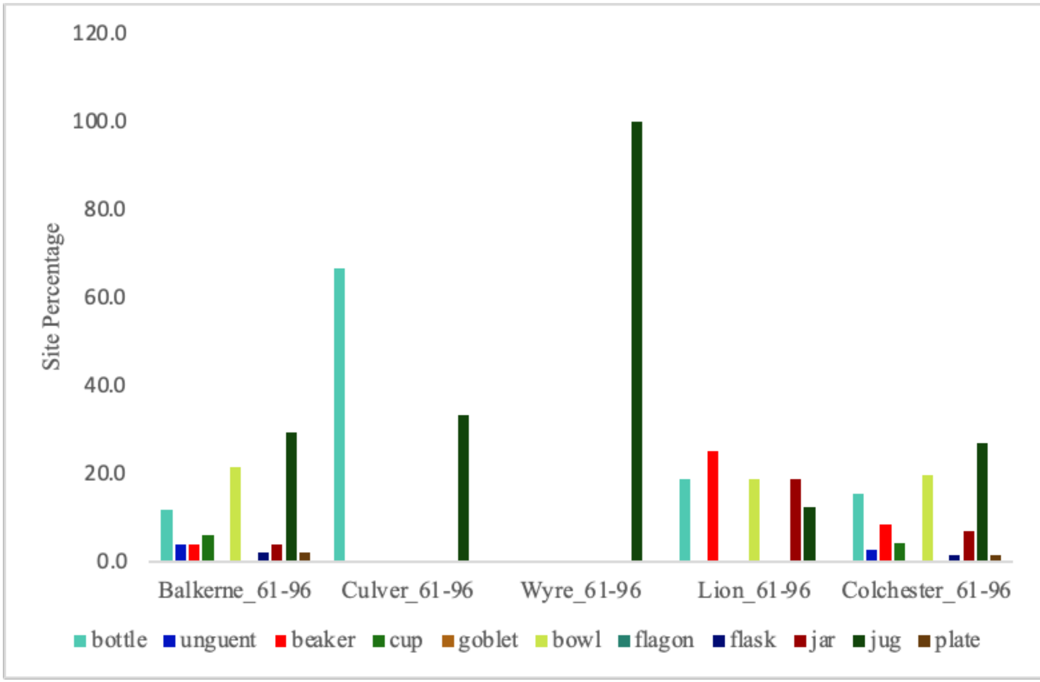


Figure 5.16 Colchester Sites Percentage Compositions for the Period 61-96 CE

The change is dramatic, with the Balkerne Lane and Lion Walk sites having sample sizes that could be used for analysis shown together with the Colchester site for comparison. The glass type patterns show the Culver Street and Long Wyre sites with much reduced ranges of glass types represented than at the Balkerne Lane and Lion Walk sites. These changes in the presence of glass reflect changes with the community lifestyles and supply into those areas. The archaeology has identified the areas of destruction to Colchester from the Boudican revolt that seem to be mainly those areas inside the original fortress boundaries (Figure 5.17). The changes to the glass assemblages from the individual sites following this event include a reduction in the proportions of bowl that is consistent with the overall large city data. The Balkerne Lane site was at the perimeter main gate and would have been less impacted by destruction than the Long Wyre, Lion Walk and Culver Street sites, that included the inner-city barrack and tribune buildings.

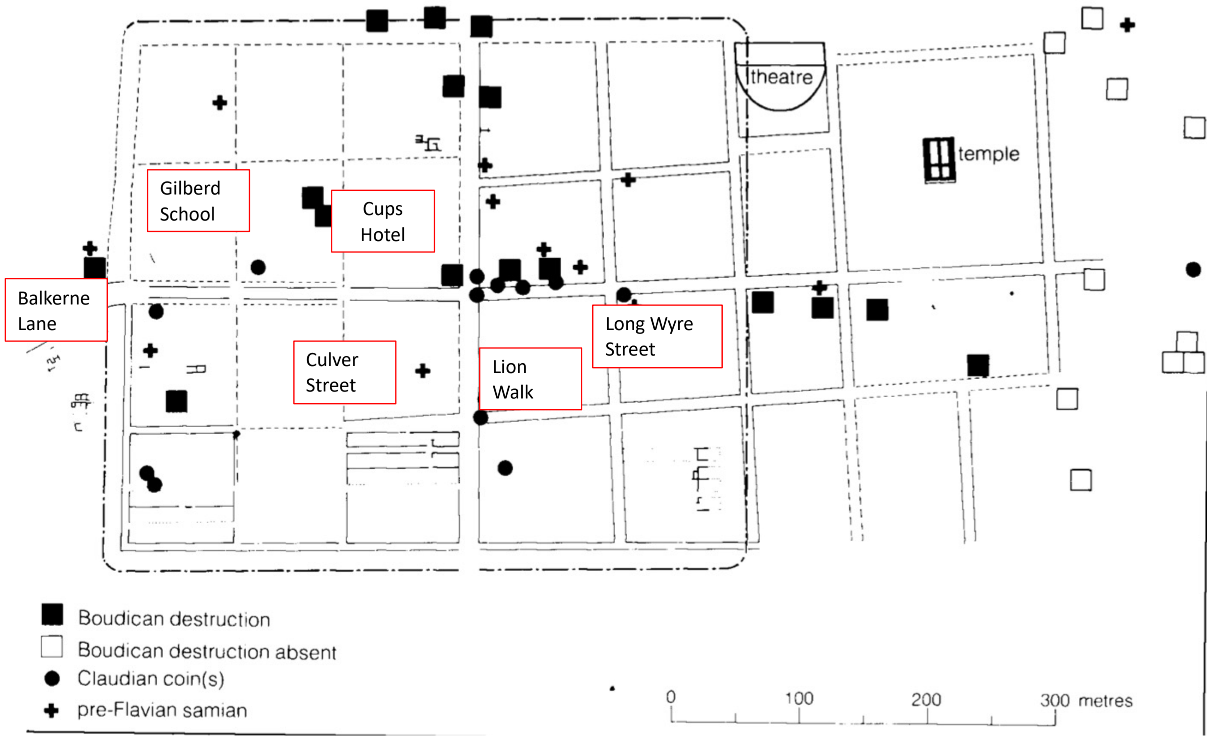


Figure 5.17 Colchester Sites Showing the Boudican Destroyed Areas – Colchester Period 2 (49-60/1 CE)

Source: (Crummy, 1984, p. 4 Fig. 4 with additions)

The 2nd century Colchester vessel profiles represent a resurgence of the types and forms at the Culver Street and Lion Walk sites. Middleborough was developed as a suburb of Colchester and the site profile can be seen to be different from the city sites with the higher proportion of bottle and bowl as shown in Figure 5.18.

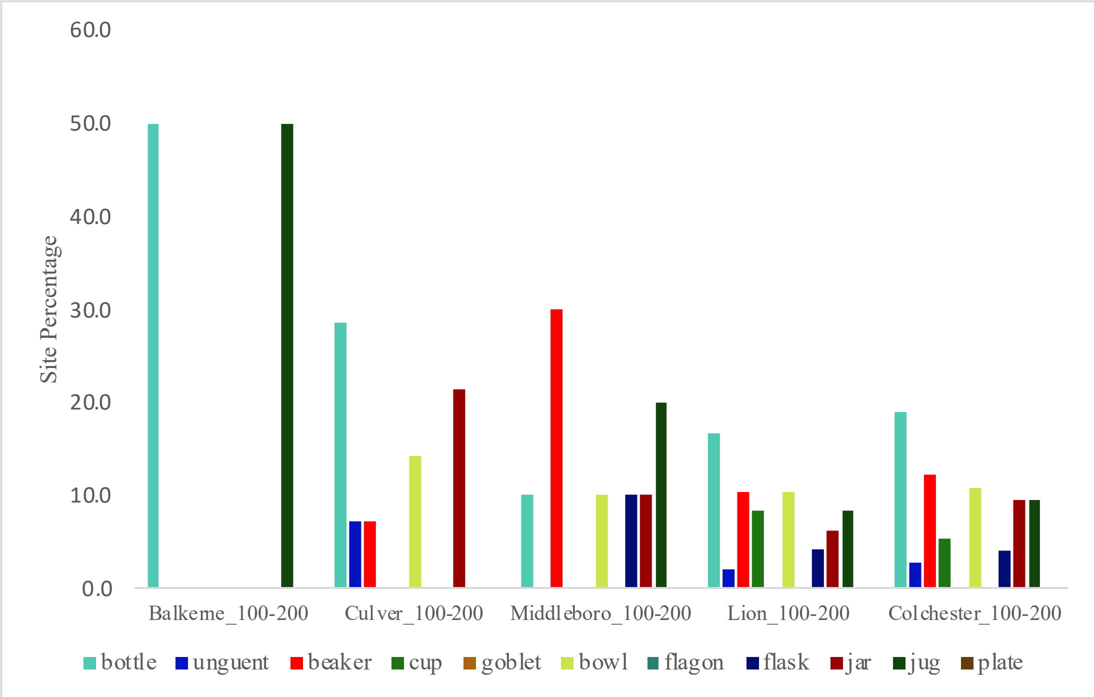


Figure 5.18 Colchester Sites Percentage Compositions for the Period 100-200 CE

This could be a pattern synonymous with rural or native drinking habits that will be investigated further with other city and rural settlements (Cool, 2006, p. 178). The data analysis as illustrated in Figure 5.19 shows that by the periods 200-400 CE, there was a return to the variety of vessel types and forms towards more drinking vessels such as the beaker and cup in proportion to the bowl.

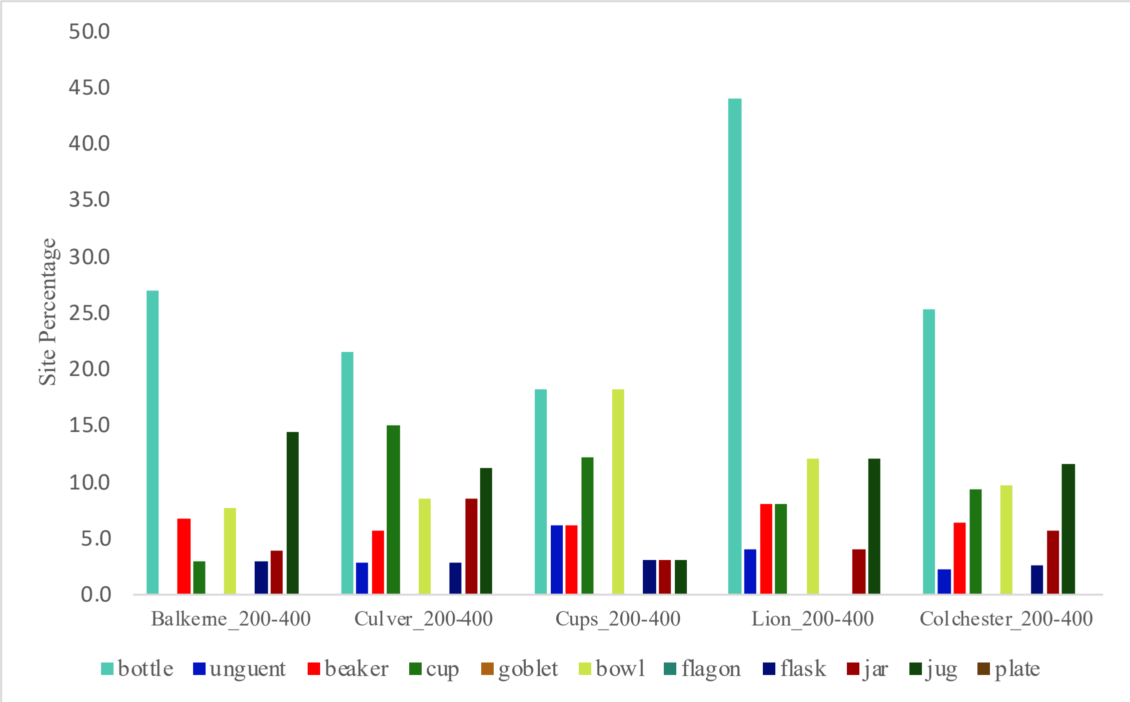


Figure 5.19 Colchester Sites Percentage Compositions for the Period 200-400 CE

This was also associated with a shift in the colour spectrum towards colourless glass as shown in Figures 5.20, 5.21, 5.22, 5.23 that would be associated with the trend towards more drinking vessels across the sites.

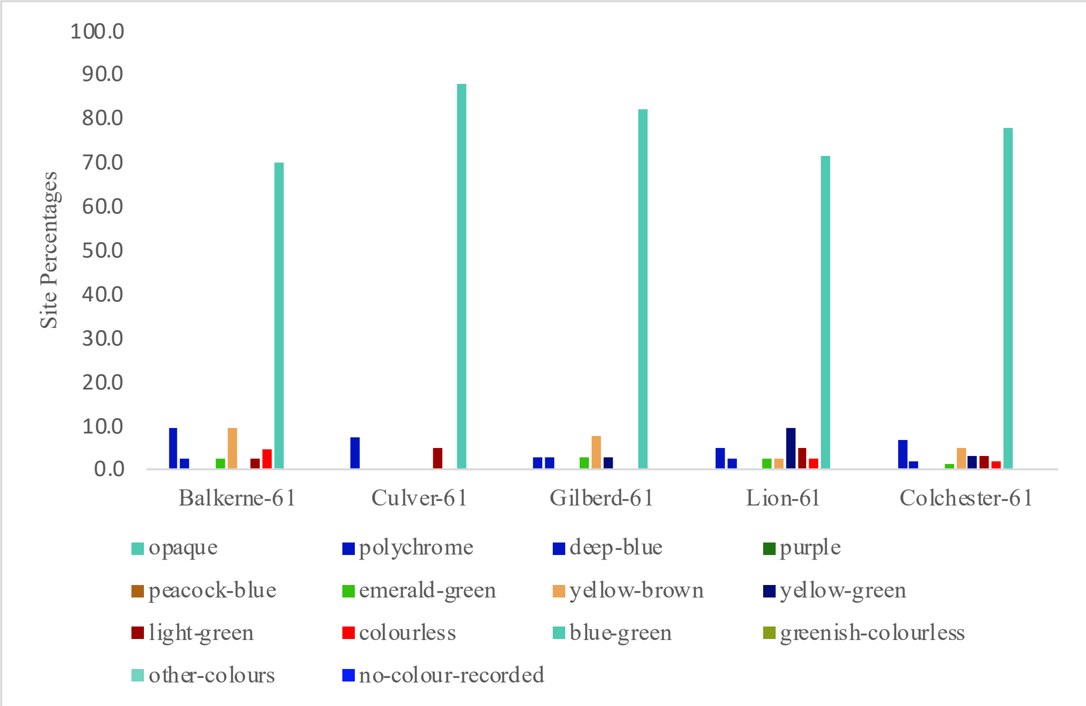


Figure 5.20 Colchester Sites Percentage Vessel Colours for the Period to 61 CE

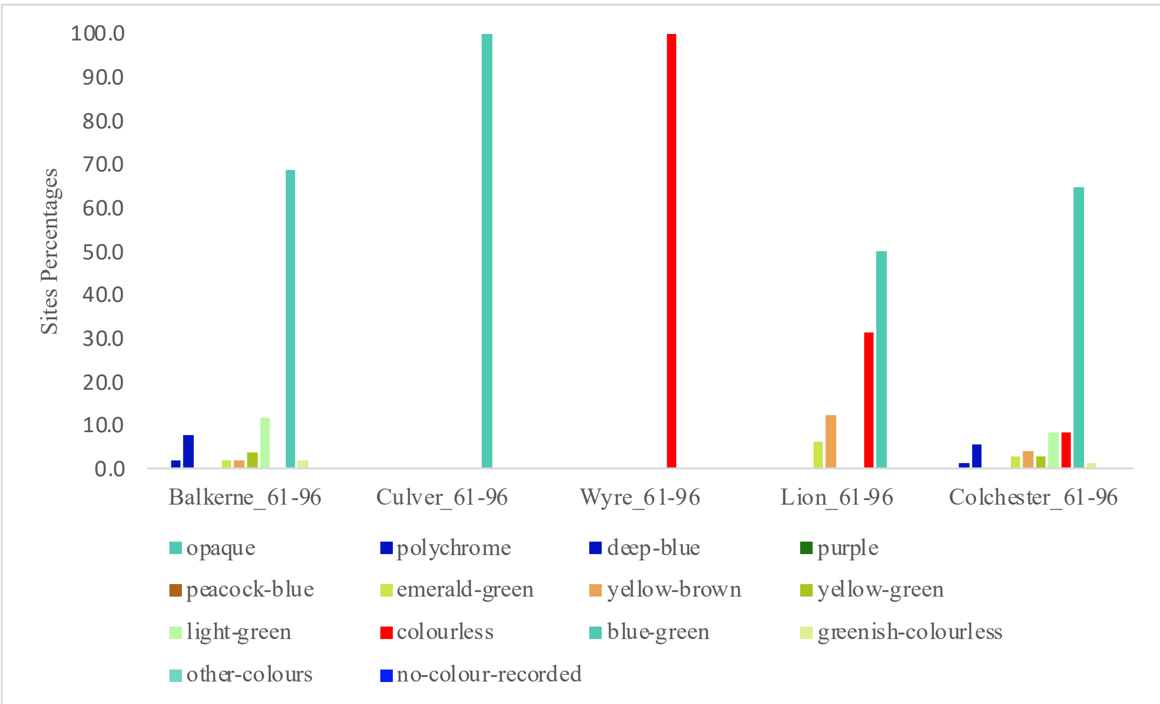


Figure 5.21 Colchester Sites Percentage Vessel Colours for the Period to 61-96 CE

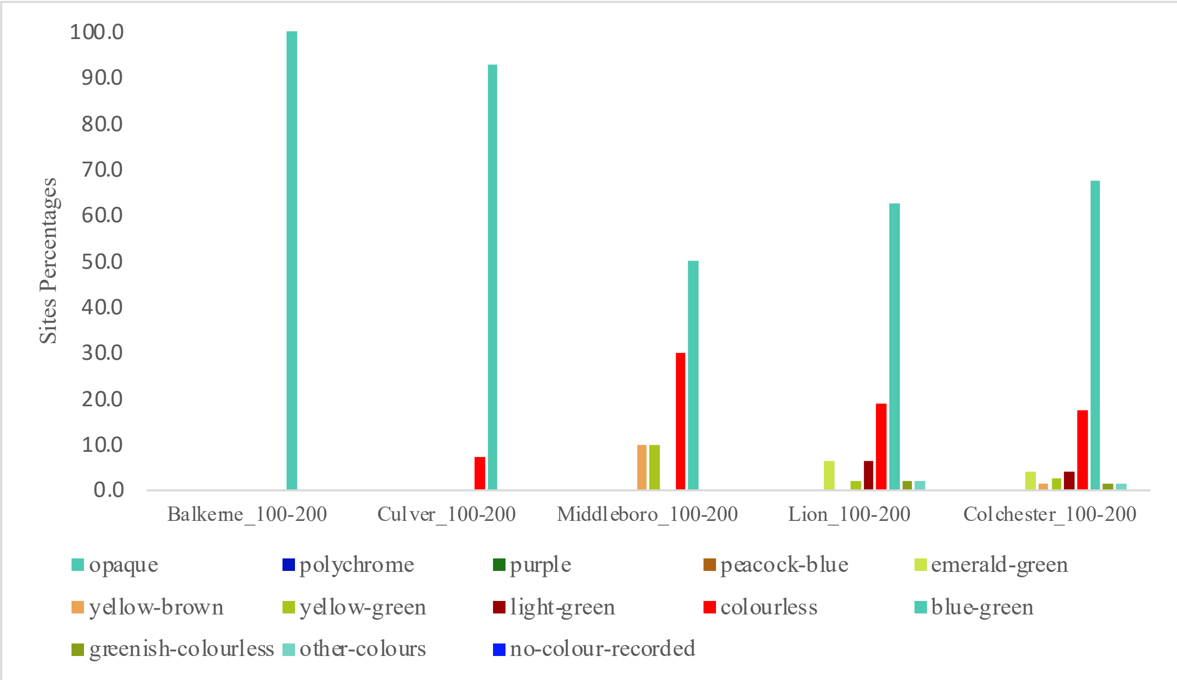


Figure 5.22 Colchester Sites Percentage Vessel Colours for the Period to 100-200 CE

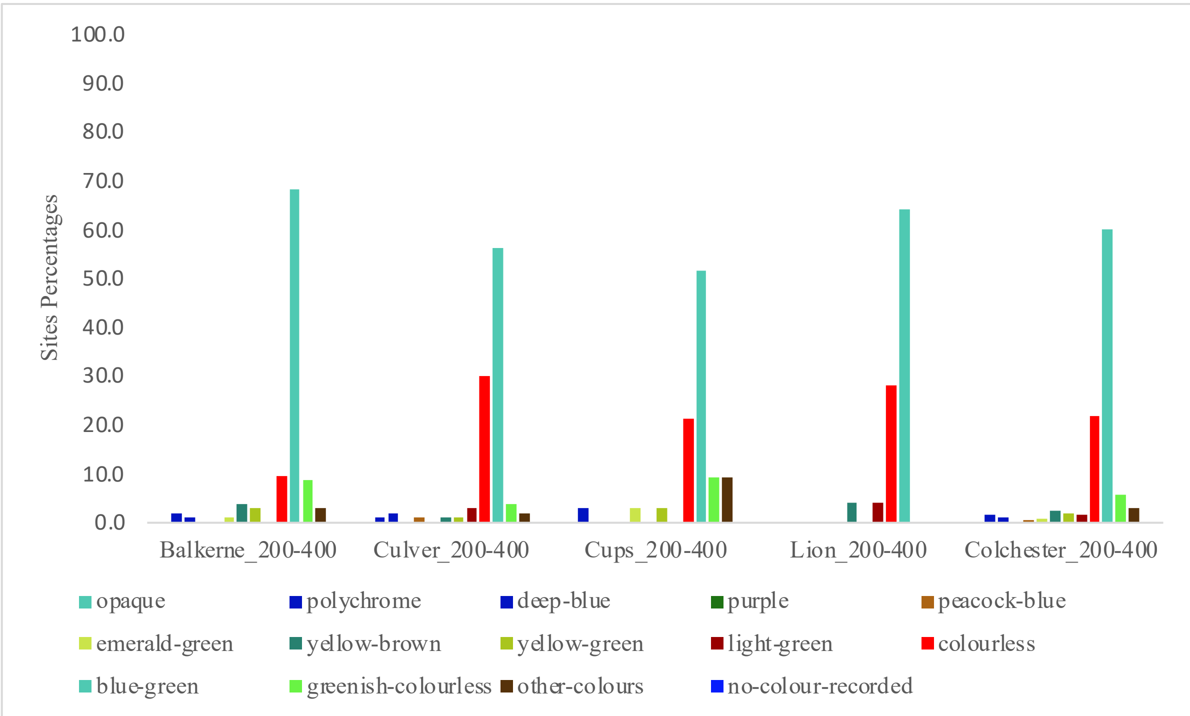


Figure 5.23 Colchester Sites Percentage Vessel Colours for the Period to 200-400 CE

The increased use of bottles in this period is also noted across all the Colchester sites, including in particular the Lion Walk site that was in the vicinity of the presumed *basilica*. This is an indication of the increase in social activity and trade in oil and wine glass containers over these periods.

The analysis of the Colchester individual sites and the evidence confirm the following:

- The Colchester inner city sites had a very similar profile to that for the overall Colchester large city - as shown by the % site distribution and % graphical profiles
- Middleborough was a site outside the fortress ramparts and is described as a suburb. As an individual site, this had a different profile to the city sites, and will be compared to rural and town settlements (Middleborough existed for the 2nd and 3rd centuries only)
- The changes in the material record for the 1st century reflect the withdrawal of the *Legio XX* and the impact of the Boudican revolt with reduced glass forms following the event and a reduced proportion of bowls on all the individual sites
- The evidence of glass bowl and bottle type associations from barracks may be an indication of communal drinking versus jar, cup and jug associations from tribunes' houses
- The pattern of changes from the 2nd century suggests a levelling of proportions through to 500CE, and the counts return to the pre-61CE levels
- This is affirmational evidence that there is percentage proportional equivalence across data sets that further supports the sites comparative analysis approach independent of site sample size

These points will be further considered through the analysis of the study corpus selected site types in the following section starting with the large city sites.

5.2.3 Large City Sites

The site type profiles of the vessel classes show the proportions of the glass classes for each of the site groups, based on the collated data for the individual sites that has been presented in Chapter 4, Figures 4.2 and 4.3. The site vessel type profiles for the large cities and fortresses have similar broad ranges of types, with the bottle, beaker and bowl dominant on each of the sites. There are observable patterns with the profile for Colchester similar in range and shape to Wroxeter. These site profiles are also fairly similar to the Usk, Wroxeter and York fortresses in range and shape. The range and shape of the St Albans and the Silchester profiles are noticeably different to the others.

A comparison of Colchester with the other large city settlements is first based on the relative proportions of glass types for the chronological period to 500 CE. There is a broad range of vessel types in the large cities as shown in Figure 5.24.

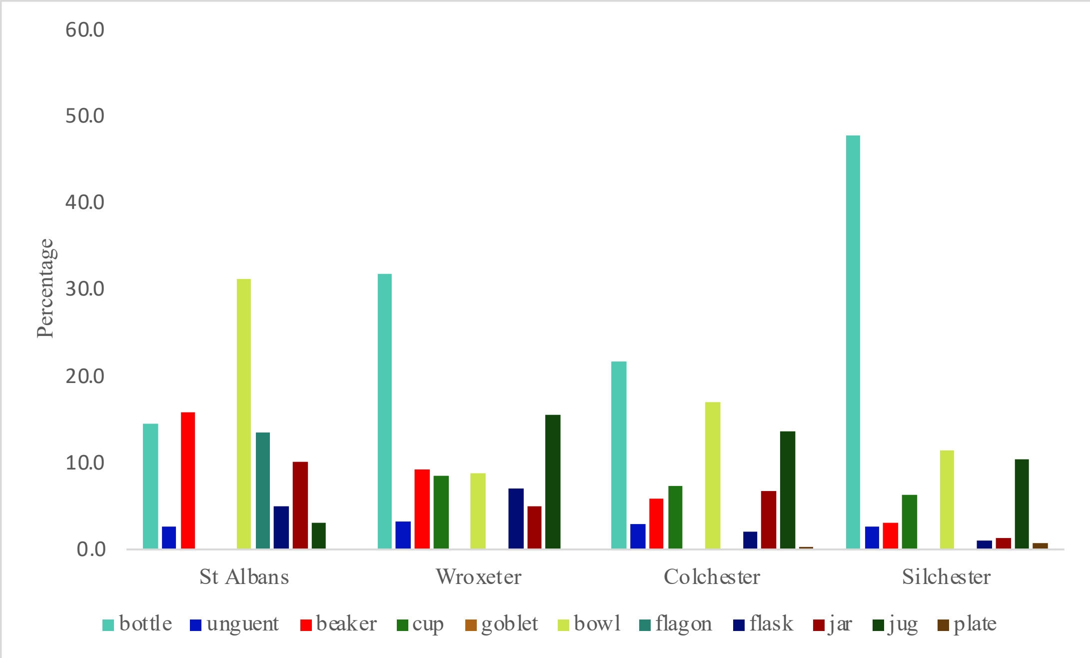


Figure 5.24 Large Cities – Site Glass Types Percentage Counts to 500 CE

The *Verulamium* site (near St Albans) records included the flagon as a vessel type with 52 accession line counts of mainly single fragments dated the 1st to 2nd century CE (Charlesworth, 1972). The description of the flagon fragments was written into the narrative of the report that gives details of the body, neck and handle shapes without being specific about each fragment. Based on the evidence, the flagon vessels either had a shortish, wide neck with a globular or conical body or they had a long narrow neck with various body shapes. There was a figure showing the rim part for two fragments, with one also attached to a long thin neck with the handle attachments visible (Charlesworth, 1972, p. 202). The figure shape could be a conical or convex jug with a long neck (Price and Cottam, 1998, pp. 150, 152, 155). Both are shown in Figure 5.25 for comparison.

If for analysis purposes we accept that the *Verulamium* flagons are variants of conical jugs, then the tableware assemblages for *Verulamium* (St Albans) are consistent with those of the other cities. The flagons are representative of tableware serving vessels for liquids and the examples from *Verulamium* had a spectrum of natural blue-green with also strong colours, including a rare red wine colour. These records of large city vessels show that a wide variety of glass was available and that was part of the material culture at *Verulamium* that presumably included social dining in the 1st and 2nd centuries.

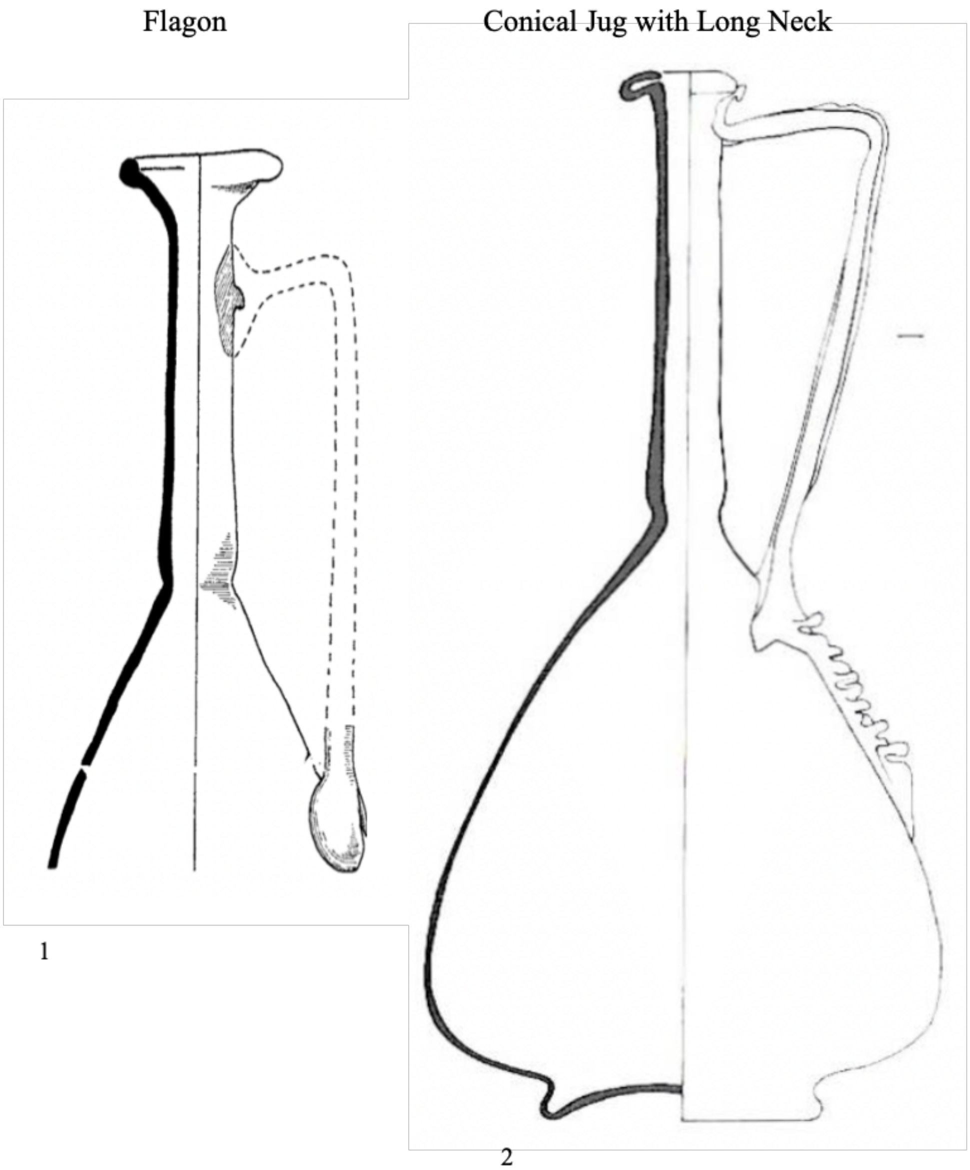


Figure 5.25 Flagon Verulamium and Conical Jug Form

Sources: (Frere, 1972, p. 220 Fig. 20; Price and Cottam, 1998, p. 156 Fig. 68) - illustration by Y Beadnell

The percentage counts profile and correspondence analysis of the large cities' vessel data (Table 4.54) with the flagon type replaced by the jug type for St Albans are shown in Figures 5.26 and 5.27. The other difference of St Albans to the other large cities was that the range of drinking vessel types did not include cups (refer to Section 4.4.3).

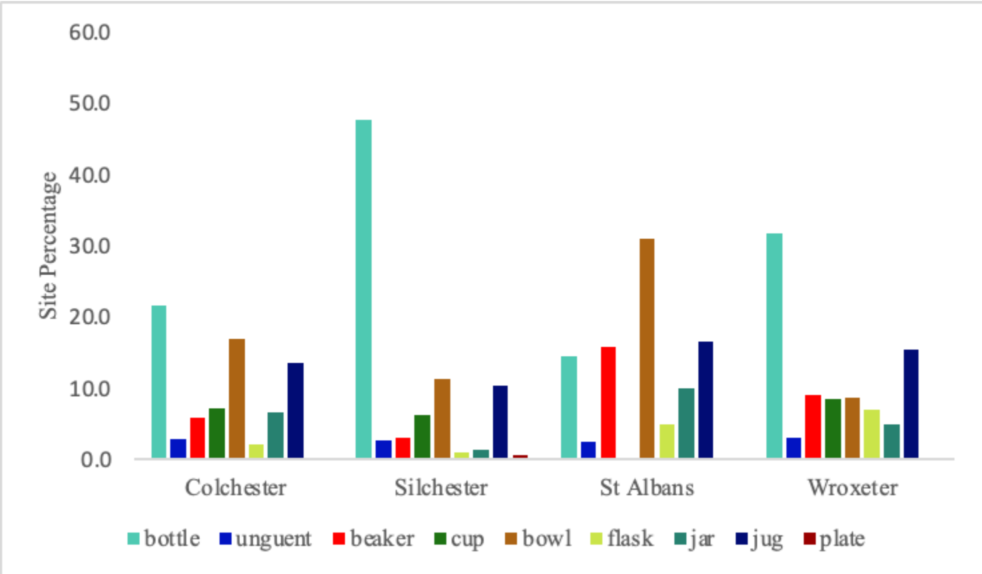


Figure 5.26 Large Cities – Site Glass Types Percentage Counts to 500 CE
(Amended with flagon added to jug for St Albans)

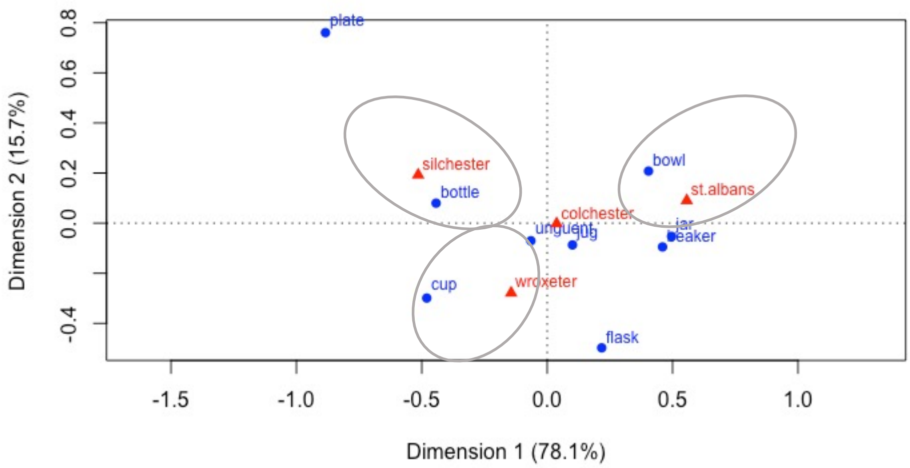


Figure 5.27 Large Cities – Correspondence Analysis of the Site Glass Types Percentage Counts to 500 CE – with St Albans Flagons as Jugs

The Colchester and Wroxeter cities had similar site percentage profile components with the bottle, bowl and jug as the main proportions. The correspondence analysis plot (Figure 5.27) shows Colchester with close associations for the unguent, jug and also bowl. Wroxeter has a site profile close to that of Colchester and with a quadrant association with the cup. The association of Silchester with the bottle represents the significant proportion of bottles on the Silchester site relative to the other large city sites. The bottle count on the Silchester settlement is disproportionally higher than for the other city sites. As the site counts are sufficient (300), this is unlikely to be just a sample size effect. Over 61% of the bottle counts were from within street building ground deposits on one of the three Silchester excavation sites (Silchester IX) in a period phase from *c.*40/50 to *c.*300 CE. During this period, Silchester developed from a town to a city that was a regional centre for the *Atrebates* tribe which developed into a Roman model city by the 2nd century (Fulford, 2021). Silchester was a centre for trade across the south of Britain and for Continental and Mediterranean imports from the late Iron Age (Fulford, 2021, pp. 42–43). The bottle counts may be high as the excavations did not reveal the presence of other vessel types in the expected proportions. One reason for this could be that the disposal of wastes was moved from the town dumps to purposeful pits outside of the developed city, potentially an early example of city planning (Fulford, 2021, p. 102). The disposal pits are still to be located.

The large city glass forms are shown as drinking vessels in Figure 5.28, tableware in Figure 5.29 and container vessels in Figure 5.30.

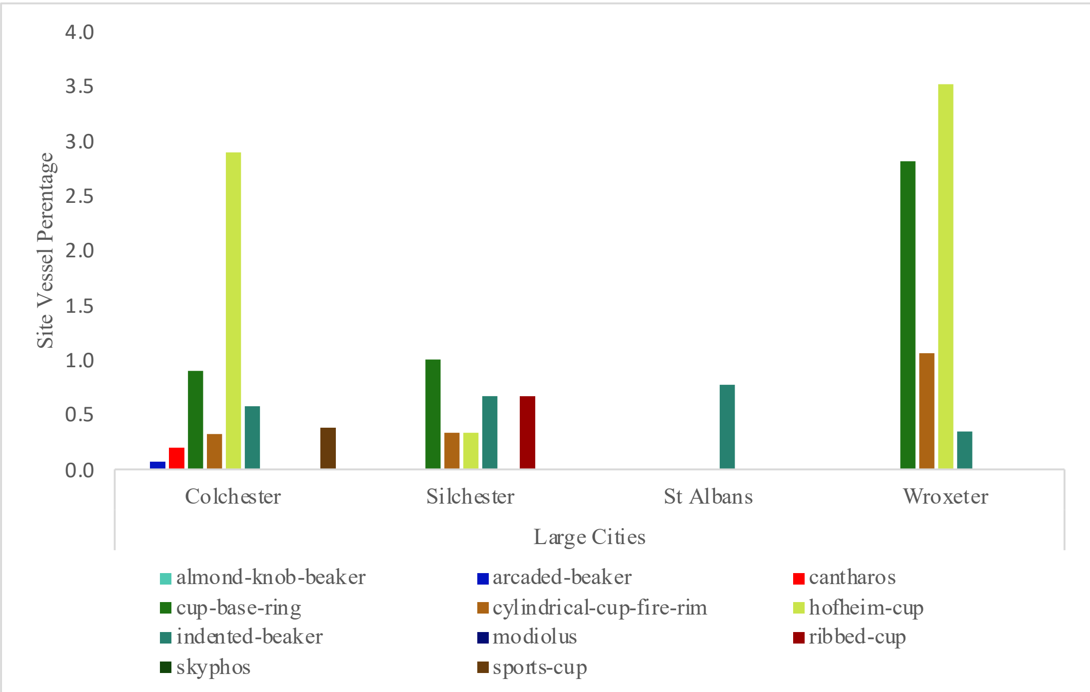


Figure 5.28 Large Cities – Comparison Site Glass Drinking Vessel Forms Percentage of Vessel Counts to 500 CE

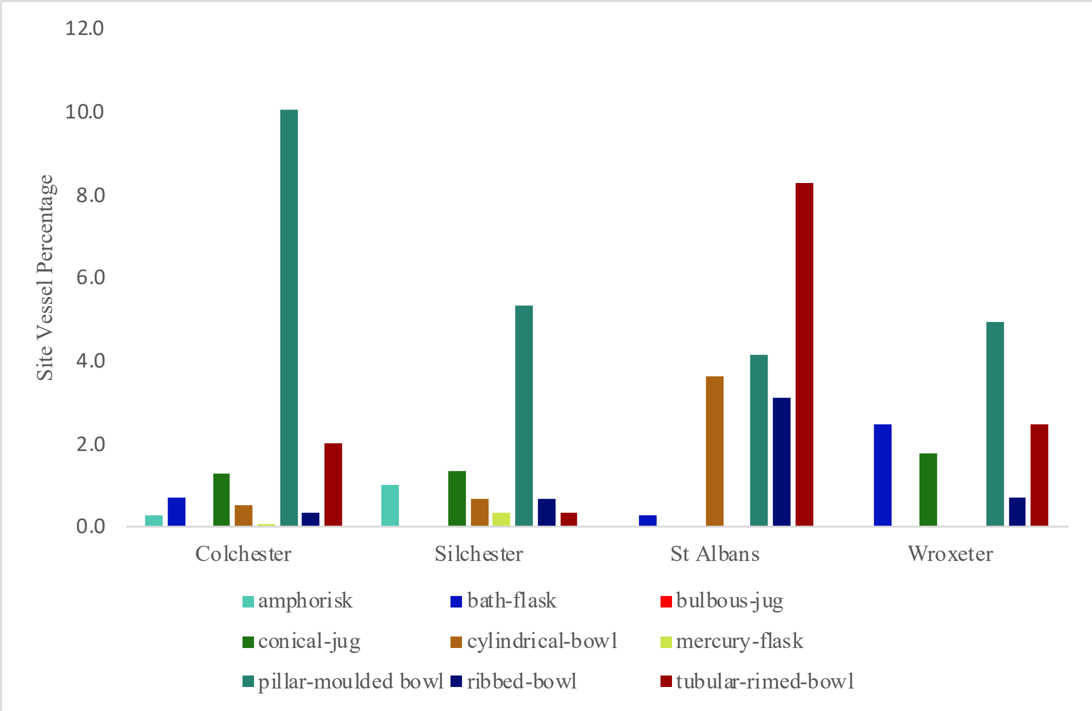


Figure 5.29 Large Cities – Comparison Site Glass Tableware Vessel Forms Percentage of Vessel Counts to 500 CE

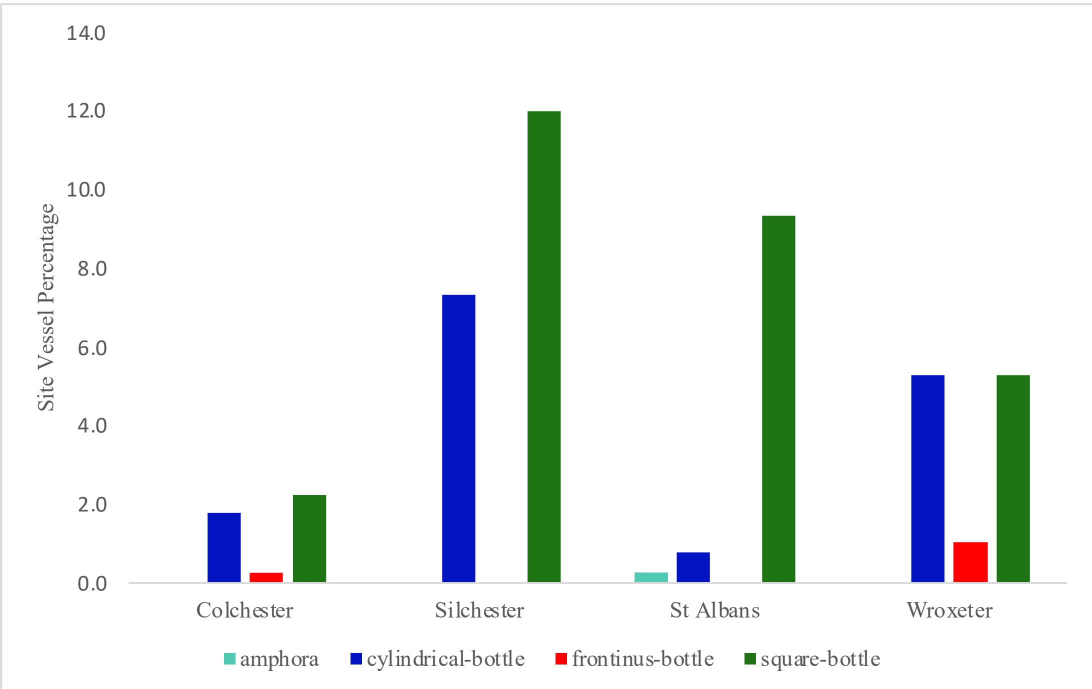


Figure 5.30 Large Cities – Comparison Site Glass Container Vessel Forms

The comparison shows that the Colchester, Silchester and Wroxeter form profiles for the drinking vessels, tableware and containers are similar in range and broadly similar in shape. The St Albans form profile is significantly different in all the glass classes and this is particularly evident with just the indented beaker form recorded. This replicates the earlier patterns of similarity of Colchester and Wroxeter and the differences of St Albans to the other large cities, notably the range of drinking vessel types but no evidence of cups (Chapter 4).

The sample sizes of the city sites were all broadly of a similar range with the exception of the Colchester site. However, the individual Colchester inner city sites were in the 'city range', with each representing patterns of difference and similarity to the overall city. While increases in sample size will increase the possibility of more glass types and forms, in practice this is not seen as a dominant effect.

These are complementary profile views that indicate associations between Wroxeter and Colchester that are different than for the other large city sites everything else being similar. There are burial inscriptions for Colchester and Wroxeter providing evidence that veterans settled in both cities (Tomlin, 2018, p. 24). The fortress at Colchester was operational for less than a decade to 49 CE, and at Wroxeter *c.*50s-90 CE. These material patterns could be an indication of material cultures associated with a Roman lifestyle. There are debates about whether military bases at both Silchester and *Verulamium* even existed, without firm conclusions to date. This may also support the suggestion that there is no military base associated with them, unlike Colchester and Wroxeter. Silchester is now unequivocally accepted never to have been a military site; St Albans less so, but there is no firm evidence for a military site there as yet (Niblett *et al.*, 2006; Niblett, 2010, p. 58; Fulford, 2021, p. 54).

5.2.4 Fortress Sites

Fortress sites were legionary campaign bases constructed to support the military invasion and either then were decommissioned and abandoned (e.g. Usk, Caerleon) or became the foundational part of a city and were assimilated into the city plan with no further military presence (e.g. Colchester, Wroxeter). For these latter locations, the military presence could have influenced the next development of the city and be reflected in the materials records. This could explain why the vessel type profiles for Usk, Wroxeter and York fortress sites are very similar to each other and to the large city profiles when they became colonies, as at Colchester.

The fortress vessel types are shown graphically in Figure 5.31, and as a correspondence plot in Figure 5.32.

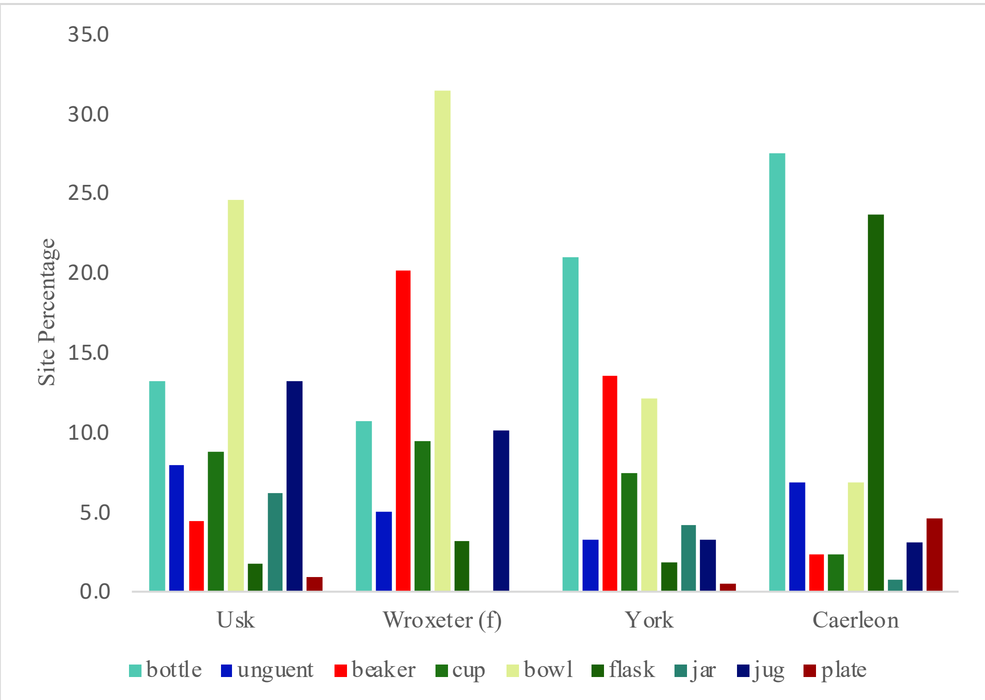


Figure 5.31 Fortresses– Site Glass Types Percentage Counts Profiles to 500 CE

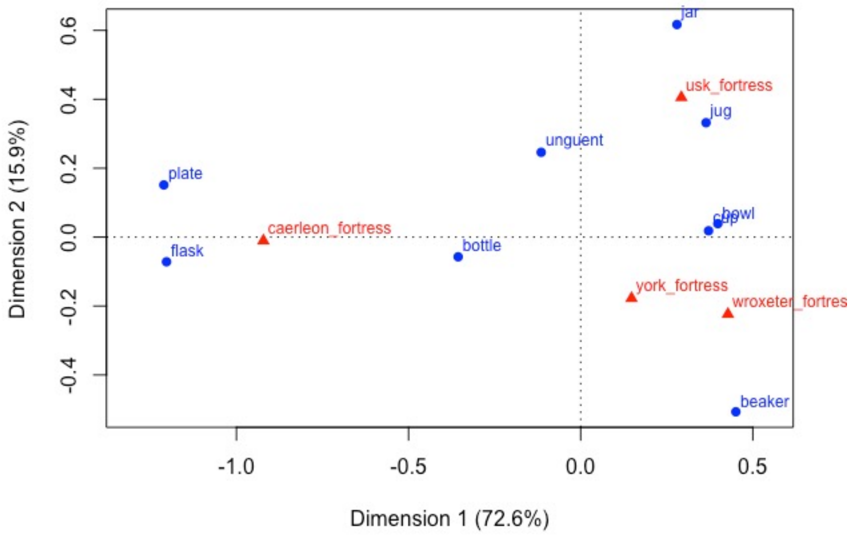


Figure 5.32 Fortress Sites – Correspondence Analysis of the Site Glass Types Percentage Counts to 500 CE

The percentage counts for the Caerleon fortress represent the separate areas as the fortress defences and the fortress baths as presented in Chapter 4. The defences counts were 27 in total in comparison to the baths area 104 counts. The Caerleon profile shown in Figure 5.31 shows the high proportion of bottles mainly from the defences and flasks from the baths. In the associated correspondence analysis plot shown in Figure 5.32, the association of Caerleon with the flask and bottle is displayed. The bottle counts were 22 from the defences and 14 from the baths. The flask counts were skewed with one from the defences and 30 from the baths of which 20 flask counts were the bath-flask form. The correspondence plot (Figure 5.32) shows these archaeological associations for Caerleon.

The correspondence analysis plot shows both the York and the Wroxeter fortresses in the same quadrant with a statistical association with the beaker type. The Usk fortress is associated with the jug vessel type. The absence of jars at Wroxeter would change the vessel statistical associations from those expected and so there could be a bias. The deposition areas for the Wroxeter fortress were the ground surfaces and buildings with lost or broken fragments, whereas for Usk the recovery of finds was more from disposal pits of discarded and broken objects. These associations can be seen as variations from what are similar site profiles with the differences due to possible supply connections given the road and sea transport routes differences.

Unguent bottle types were seen on three of the fortress sites and for *c.* 60% of the military forts in the selected corpus. The evidence of unguent bottles as small containers that contained scent or medicinal substances was also recorded on all the large city sites and also at Gorhambury (rural) and Catterick and Walton-le-Dale (town industrial centre). These small containers are be associated with personal well-being and as such as a material indication of individual wealth (or health) in a settlement.

5.2.5 Rural Sites

In contrast to the large cities, rural settlements were primarily agricultural production centres. Many continued from the Late Iron Age into the Roman era. Whereas the cities of Roman Britain developed through the 1st and 2nd centuries based on an urban template as administration and trading centres, the rural settlement landscape generally remained unchanged until the 2nd century (Perring and Pitts, 2013, p. 3). Although private land ownership may have been owned in the Iron Age, the Roman extension of this to farming tenancies and animal husbandry during the 2nd century CE was aimed at greater productivity in agriculture (Kehoe, 2015; Broekaert and Zuiderhoek, 2020). These changes have been attributed to the drive to satisfy the demand from the urban consumer and to generate surplus from agriculture. This resulted in the development of farmsteads particularly in the south and east of Britain as evidence of a changing rural economy. These villa farmsteads were not numerous and unlike cities were not constructed to a template, however, they combined estate farming with luxury lifestyles (Erdkamp, 2015). The selected rural sites represent a cross-section across this group. Gorhambury was a Roman villa close to *Verulamium* and Graeanog Ridge was a simple remote farm in north Wales. Both Frocester and Barton Court Farm were villa farmsteads in the south of England, with the Piercebridge Villa one of the most known northerly villa settlements in Roman Britain.

The rural sites vessel type counts and percentage counts are displayed in Figure 5.33 with the correspondence analysis plot as Figure 5.34.

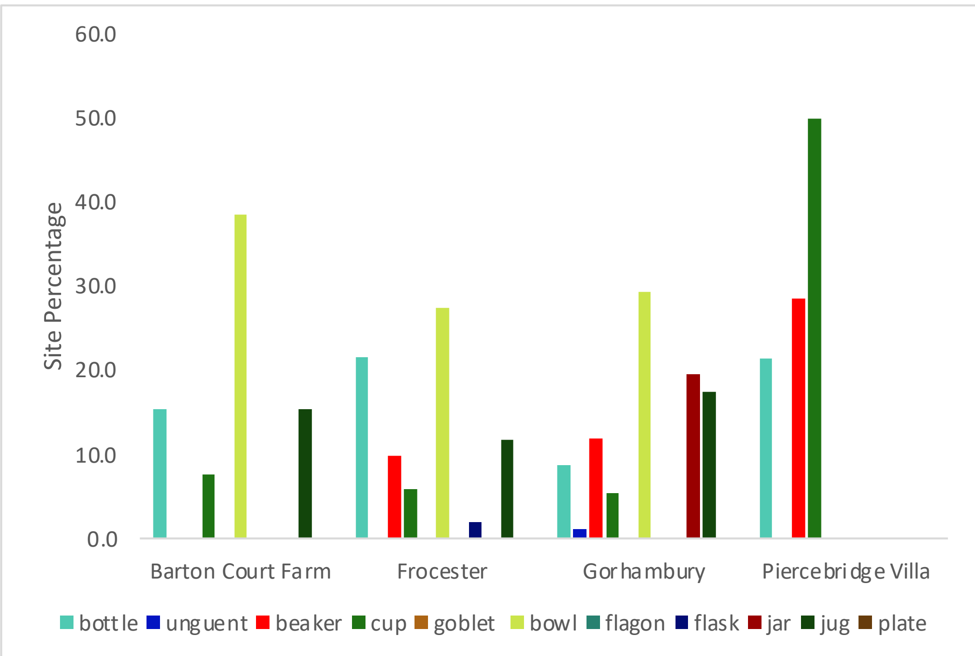


Figure 5.33 Rural Settlements– Site Glass Types Percentage Counts to 500 CE

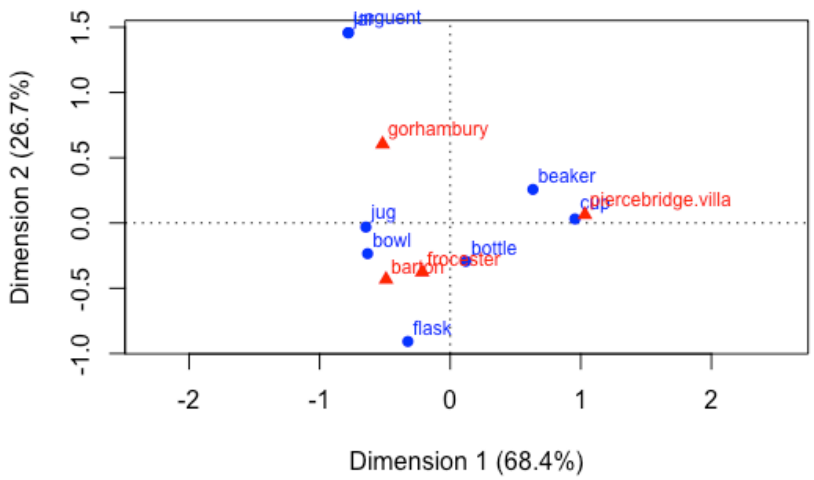


Figure 5.34 Rural Settlement Sites – Correspondence Analysis of the Site Glass Types Percentage Counts to 500 CE

The rural settlements had a much-reduced range of vessels in comparison to the large city sites with the bottle, beaker and cup vessel types common on all the rural sites, except for at Graeanog Ridge with just one bowl fragment. There was not one pattern of glass types for rural settlements and this is illustrated from the correspondence plot with the settlements in different quadrants.

These sites would not have been centres of trade as for the cities, but by being close to large cities and with connections to the Roman road network, they could have traded products with cities. That could have been the case for Gorhambury given its closeness to *Verulamium.* Gorhambury had a broad range of glass vessel types. An explanation for the small sample size at Graeanog Ridge is that it was a remote settlement. There was no evidence of glass-working on any of these rural sites.

Figure 5.35 includes the Middleborough site for comparison with the rural sites.

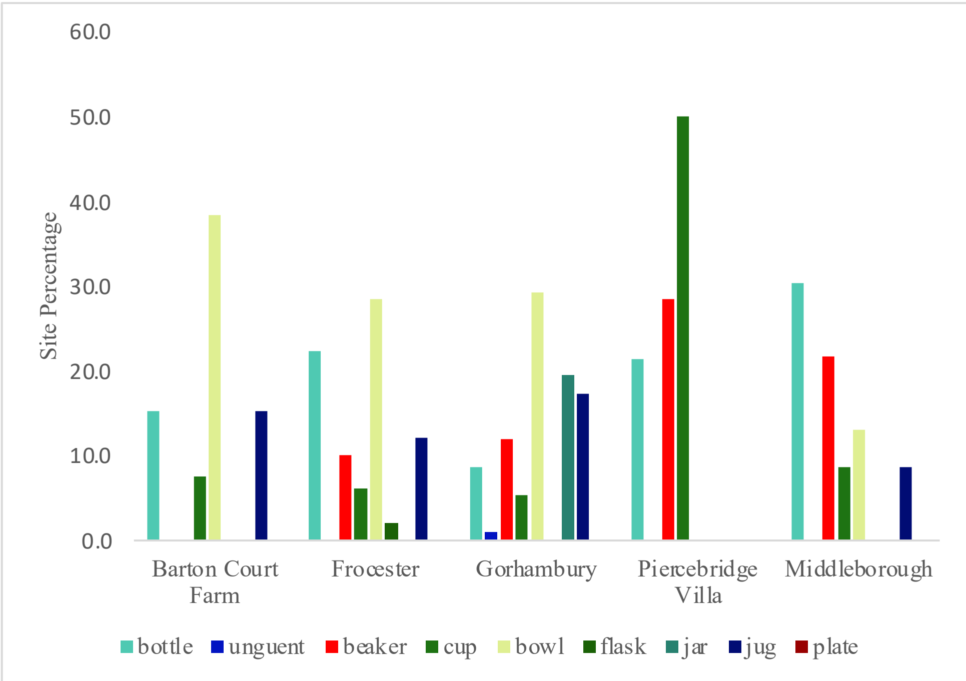


Figure 5.35 Rural Sites and Colchester Middleborough Glass Types Percentage Composition (to 500 CE)

Frocester has a similar percentage profile composition to that for the Colchester Middleborough site. This could suggest similar material cultures associated with Frocester an agrarian farmstead and Middleborough a settlement just outside the city walls of Colchester. The correspondence analysis of the rural sites, excluding Graeanog Ridge, but including the Colchester Middleborough site is shown in Figure 5.36.

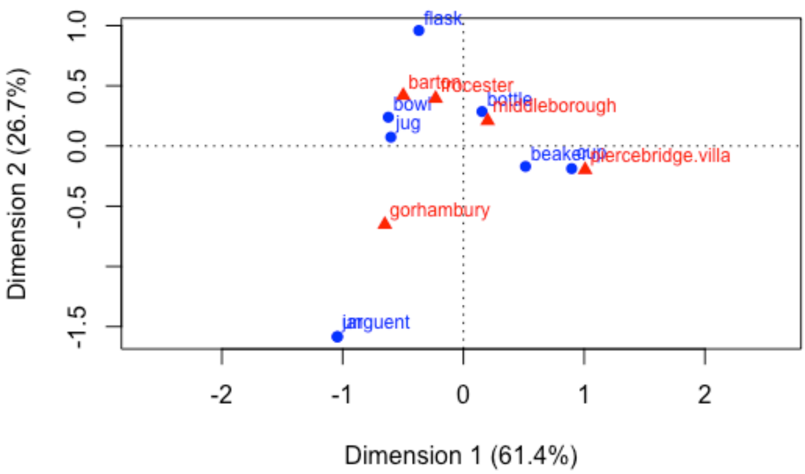


Figure 5.36 Rural Settlement Sites and Colchester Middleborough – Correspondence Analysis of the Site Glass Types Percentage Counts to 500 CE

The correspondence analysis shows patterns of different vessel associations between the rural sites excluding Graeanog Ridge. While Frocester and Middleborough have similar type profiles, the correspondence plot does not show a close association of Frocester with Middleborough. Small differences in the profiles can influence the associations and, in this case, the likely differences are the proportional relationships between the bottle and bowl on the two sites. The sample size at Middleborough was 23 counts (Frocester has 51 counts) and this could have introduced proportional bias between the sites.

5.2.6 Town - Industrial Settlement Sites

In this study, the distinction was made between the large cities that were *coloniae* (Colchester), St Albans (*Verulamium*) as a *municipium*, the *civitas* capitals (Silchester and Wroxeter) and the smaller industrial centres (Catterick, Scotch Corner, Walton-le-Dale and Wilderspool). Towns and industrial settlements were important to the economy, but with no apparent legal status or common function (Perring and Pitts, 2013, p. 4). Their role to supply goods for the military or civil settlements was the interest for this study. These were seen as the economic interconnections between the large city trading and administration centres and the many low-status rural agrarian production units. They could also have been supply centres as nodes in the supply network for military bases. The industrial settlement sites vessel type counts and percentage counts are shown in Figure 5.37, with the correspondence analysis plot as Figure 5.38.

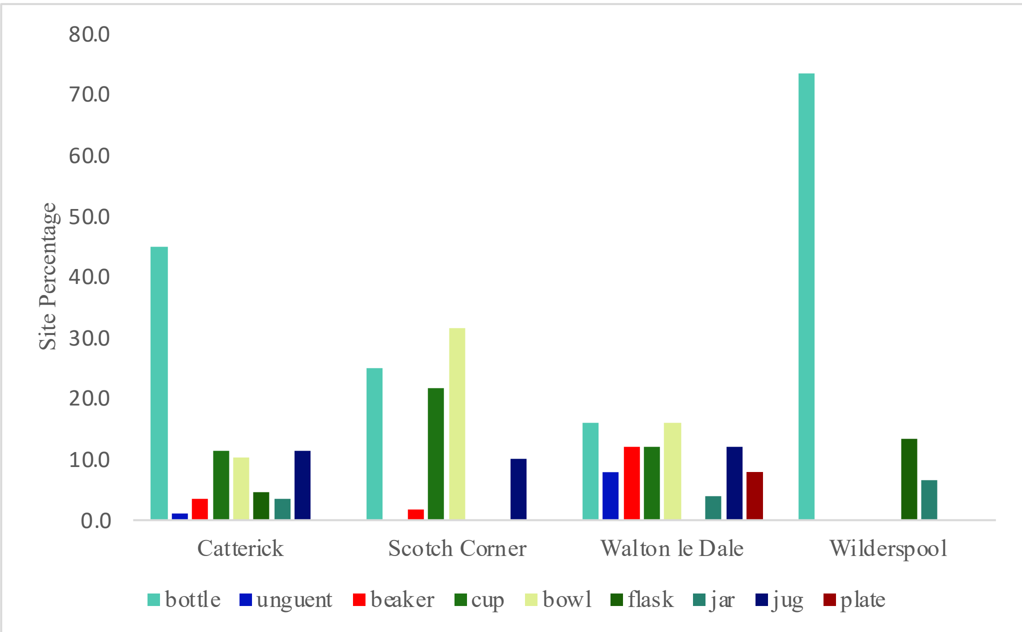


Figure 5.37 Industrial Settlements– Site Glass Types Percentage Counts to 500 CE – with Walton-le-Dale Flagons as Jugs

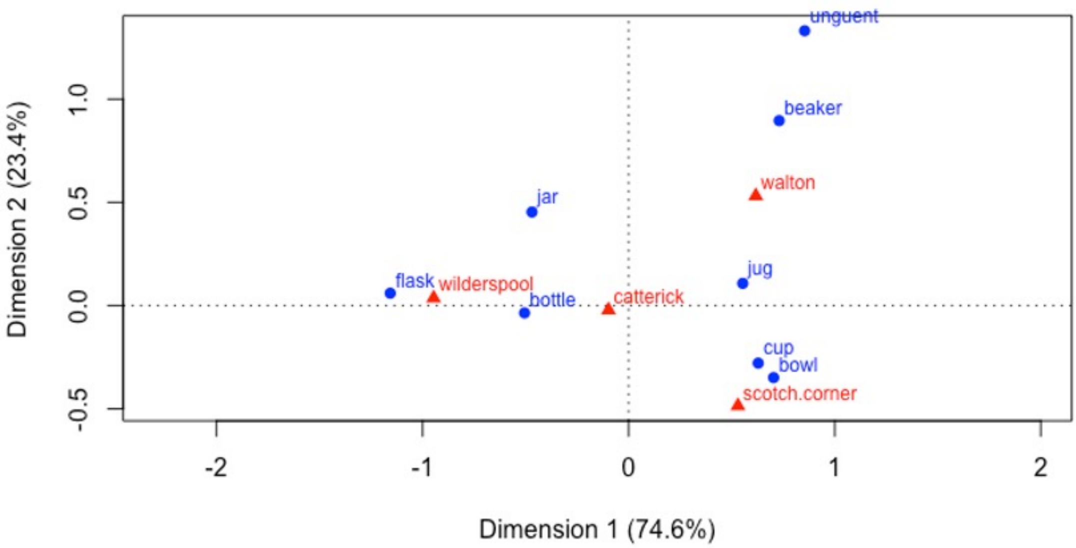


Figure 5.38 Correspondence Analysis of Industrial Settlements– Site Glass Types Percentage Counts to 500 CE – with Walton-le-Dale Flagons as Jugs

The industrial settlements had varied site profiles with no consistent patterns (Figure 5.37) and all in different correspondence plot quadrants (Figure 5.38). These industrial settlements were well connected into a distribution network of road, river, and sea routes. On the west side of Britain, Wilderspool, the industrial site near Warrington, was situated on the River Mersey, and connected by a south road to Chester (fort) and the north road to Ribchester (fort) via Walton-le-Dale. On the northeast side of Britain, both Catterick and Scotch Corner were located on Dere Street the main Roman road north from York to Corbridge. Excavations in these settlements recovered assemblages of bottles, drinking vessels, bowls, and jugs, except for Wilderspool with just bottles, jars and jugs. Wilderspool had a small sample size of just 15 glass vessels counts and this could have given a bias to the percentage of the vessel types. The bottle proportions were the highest in the industrial settlement group of sites at 73.3% based on the report (Charlesworth, 1992, p. 98). The work at Wilderspool was carried out in the periods 1966-69 and 1976 and revealed that the extent of the settlement at Wilderspool was over a large area, but that the site that was not considered to have been set out in a military way (Hinchcliffe and Williams, 1992, p. 13). This suggested Wilderspool was a civil production and trading centre, and the material record reflected that. Glass finds were found in the four site excavation areas aligned to the western, eastern, and northern parts of the site. These contained a single building with metal working furnaces (western), two buildings with also separate furnaces (eastern), and buildings with a water catchment area (northern). While there was evidence of furnace residues, the presence of glass-working furnaces was not confirmed.

The other industrial settlement that had a high proportion of bottles was in the northeast of Britain at Catterick. The majority of bottles were 2nd century prismatic bottles made of blue-green glass and found in the centre of the *mansio* and *vicus* or in a roadside settlement (Cool, Price and Cottam, 2002). These would be places where food and drink would have been consumed by travellers or people visiting the marketplace. Catterick had early military origins, *c.* 80 CE, and became a civilian settlement with evidence that it was a supply centre for hides and other goods (Tab. Vindol, 343). In the 2nd century Catterick was a place for the trade in goods (Wilson, 2002 a, p. 122). Perhaps this movement of people and goods explains the broad range of glass vessels and the proportion of bottles in the town. The correspondence analysis indicates Catterick has statistically the expected normal vessel associations and so representative of an industrial centre in Roman Britain.

The industrial sites comparison with the Colchester Middleborough site is shown in Figure 5.39 and the correspondence analysis plot in Figure 5.40.

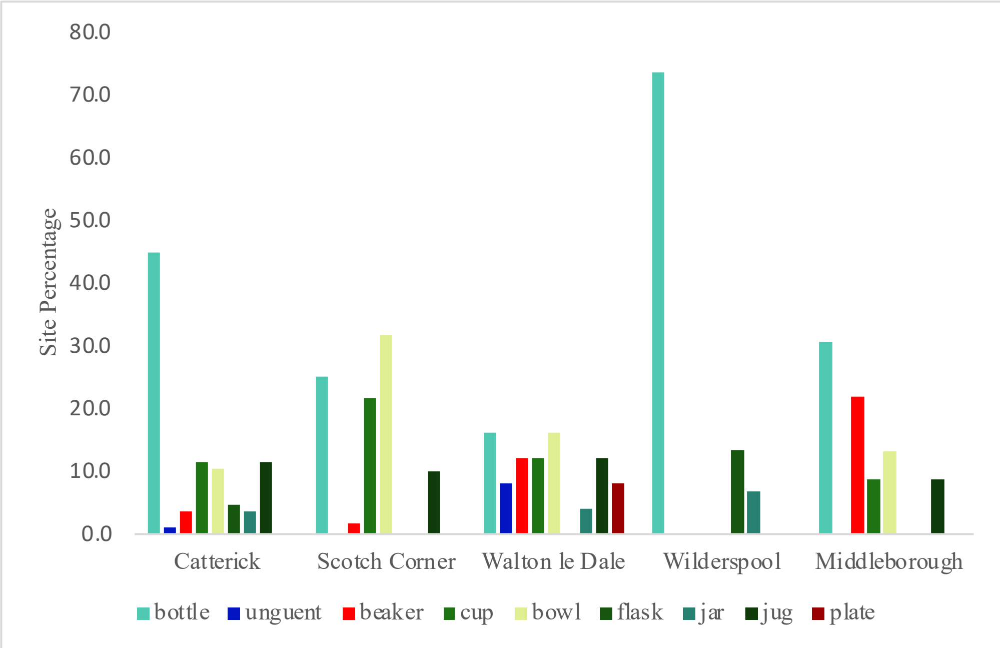


Figure 5.39 Industrial Settlements and Colchester Middleborough – Site Glass Types Percentage Counts to 500 CE – with Walton-le-Dale Flagons as Jugs

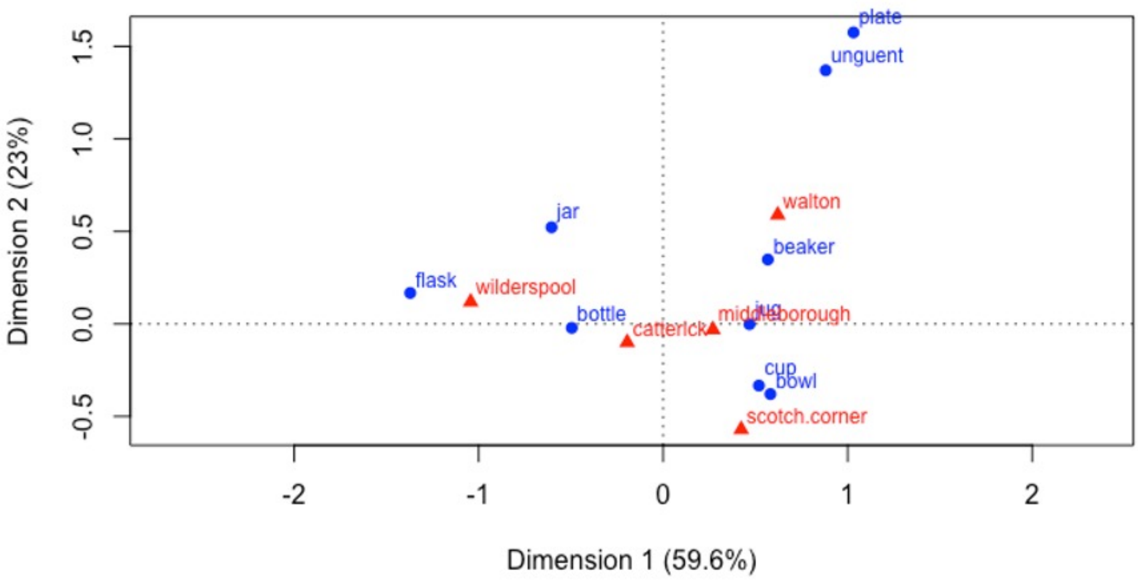


Figure 5.40 Correspondence Analysis of Industrial Settlements and Middleborough – Site Glass Types Percentage Counts to 500 CE – with Walton-le-Dale Flagons as Jugs

The site profile for Middleborough is similar to the Scotch Corner site with the absence of unguent bottles, flasks and jugs for both sites and a similar range and shape of vessel types. The site profile for Catterick has a broader range. The correspondence analysis of the industrial sites and Middleborough (Figure 5.40) show the close association between the Catterick and Middleborough sites. The Middleborough site is discussed in the rural section with a comparison with Frocester (Section 5.2.5). Although the site profiles can look similar, the correspondence plots provide the associations between the sites and vessel types. This association for Middleborough is more robust than the rural association (Figure 5.36) although Middleborough was a town house and not an industrial settlement. An explanation could be from the common tableware proportions that could reflect similar social practices and more associated with town than rural.

5.2.7 Military Sites

The comparison of the fortress sites with the large city sites has been made and with similarities in the sites broad range of vessel types noted in the preceding chapter. The military sites profiles are shown in Figure 5.41.

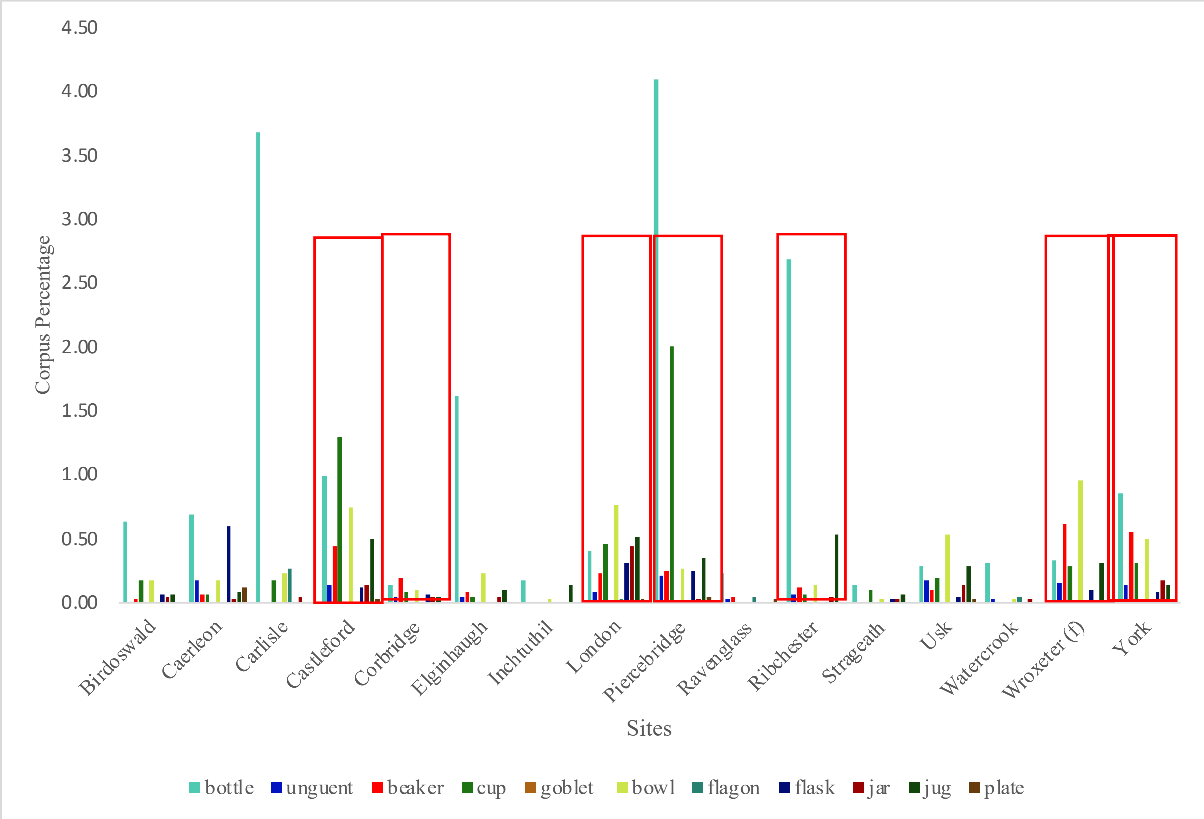


Figure 5.41 Military Sites Glass Types Percentage Counts to 500 CE

There is significant variation with the shapes of the site profiles. The sites' contexts (refer to Section 4.8.1) indicated the military sites with significant corpus distribution vessel ranges as the Caerleon, Usk, Wroxeter and York fortresses and the Castleford, Piercebridge, London and Ribchester forts.

The site profiles for these highlighted military sites are shown in Figure 5.42 together with the Hadrian's Wall fort of Corbridge.

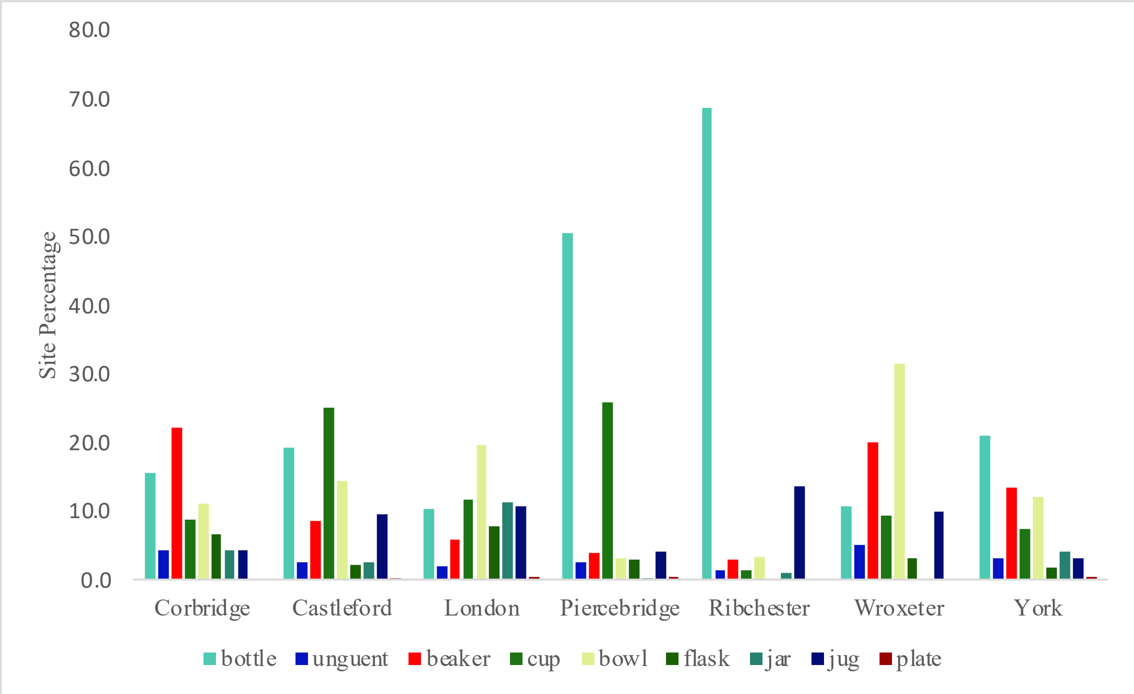


Figure 5.42 Military Sites Container, Drinking Vessel and Tableware Percentage Counts to 500 CE

The site profiles for the Wroxeter and York fortresses are similar in range and shape. The fort site profiles are different but with Corbridge, Castleford and London all with similar ranges and shapes. The proportions of bottle, unguent, beaker, cup and bowl are of relatively similar proportions. The Piercebridge fort is dominated by the bottle and cup types, and the Ribchester fort by the bottle. However, Piercebridge, like London, should not be seen as just a military base, with the former viewed as a garrison town having military associations, and the latter a fortified town and trading centre. This illustrates the complexity in roles of settlements, that are reflected in the different profile patterns of glass and varied material cultures of the communities.

The correspondence analysis of the same data is shown in Figure 5.43 of the two plots of vessels and sites where points in the same quadrant show statistically probable associations.

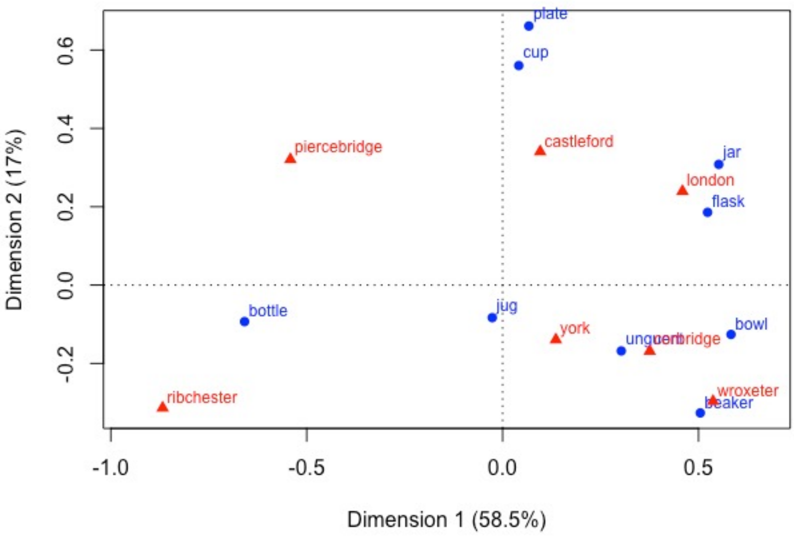


Figure 5.43 Correspondence Analysis of Selected Sites with Drinking Vessel and Tableware Percentage Counts to 500 CE

The correspondence plot shows York, Wroxeter and Corbridge in the same quadrant and associated with the unguent, beaker and bowl, London with jar and flask and Castleford with cup and plate and the same quadrant. The Ribchester fort has the main association with the bottle type. The Piercebridge fort is without any particular significant vessel associations. The jug in the centre of the plot represents associations with all the sites. These two comparative analyses are discussed as follows.

The glass vessels from the Corbridge site were dated to the 1st and 2nd centuries and found in the barracks in the *Retentura* area of the fort (Allen, 1988, pp. 287–293; Bishop and Dore, 1988, pp. 67–68). The drinking vessels from the Wroxeter fortress were located in the military occupied areas that included the barracks and mess hall (Cool and Price, 2002, p. 225; Webster and Chadderton, 2002, p. 29). The York fortress vessels were found mainly in the *Praetentura* area of the fortress (Cool *et al*., 1995). These unguent, beaker and bowl associations could represent the military culture of fort(ress) life for York, Wroxeter and Corbridge even though the sites are geographically quite separate.

Most of the glass reported in the excavation archaeology report for the Castleford site was from the *vicus* to the south of the 2nd century fort and built at the same time (Cool and Philo, 1998, p. 8; Cool and Price, 1998, p. 141). From the archaeology, London can be viewed as more of a fortified trading centre with industrial glassmaking units based on the excavation sites (Bateman *et al*., 2008; Shepherd, 2012; Dunwoodie *et al*., 2015; Wardle, 2015b). This could explain the association between London and Castleford with both having a combination of military and civil communities and with trading associations.

The Ribchester fort association with bottles is not unexpected given the larger than usual expected number of bottle fragments found in a ditch at the fort (Section 4.3.3). The Ribchester fort was part of the trading network on the west coast (Buxton and Howard-Davies, 2000).

Although the Piercebridge fort was constructed in the mid 3rd century on the road between Corbridge and York (Section 4.3.4), the earlier settlement in the 2nd century could be described as a garrison town, with a military presence but without fortifications. Piercebridge was very close to Scotch Corner and Catterick and had signs of bath-house, industrial buildings and kilns. The site profile has a dominance of bottles and cups that probably explains why the settlement sits in the quadrant between the other quadrants with bottle and cup types.

In these cases the evidence of drinking vessels and tableware could be associated with the communities in the fort or fortress (Corbridge and Wroxeter) or in the *vicus* near the fort (Castleford and London), or as a garrison town as for Piercebridge with these complex origins all likely to be a mix of native and military people and cultures.

5.2.8 Evaluation

There is sufficient evidence that the large cities and fortresses had large ranges of vessel types and forms. These are indications of the role of the large cities and fortresses as centres of demand for materials and for the flow of money through the economy. The civil large cities could indicate the importance of the institutions as 'pull' factors to the economy. That also could apply to the military fortresses with the added perspective of the role of the state in regard to the economy and the material supply into the economy. This is also pertinent given the ranges of vessels at the Catterick, Castleford, Corbridge, London and Piercebridge sites were similar to the fortress ranges of vessels. This is particularly relevant for the settlements that had the capacity to produce, such as Catterick and London as an indication of a trading role. The other civil, rural, and military forts had wide variations in the ranges of vessel types and forms. While low site sample size could have influenced some of the range of vessels recorded, the more remote sites with less access to roads and at a distance from the larger city and fortress communities could be expected to reveal reduced ranges of vessel types.

Arguably, a system to rank the sites based on the ranges of vessels could help to put some of these perspectives into order. The next section outlines the application of the site scoring model.

5.3 Site Scoring Model

5.3.1 Introduction

As a qualitative alternative to analysing the percentage counts of the vessel types for the sites, a scoring system was developed based on a simple count of the different vessel types and forms represented by the assemblages on a site. As a reminder to the description in Chapter 3, the scoring system is binary with a score =1 for the reported 'presence' of a glass vessel type or form in the original population of glass vessels accumulated over the period 43-500CE, otherwise no score. This is a profile measurement tool that is complementary to the previous site profiles analyses. It is subjective in that the scoring registers the presence of each glass type and form in a range of vessels but does not relate to the quantity or quality of the materials.

The assumption is that all the discarded, lost or disposed fragments of the original vessels had an equal chance of entering the archaeological material record. Any bias from the size of the vessel and therefore the size of the fragments will not be relevant as this scoring system is based purely on the presence of an identified glass vessel type and form. The site scoring system was developed for this study to supplement the site profiles by being able to rank sites. The archaeological data needed to be at the lower level of detail to be meaningful and that means using the data for vessel types and forms for the individual sites. The assumption was made that the original reporting identifications were correct and consistent across the reporting periods.

The vessel type percentage compositions are detailed for the military sites in Tables 4.6, 4.7 and for the civil large city, rural and industrial settlements in Tables 4.8, 4.9. The glass forms site percentage compositions as tableware, drinking vessels and containers for the military sites are set out in Tables 4.10, 4.11, 4.12 and the civil settlements in Tables 4.13, 4.14, 4.15. The scoring model results are shown in Tables 5.14, 5.15.

Table 5.14 Qualitative Scoring of the Civil and Fortress Sites Vessel Profiles

	Large Cities				**Towns**			
Vessel / Sites	Colchester	Silchester	St Albans	Wroxeter	Catterick	Scotch Corner	Walton le Dale	Wilderspool
container types	2	2	2	2	2	1	2	1
drinking types	3	3	1	3	3	2	2	-
tableware types	6	6	6	5	5	3	6	2
no-class	1	1	1	1	1	1	1	1
bottle forms	3	2	3	3	2	2	2	2
drinking form	7	5	1	4	2	2	3	-
tableware forms	8	7	5	5	5	-	-	-
Total score	30	26	19	23	20	11	16	6

	Rural Settlements				**Fortresses**			
Vessel / Sites	Barton Court Farm	Frocester	Gorhambury	Piercebridge Villa	Usk	Wroxeter	York	Caerleon
container types	1	1	2	1	2	2	2	2
drinking types	1	2	3	2	3	3	3	3
tableware types	2	4	4	-	6	4	6	6
no-class	1	1	-	-	1	1	1	1
bottle forms	1	-	3	1	1	2	2	2
drinking form	-	1	1	1	2	3	3	-
tableware forms	1	1	3	-	4	3	3	1
Total score	7	10	16	5	19	18	20	15

Table 5.15 Qualitative Scoring of the Military Sites Vessel Profiles

Vessel / Sites	Birdoswald	Caerleon	Carlisle	Castleford	Corbridge	Elginhaugh	Inchtuthil	London
container types	1	2	1	2	2	2	1	2
drinking types	3	3	1	3	2	3	-	2
tableware types	5	6	4	6	5	4	2	6
no-class	1	1	1	1	1	-	1	1
bottle forms	2	2	1	2	1	2	2	2
drinking form	-	-	-	4	2	3	-	6
tableware forms	2	1	2	4	2	3	2	2
Total score	14	15	10	22	15	17	8	21

Vessel / Sites	Piercebridge	Ravenglass	Ribchester	Strageath	Usk	Watercrook	Wroxeter	York
container types	2	2	2	1	2	2	2	2
drinking types	3	1	2	1	3	-	3	3
tableware types	6	2	4	5	6	3	4	6
no-class	1	1	1	1	1	1	1	1
bottle forms	3	1	2	2	1	2	2	2
drinking form	3	-	-	-	2	-	3	3
tableware forms	2	-	3	3	4	-	3	3
Total score	20	7	14	13	19	8	18	20

These show the scores based on the presence of vessel types and forms and including the presence of vessels that could not be confirmed as a single vessel type.

5.3.2 Large Cities Scores

The large city group registered the highest scores, and the largest score was for Colchester reflecting the presence of a wide range of glass types and individual forms. This was expected given Colchester was a Roman administrative centre with expectant consumers, it was well connected by main Roman roads to London, St. Albans (*Verulamium*) and Lincoln, and so also would have been a significant trading centre. The individual city sites and the overall Colchester site scores are shown in Table 5.16.

Table 5.16 Qualitative Scoring of the Colchester Individual Sites Vessel Profiles

Vessel / Sites	Balkerne	Culver	Lion	Middleborough	Cups	Gilberd	Colchester
container types	2	2	2	1	2	2	2
drinking types	3	3	3	2	3	3	3
tableware types	6	6	6	3	4	5	6
no-class	1	1	1	1	1	1	1
bottle forms	3	2	3	1	1	2	3
drinking form	6	6	4	-	-	4	7
tableware forms	8	7	7	1	2	6	8
Total score	29	27	26	9	13	23	30

There is a consistency across the scores for the inner-city sites (23-29) that is consistent with the overall Colchester score. The Cups Hotel score of 13 could reflect that while this site was close to the presumed forum the excavation site itself was relatively small. The suburbs site at Middleborough had a score 9 that reflects the reduced range of the tableware types and forms for the period 1st-3rd centuries CE.

After Colchester with a score of 30, Silchester and Wroxeter have fewer tableware types, but still have the highest scores across all the sites with scores of 26 and 23. St Albans (*Verulamium*) has the lowest score in the city group (19), mainly due to fewer drinking vessel types and forms. All these large city sites had recognised Roman legal status and were established places on the Roman trading network. In the south of Roman Britain, there were similar large cities that included Bath, Chichester, Ilchester, Gloucester, Winchester that would be expected to have similar scores. While these were not all recognised with Roman legal titles, they would have been urban centres for trade.

The following analysis considers whether the sample size, excavation scale or proportional bias could have influenced the scores. All the city sites had high sample sizes (*c.*200-400+ counts). Colchester was the largest excavation scope comprising several individual sites, a sample size of 1552 glass counts, a broad range of glass forms and the highest qualitative site score ranking. The evidence from the individual Colchester sites was analysed chronologically and compared to Colchester overall. The individual Colchester sites proportional profile, scores and percentage counts are shown in Table 5.17.

Table 5.17 Colchester Periods Glass Types Percentages Based on Data from Cool and Price (1995)

Glass Type %	Colchester 43-61	Colchester 61-96	Colchester 100-200	Colchester 200-400	Colchester 43-500
bottle	10.2	15.5	18.9	25.9	21.7
unguent	4.8	2.8	2.7	2.3	2.9
beaker	5.4	8.5	12.2	6.5	5.9
cup	9.0	4.2	5.4	9.5	7.3
goblet	-	-	-	-	-
bowl	32.5	19.7	10.8	9.9	17.0
flagon	-	-	-	-	-
flask	-	1.4	4.1	2.7	2.1
jar	2.4	7.0	9.5	5.7	6.7
jug	15.7	26.8	9.5	11.8	13.5
plate	-	1.4	-	-	0.3
drinking-misc	4.8	2.8	4.1	4.9	3.2
table-misc	12.0	8.5	18.9	16.7	16.1
no-class	3.0	1.4	4.1	4.2	3.4
Total %	100.0	100.0	100.0	100.0	100.0
Site counts	166	71	74	269	1552
Profile	19	19	16	22	30

The data is from sites stratified occurrences and residuality can be expected but was assessed as small (Cool and Price, 1995, p. 6). The evidence of glass forms such as the 1st century pillar-moulded went out of fashion after the 1st century, and bottle forms that increased into the 2nd – 3rd centuries CE are trends both illustrated in Table 5.17. The table shows the comparison between the overall Colchester profile and chronological type profiles and scores with the reported period counts. These show the Colchester period scores were 19 in the period prior to and immediately after the Boudican revolt and increased to a score of 22 for the period 200-400. The scale of the excavations carried out between 1971-1985 has greatly increased the range of vessels known to have been present at Colchester and with the material identified and collated by the glass specialists, Hilary Cool and Jennifer Price, and published by the Romano-British Glass Project, this has provided confidence of consistency for all the periods.

These period site profiles and site scores reflect similar ranges of vessel types across the periods and can be viewed as representative of the original presence of glass vessels on the sites. The following descriptions of the rural, industrial and fortress groups will detail the scores for those site types and note the locations and proximity to trading centres to provide context.

5.3.3 Rural Settlements Scores

The rural group of sites is a broad category of farming settlements that includes the remote farmstead at Graeanog Ridge, Piercebridge Villa near Catterick in the north of Roman Britain, the more transport connected farmsteads at Barton Court Farm (*c.* 80km to Gloucester and St Albans and *c.*60km north from Silchester), Frocester (20km from Gloucester), and the villa at Gorhambury *c.* 1km from St Albans. These represent the range in size and locations of the many Roman farming communities across Roman Britain.

Graeanog Ridge was a farmstead in north-west Wales (Fasham *et al.*, 1998). This farming settlement existed from the Iron Age into the Medieval period, and the single dated fragment must represent the isolation of that farming community and that glass materials were not a part of the material culture there. Other unstratified fragments found on the Graeanog Ridge site were bowl or dish fragments with one from a cylindrical blue-green bottle, more than likely a Roman bottle. Piercebridge Villa existed as an Iron Age settlement until the end of the 2nd century CE and was one of the most northerly villas in the Roman Empire (Cool and Mason, 2008). It was similar to Barton Court Farm and Frocester in scale and structures. The glass profile comprised of bottles and drinking vessels that compared with Graeanog Ridge would suggest wealth was a key factor in relation to the presence of glass types.

Barton Court Farm was also a farmstead, 1.5 km from Abingdon, 60 km north of Silchester, and between Gloucester and St Albans (*c.* 85km to the west and east). Late Neolithic, Iron Age, Romano-British, and Saxon settlements existed on the site (Miles, 1986). The Barton Court Farm score of 7 represents the glass assemblages of container, drinking vessel and tableware types and forms (Price, 1973). This site had similar origins to Graeanog Ridge but had a broader range of vessel types that is likely to be due to being close to the large cities noted above and main Roman roads.

Frocester developed from a rural Iron Age community living in roundhouses into a Roman villa with buildings constructed as rectangular structures reflecting the changes in domestic living across Roman Britain (Price, 2000). This rural settlement was *c.* 20km south from the large Roman city at Gloucester and was close to Bath. With a score of 10 this was similar to Barton Court Farm.

The glass archaeological evidence at the Gorhambury site consists of glass bottles, unguent bottles, drinking vessels, serving jugs, storage jars and bowls and a score of 16. The site has been described as a Roman villa (Neal *et al.*, 1990). Gorhambury was very close to the large city of *Verulamium* (St Albans).

The archaeology for all these sites revealed the building structures changed from Late Iron Age (LIA) timber framed round-houses to Roman rectangular stone buildings. While this does not necessarily mean that the farmsteads were not managed by natives, it does indicate a Roman influence on the sites. The inference then is that these show a simple pattern whereby distance from a major urban site was proportional to the quantity and range of glass and an indication of the prosperity of a site.

5.3.4 Town - Industrial Settlements Scores

The selected industrial settlements represent the supply and, in some cases, also manufacturing centres for regions. The expectation was that the industrial settlements with significant assumed manufacturing activity would have had good transport connections, with associated civilian communities or military bases in proximity. There is a wide range of scores across this group (6-20) and the context for each site is now examined.

The archaeological excavations for the Wilderspool site did not report any drinking vessels and a limited range of tableware in the material record that contributed to the score of six, the lowest score in this group. This was a Roman industrial site with activity from the end of the 1st century CE until the 3rd century CE with evidence of furnaces and pottery kilns and structures irregularly organised (Hinchcliffe and Williams, 1992). Wilderspool, known locally as the causeway, was located at a ford on the River Mersey and had transport connections north to Preston, south to Chester and east to Manchester.

Walton-le-Dale was a military supply centre located at Preston *c.* 45km north of Wilderspool with road, river and sea transport connections to the west side of Roman Britain and was close to the fort at Ribchester. The buildings on the site were industrial in nature and with evidence of a civilian community as a *vicus* on the site although there was little evidence of a military presence on the site (Pickering, 1956; Gibbons and Howard-Davis, 2001). The material record led to a score of 16 based on the presence of containers, drinking vessels and a range of tableware.

Scotch Corner was an Iron Age industrial settlement, with roadside buildings and was a main Roman road junction to Dere Street, the main road from York to Corbridge (Fell, 2020). This was a settlement with workshops for metals, with evidence of imported pottery, and mineral processing. As a possible Roman military supply base, the score of 11 reflects the materials use and handling on the site. However, between *c.* 85-150 CE, there was a significant contraction in occupation. New supply routes appeared to have bypassed the site in the mid 2nd century and it seems likely that Catterick became the main supply centre for the region.

Catterick with the highest score of 20 in this group had a broad range of vessel types and forms on the site. The settlement had military connections, a civilian community, craft activities, and a flow of goods via the road connections to York and military bases in the region, including Piercebridge and Corbridge and via the river (Wilson, 2002 a, pp. 185, 247, 249). It was clearly a Roman industrial settlement with inscriptions recording the importance of road networks and communications in the area (Tomlin, 2018, p. 268). Writing tablets from Vindolanda refer to Catterick as a supply centre for hides and other goods (Tab. Vindol. 343).

All these sites were recognised supply centres and as such would have been involved in the movement and processing of materials across the Roman civil and military world.

5.3.5 Fortress Scores

The fortress sites would have been consumers of materials in the Roman era, supplied through the military supply network and with a priority for delivery given their legionary status. The scores for the fortresses are 15-20.

Caerleon was garrisoned in the 70s CE and was maintained throughout the Roman period with an extensive settlement *vicus* attached to the fortress (Gardner, 2001, p. 40). The likely reason for the score of 15 was that the fort excavation site was in the southern fortress defences for the waste from the storerooms and cooking ovens (Mason and Macdonald, 2010, p. 40). This could be an explanation for the high proportion of the large container bottles in the glass assemblages that resulted in a biased profile for the fortress. The excavation evidence was also from the fortress baths that would have had glass fragments related to the use of the baths, such as unguent bottles and bath-flasks and so this possibly limited the range of types and forms.

The fortress at Usk was operational from *c.*58-66 CE (Manning, Price and Webster, 1995). This fortress was key in a series of forts in the Wales and the Marches region and would have been a key military supply site for this period. The glass tableware included vessels for serving liquids and foods and was of good quality glass, although these were common for the period and not of high-status value (Manning, Price and Webster, 1995, p. 139). The glass was excavated from the fortress barracks, granaries and storeroom areas that could explain the broad range of vessel types, forms, and the score of 19 for Usk. The glass types included in order of percentage proportion the bowl, jug, bottle, cup and unguent as a combined *c.* 84% of the vessel types. The main glass forms were the commonly distributed pillar-moulded bowl and the square bottle. The unguent site proportion was unusually high, however, the corpus proportion for Usk was within the range 0.1-0.5% found for the other seven military sites and the five settlement sites including Silchester, St Albans and Wroxeter. The unguent small container was associated with individual health with the contents assumed to be cosmetics or medicinal products (Derrick, 2021).

The fortress at York was built in 71 CE and occupation continued until the end of the Roman occupation with the city York becoming a significant urban administration centre and a *colonia* in 237 CE. The excavation report for the fortress at York does not try to identify the nature of the occupancy in any of the excavated areas other than the military presence is recognised (Cool *et al.*, 1995, p. 1646). The score of 20 for York reflects a broad range of glass types including in order of percentage proportion the bottle, beaker, bowl, cup and jar (a combined 87%) with the remaining types being the unguent, flask and jug. The glass forms include the commonly distributed pillar-moulded bowl, cup with base-ring, the cylindrical and square bottle.

The legionary fortress at Wroxeter was built in the 50s CE and occupation continued until the mid 70s CE. The excavated glass finds were recovered from the military levels that included for example the fortress streets, buildings, cooking ovens, and waste pits (Cool and Price 2002; Webster 2002). The broad range of vessel types were in order of percentage proportion the bowl, beaker, cup as 75% of the vessel types followed by the bottle, unguent, and jug. The commonly distributed pillar-moulded bowl form was *c.* 20% of the vessel types and altogether the broad range of glass gave a high score of 18 for the fortress at Wroxeter.

The common features of these military sites are that when operational, the sites themselves were on the fringes of the Roman territories for the periods of occupation and as legionary bases would have been strongly connected to the military supply network. They were occupied by military people with non-native material cultures and the glass finds, the archaeology context, and the high scores therefore represent the profile of a legionary military fortress.

5.3.6 Military Forts Scores

In addition to the fortress sites, there were military forts that were used for campaigns with smaller numbers of foot-soldiers or cavalry. These were constructed to a similar template and in some cases became more permanently established and with associated civilian *vicus* settlements. This is an important context that has been used to position the scores from the military sites in comparison with the settlement sites. The fortress scoring was used to bridge the two sets of data.

The three fort sites Castleford, London, and Piercebridge have the high scores 20-22. Castleford was 32 km southwest of York and 16km south-east of Leeds and continued operationally until the 5th century. The site score of 22 reflected the broad range of drinking and tableware vessel types and forms, including the common pillar-moulded bowl, square and cylindrical bottle forms. In order of proportion these were the cup type mainly found in the *vicus,* the beaker type from the fort trenches and the other types across the site. The *vicus* was immediately to the south of the fort and was occupied from the 1st century and abandoned in the late 2nd century CE (Cool and Philo, 1998, p. 5; Cool and Price, 1998, p. 141).

London was already a major trading centre in the mid 1st century CE and included military forts and a town - industrial settlement. The forts at Plantation Place and Cripplegate (combined periods of 60 – 200 CE) would have had access to the materials moving through the urban environment. There are signs that London was a significant centre for glass-working in the 1st-2nd century CE at the Basinghall Street, the Guildhall, Moorgate sites and in the Bow Bells House site Cheapside (Seeley and Drummond-Murray, 2005; Bateman *et al*., 2008; Howell, 2013; Dunwoodie *et al*., 2015; Wardle, 2015a It). was not possible, however, for London-made glass to be identifiable in the town and other parts of Britain (Shepherd and Wardle, 2009; Shepherd, 2012; Wardle, 2015b, p. 202). Nevertheless, glass producing at London would have contributed to the breadth of the range of glass types and glass forms in Roman Britain through taking the advantage of the road, river and sea connections. The range of glass vessel types from the London forts and town included in order of proportion the bowl, bottle, cup, jar, jug and beaker types, with many drinking vessel forms and the common square and cylindrical bottle forms. This broad range of type and form resulted in the high score of 21. There was in the glass forms an unusually low proportion of the common pillar-moulded bowl given the forts combined operational dates from the mid 1st century through to the end of the 2nd century CE. The distribution of this bowl form declined significantly after the 1st century and there was no evidence of this form in the Basinghall glass-working assemblages in the 2nd century (Shepherd and Wardle, 2009, p. 57). The conclusion made is that this bowl form, very common in the 1st century CE, made with the cast technology and so time-labour intensive, would have been imported from the Continent, but was not as popular in the London forts and town as for the other military bases.

The fort at Piercebridge was located on Dere Street that was the main road north to Corbridge via Scotch Corner and close to the supply centre at Catterick. This fort had close links to a settlement (*vicus*) at Piercebridge as well as those other sites in the vicinity including Catterick and Scotch Corner and the material record and high score could well reflect the complicated origins. The bottle type was over 50% and the cup at *c.*27% of the site percentage proportion of vessel types, with the beaker, jug, bowl, unguent, and flask in order combined at *c.*19%. Most of the assemblages' disposal areas were attributed to the *vicus* and the fort/*vicus*. The main vessel forms were the common square and cylindrical bottles that with the vessel types gave a high score of 20 for Piercebridge. The *Frontinus* bottle form was present at Piercebridge. This is the corrugated form of the cylindrical bottle that was fairly common across Roman Britain in the 3rd and 4th centuries, a timeframe that fits with the operation of the Piercebridge fort (Price and Cottam, 1998, p. 209). The Mercury flask (bottle) form was also present (Figure 4.110). This mould-blown square body flask with the image of the god in the base design was not common and in use in the second half of the 2nd century CE (Price and Cottam, 1998, p. 179). This broad composition of glass types and forms at Piercebridge could have been as a result of the movement of people, particularly those associated with the military, or as traded material goods using the military supply chain.

With the fortresses at York, Usk and Wroxeter included, all these military locations have high scores that reflect the broad range of glass types and forms on each of the sites. As has previously been noted, the material cultures for these sites would have been strongly influenced by the non-native military occupants.

While all these sites were established as major points on the transport network and would have been supplied with material goods as they were consumer trading locations, the possibility of individual travel contributing to the movement of glass cannot be discounted. Indeed, there were examples of glass forms that probably were personal possessions that travelled with the owners and the presence found on sites. To explore this concept further, the forts at the extremities of the Roman occupation in Britain have been analysed as follows. They include Birdoswald and Corbridge on Hadrian's Wall, and Elginhaugh in Scotland.

The Birdoswald fort was constructed at the start of the 2nd century CE, during the period of major stone works at Hadrian's Wall and was occupied until the 5th century with several structural changes during that period. The fort had a score of 14 based on the range of glass types with the bottle (over 55%), the cup and bowl (*c.* 30%) and the jug, flask and beaker completing the profile. The common glass forms of the square bottle and cup with a base-ring were present at 5.6% of the vessel types.

The fort at Corbridge was developed from the end of the 1st century, abandoned by the end of the 2nd century, and with a similar glass type and form profile to Birdoswald (full details in Chapter 4). The exception is the presence of the amphorisk jug glass form at Corbridge (Allen, 1988; Bishop and Dore, 1988). This jug form has also been noted at the fortresses Usk, Wroxeter and York, and the large cities of Colchester and Silchester with all dated in the second half of the 1st century CE. The amphorisk is a convex jug with two decorated handles and is a particularly striking vessel jug design, dated to the mid 1st century CE and reported as a not very common form except on early sites in southern Britain (Price and Cottam, 1998, p. 147). The presence at Corbridge suggests that this form could have travelled as individual vessel(s) or with a military group. This glass amphorisk form by design can be associated with a Roman material culture.

The Elginhaugh fort was operational for the decade from 78-88 CE. It was situated at the most northerly stretch of Dere Street from York to guard the crossing of River Esk (Hanson *et al* 2007). The site score for Elginhaugh was 17 that was based on a broad range of glass types that included the bottle type (over 78%) with the unguent, beaker, cup, bowl, jar and jug at all relatively similar proportions in the range 1.4-8.7% (Price and Worrell, 2007). The common cylindrical bottle form was 46% of the vessel type profile; the arcaded beaker was also present at Elginhaugh and the Wroxeter fortress. The less common glass forms at Elginhaugh included the cantharus cup (also at Colchester and the London fort in the study corpus) and the modiolus cup - refer to Chapter 4 for details of these glass forms. The modiolus cup fragment is the only example in this study corpus of this form that is rare in Britain (Price and Cottam, 1998, p. 70). There are examples of this glass form from the Continent at Marseille, Lyon, Aix-en-Provence, and Pompeii on mostly 1st century contexts (Cool, 2016; Foy *et al.*, 2018). While the modiolus form is a cup, it could have been used as a measuring cup. This then could have part of the army quartermaster's toolkit that moved with the army that brought it into Britain. The presence of these less common and rare finds so far north, raises the possibility that they could have travelled as personal items, possibly as the property of a peripatetic wealthy owner or via travelling merchants and itinerant glass workers (Cool, 2002, p. 147).

5.3.7 Evaluation

The civil and military sites' scores are shown in Figure 5.44 in order of descending scores and with the site types colour coded for city, fortress, fort, rural and town. The civil and military sites vessel distribution proportions across Roman Britain are also shown in descending order of frequency and similarly colour coded as Figure 5.45.

The civil and military sites' scores in Figure 5.44 can be compared to the percentage distribution in Figure 4-45. The top ten sites in the scoring chart are similar to those in the percentage distribution chart. It is striking that the forts have such a broad range of scores. The forts at Carlisle and Ribchester are included in the distribution graph primarily because of the high bottle percentages on the sites but the scores reflect narrow ranges of glass types. In contrast, the Castleford and Piercebridge forts have scores that recognise wide type ranges and high distribution percentages as indications of the consumption of glass.

The corpus distribution shape (Figure 5.45) has *c.* 30% of the sites with over 80% of the corpus distribution and a long tail of sites with little change in distribution. This distribution will be used in the analysis of the spread of glass across Roman Britain to show how the distribution density patterns relate to history and geography. In contrast, the scoring shape represents the ranking of the sites based on a qualitative measure of the range of site vessel types.

The sites' scores are a way to visibly rank site profiles for comparison, as illustrated by the above chart (Figure 5.44). The qualitative scores can be a useful guide towards interpreting the site profiles with the archaeological context and correspondence analysis associations. The differences between the high-low scores reflect the variations in the ranges of the vessel types and forms displayed in the tables and figures, and sign-posted with the site scoring system.

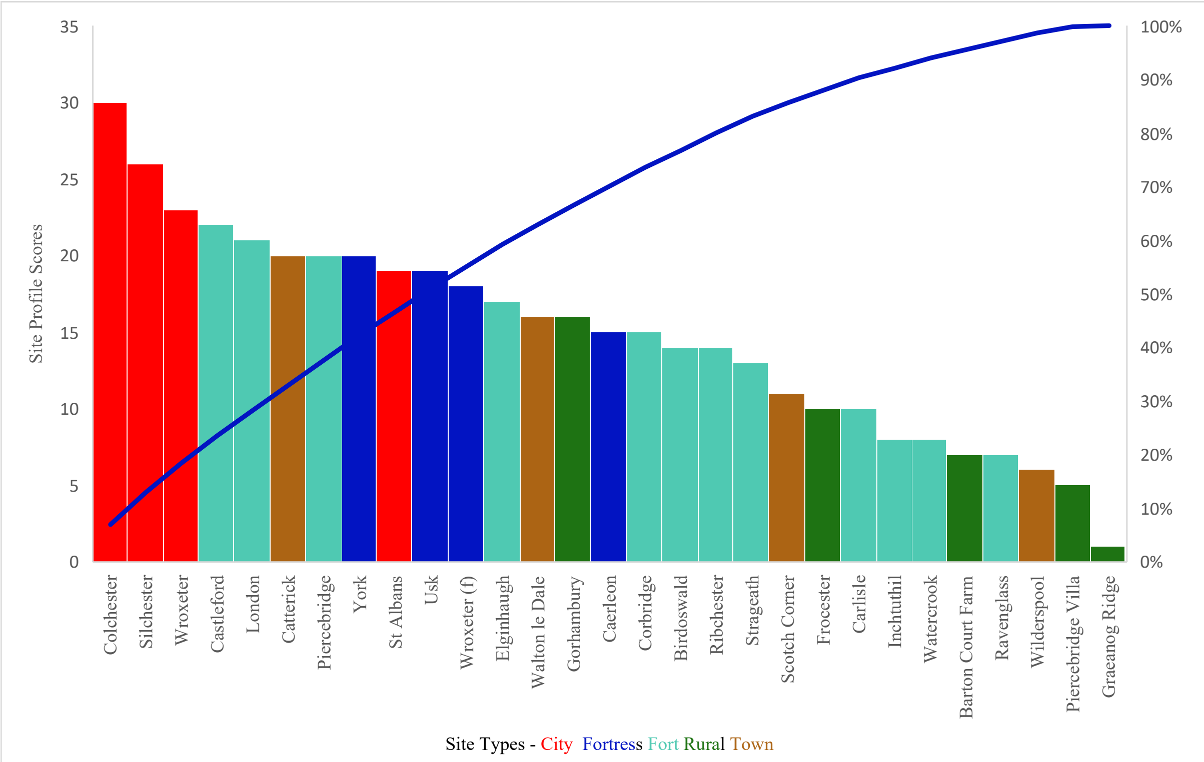


Figure 5.44 Civil and Military Sites Scores in Descending Proportions

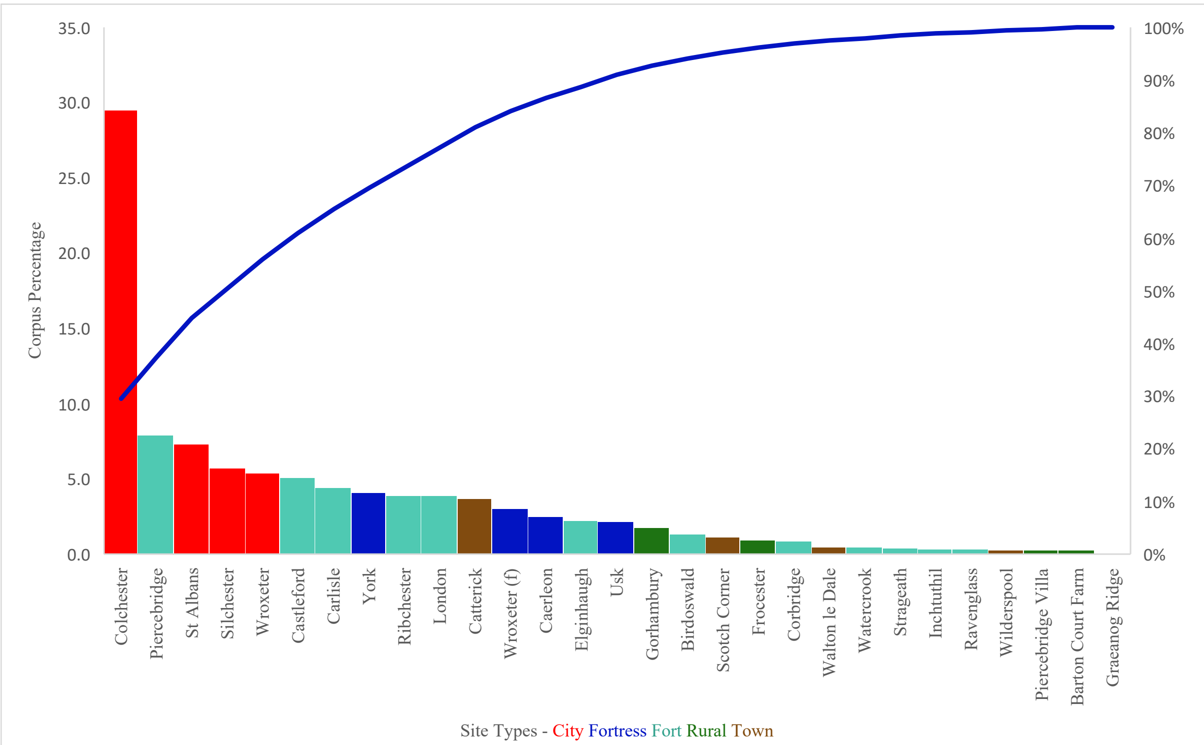


Figure 5.45 Civil and Military Sites Corpus Vessel Distribution in Descending Proportions

The next section on site glass characterisation used the glass forms as identified vessel types to add to the understanding of the social activities and trading implications so far identified.

5.4 Investigation of the Sites Material Cultures

5.4.1 Civil and Military Sites

This section records the investigation of whether glass vessels were indicators of material cultures across the range of civil settlements and military bases. Table 5.18 shows the vessel type averages for the settlement and military sites with the main differences seen as for the bottle type and bowl type.

Table 5.18 Comparison of Civil Settlement and Military Sites Based on the Average of the Sites Vessel Type Proportions

Glass Type	Civil	Military	Combined
bottle	26.3	40.3	33.3
unguent	1.6	3.0	2.3
beaker	7.8	6.1	7.0
cup	10.5	8.8	9.6
bowl	24.7	10.5	17.6
flask	2.7	3.7	3.2
jar	4.4	2.8	3.6
jug	8.6	8.2	8.4
plate	0.7	0.8	0.7
other	12.7	15.9	14.3
Total	100.0	100.0	100.0

Note: Flagon counts are added to the Jug counts

The bottle type average percentage counts for the military sites were significantly greater than for the settlement sites (40.3% versus 26.3%) and for many of the military sites, the bottle was associated with the military barracks and associated *vicus*. The bottle type was very likely a container for wine, oil or salted fish products and although the vessel would not compete on bulk movements with pottery amphorae, the glass bottle could have been a container for dispensing the contents (Fleming, 1999, pp. 61–66) . The glass bottle was introduced with the Roman invasion and rapidly became a common glass type more than likely as imports from the Continent with the contents provided with the bottle for the first-fill move. The other large difference between the civil and military sites was that the bowl type percentage counts were much larger for the civil than for the military sites (24.7% versus 10.5%). Individual place setting vessels include cups and bowls, and these have been associated with Roman assemblages (Cool, 2006, p. 54). However, we should remember that pottery bowls were also a common vessel and glass bowls may have had a different functional value for drinking and dining. The actual moving averages are shown for the sites in the Figures 5.46, 5.47.

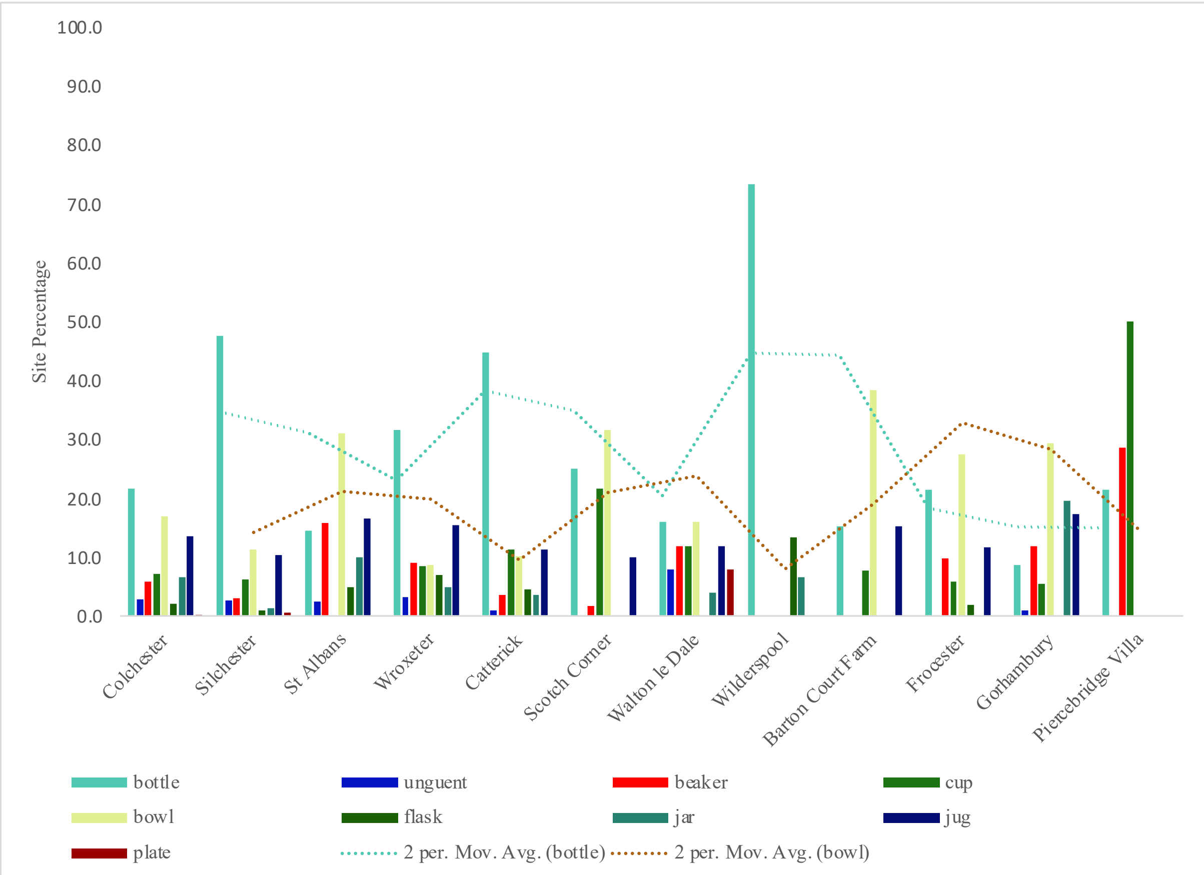


Figure 5.46 Civil Settlement Site Vessel Type Percentage Compositions

(The flagon counts were added to the jug counts)

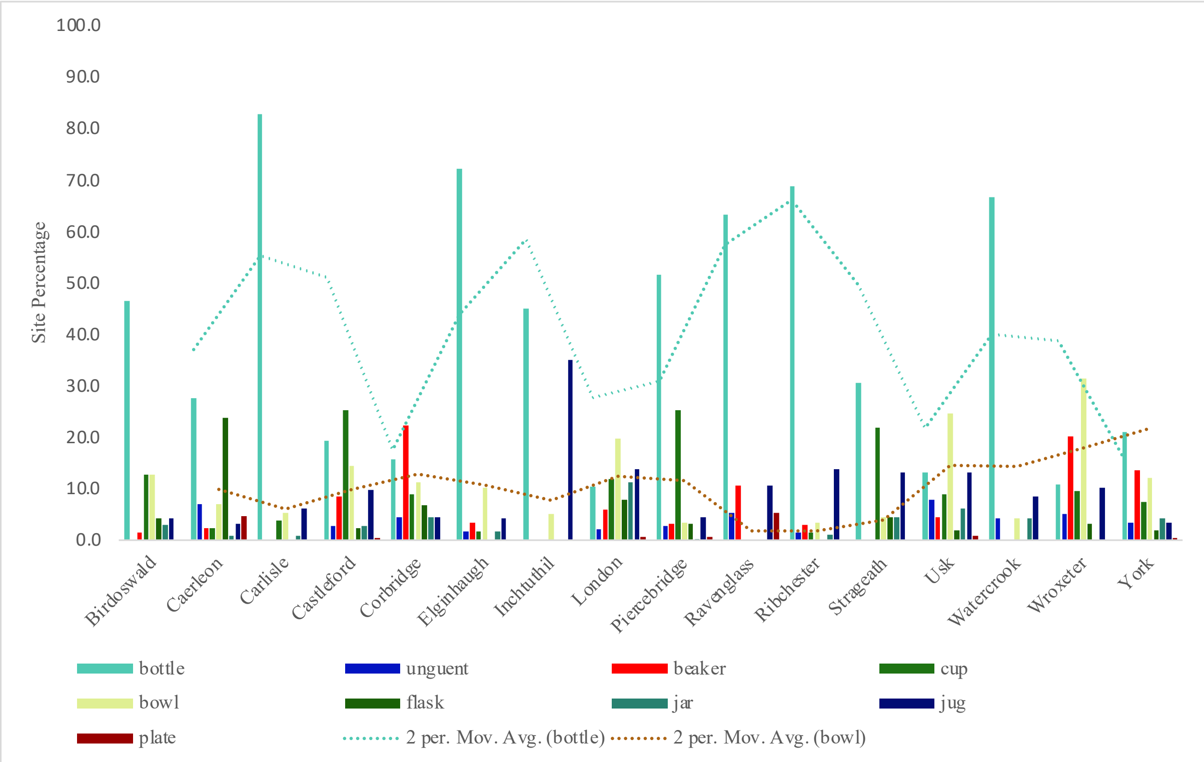


Figure 5.47 Military Site Vessel Type Percentage Compositions
(The flagon counts were added to the jug counts)

The standard deviation of the bottle and bowl types data is represented by the moving average range that is calculated to show a smoothed line for the bottle and bowl types (refer to Appendix 4 for more details). These figures illustrate the variation of glass types across the sites and the smoothed lines represent the bottle and bowl moving averages for the civil and military settlement sites. There are observations at this site level of detail. The rural sites bottle and bowl trend lines are different to the other civil sites with a lower proportion of bottle to bowl. The lower bottle proportion could be an indication of the reduced access to trading city communities, and the higher bowl proportions an indication of cultural differences between rural and urban settlements. The other observation for the military sites is that the Wroxeter and York fortress sites have the trend of more average percentage bowl and lower average percentage bottle than the forts. The legionary fortresses would have been prioritised for supplies and they would have been occupied permanently. The range and shape of the fortress profiles with the similarity to the large city profiles has already been noted. For the Wroxeter and York fortresses, this could have been an indication of urban-rural lifestyles with the bowl used as a communal vessel (Taylor, 2013).

The difference between the two site groups is relevant to the next section that investigates the association between material culture and lifestyle.

5.4.2 Civil Settlements

The site profiles of the civil settlement sites can be used to describe the character and socio-economics of the settlement based on the consumption of glass vessel types and forms. This involves making certain assumptions about the community practices of dining and drinking that could imply common characteristics of site type profiles. It has been suggested that drinking was a social activity that depended on community groups in an area, whereas dining could have been more associated with power networking of perhaps elite groups involved with the administration of regions (Perring and Pitts, 2013, p. 154). Comparisons of the site profiles for Colchester, Silchester, Wroxeter and St Albans show similarities between the Colchester and Wroxeter overall profile shapes. This has been discussed earlier using the correspondence analysis (Figure 5.27) that shows the association of St Albans with the bowl type, Wroxeter with the cup, Silchester with the bottle and Colchester has a general association with all vessels.

A comparison of vessel types for the four cities is shown in Figure 5.48. The bottle bias for Silchester has already been discussed. The absence of cups at St Albans is now explored given this is unusual for a large city. There could be several reasons for this, including the differences between the scope of the respective archaeological excavations. However, given the presence of glass beakers at 15.8% of the St Albans vessel types does correspond to the combined drinking vessel types for Colchester and Wroxeter (13.2% and 17.7% respectively).

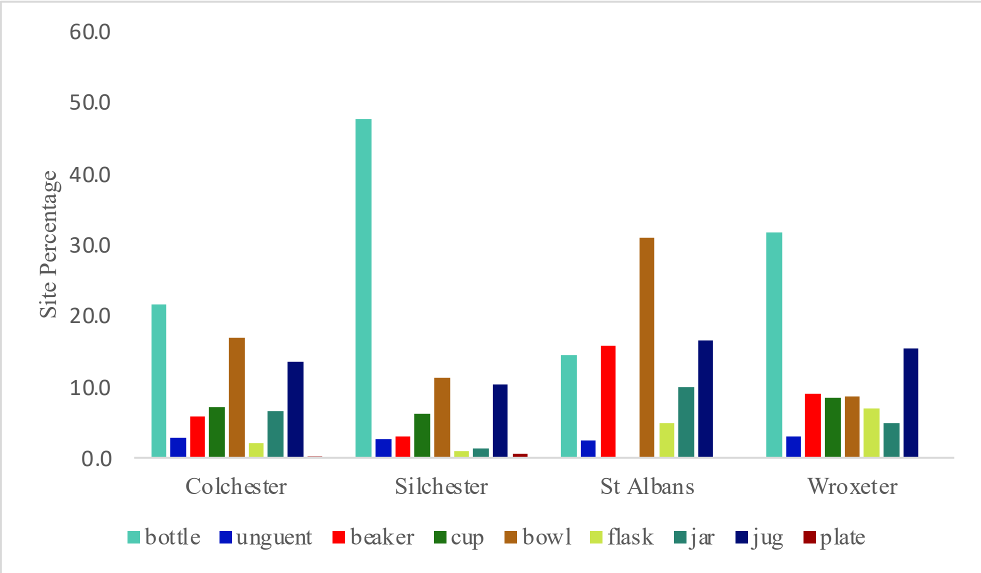


Figure 5.48 Comparison Colchester Silchester St Albans and Wroxeter Site Glass Types Percentage Counts to 500 CE

(Amended with flagon replaced by jug for St Albans)

The obvious alternative to glass cups would have been pottery cups and there were examples from St Albans of mica-coated indented beakers of similar dimensions to glass cups (Frere, 1972, p. 324 cat.id. 836). The coating is a silicate material that could have been used as a surface glaze and drinking vessels with similar non-absorbent properties to glass. These pottery types are however a small proportion of the overall pottery beaker assemblages. The implication is that larger beakers represented the material culture or also could have been because of the available vessel supply to St Albans.

The comparison of the glass tableware forms between Colchester, Wroxeter, Silchester and St Albans is illustrated in Figure 5.49. The proportion of the combined bowl forms for St Albans was significantly higher at 31.1% than for the other cities. The presence of the pillar-moulded bowl was very common in the 1st century CE and is seen on all the sites. There is an increased presence of the cylindrical bowl, ribbed bowl and tubular-rimmed bowl forms (Figure 4.92) that reinforce this pattern of difference over the period to 500 CE.

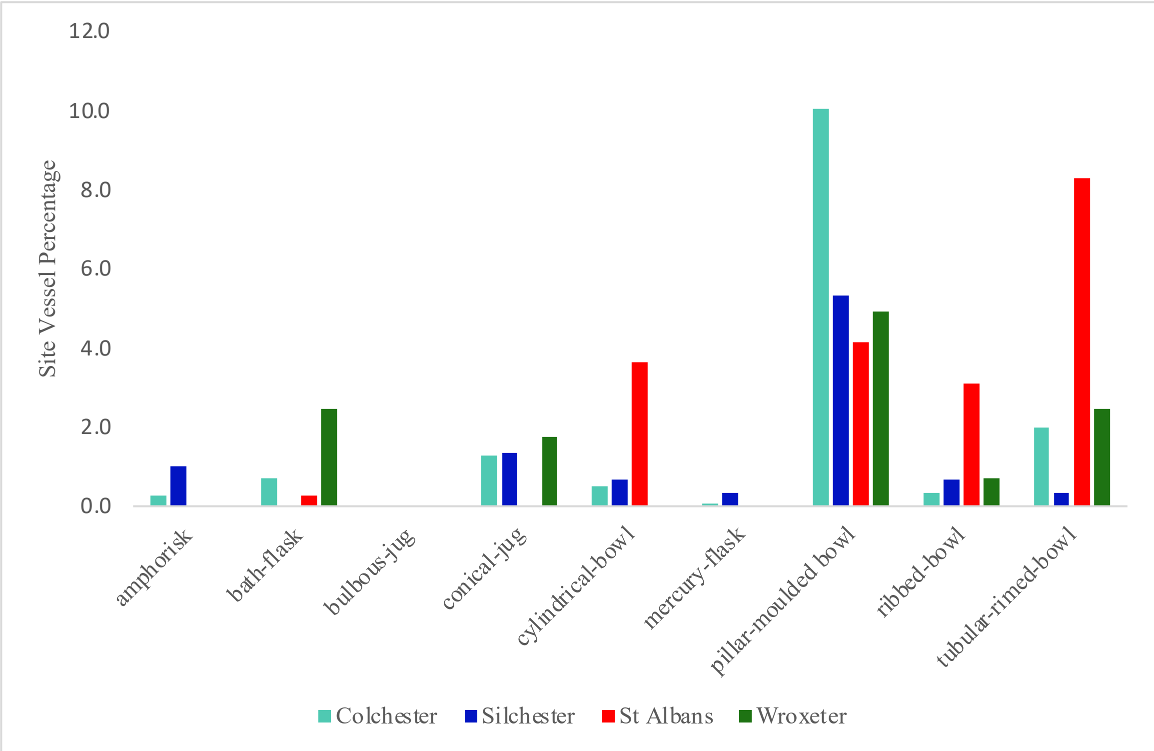


Figure 5.49 Comparison Site Tableware Forms Percentage of Vessel Counts to 500 CE – Colchester Silchester St Albans Wroxeter

In summary, the pattern of difference for St Albans was that larger-capacity beakers and the use of bowls were preferred to that of the smaller-capacity cups or these were driven by the available supply. This compares to patterns previously noted from the individual Colchester sites, with the beaker-bottle association with barracks buildings and the cup-jar-jug with the higher status dwellings (e.g. the Culver Street tribunes' houses). The differences in origin and status of these cities with St Albans a *municipium* and Colchester a *colonia* (Section 5.2.3) convey these site profile differences. These indications of different social and economic conditions will be discussed in Chapter 7.

5.4.3 Glass Objects

Glass objects can be utensils for Roman kitchens, construction materials, glass manufacturing wastes and personal items. The evidence of glass inkwells from the Piercebridge fort *vicus*, the Colchester 1st century barracks, and the 4th and 5th centuries tribunes' houses and main gate sites highlight an interesting association between object and locations (Cool and Price, 1995, pp. 116–117; Cool and Mason, 2008, p. D10.4). Colchester developed into a large Roman city with public buildings, temples, theatre to become a large Roman city, designated as a *colonia* and the administration capital of the new province *Britannia*. To find literary implements there is unsurprising. The find at Piercebridge fort *vicus* dated to 75-150 CE is more interesting. During this period, Piercebridge was a garrison town and a major centre based on the material culture. This glass inkwell could have been a personal possession that travelled with the owner and one can only imagine the role played by the owner in the history of the region.

Recreation was clearly popular with glass counters, or gaming pieces, usually found in groups of white and black counters as common finds on sites in Roman Britain (Price, 2005). A set of counters and the remains of the gaming board was found at the Stanway burial site (Crummy *et al.*, 2007, pp. 352–359). In this corpus, counters were found on more than 68% of the military sites, the industrial settlements in western Britain, Gorhambury, and St Albans.

Window glass was a construction material introduced by the Romans. In Britain, fragments of window glass were found on *c.* 62% of the military sites, all the large cities and the high-status villa at Frocester. Window glass has been associated with bath-houses on the sites. There were also fragments of window glass at Wilderspool and Walton-le-Dale which could have been from supplies to be distributed to west Britain settlements and military bases. There were also glass residues from possible glass industry sites, found in London, Colchester, York and Carlisle also a candidate site. These patterns of personal objects and industrial finds emphasise the broad use of glass in Roman Britain. The above insights show that glass can be an indicator of material cultures associated with Roman veterans, and high-status settlements.

5.5 Shrines and Burial Sites

This section presents the glass types that were associated with religious ceremonies and burial practices. However, the functional use of the glass found in shrines and burial sites was very different from the original designed glass use. Taphonomy can be defined through the fragments of the original glass object found on a site. The primary distribution of the fractured object when fractured and discarded fragments become the secondary distribution and subsequent movements then the tertiary distribution. For shrines and burial sites, the placement of objects into a shrine or grave was a social practice at a religious or ceremonial site and different from an accidental loss or the disposal of materials as waste into a pit or ditch. This analysis requires an understanding of the ways that the material record is formed from the beginnings of the disposition after the primary distribution, with a subsequent secondary distribution and through time to the excavation recovery, identification, and reporting of the artefacts from the site.

The vessel type percentage profiles for the sites Stanway, Uley, Gloucester and Skeleton Green are detailed in Table 5.19 and seen in Figure 5.50. These should be seen as artefacts left as votive offerings, religious symbols, vessels used in burial ceremonies and containers for ashes.

Table 5.19 Glass Types Percentage Counts Shrines and Burial Sites

Glass type	**Stanway**	**Uley**	**Skeleton Green**	**Gloucester**
bottle	-	17.4	9.5	-
unguent	55.6	-	-	100.0
beaker	-	-	14.3	-
cup	-	26.1	-	-
goblet	5.6	-	-	-
bowl	27.8	21.7	28.6	-
flagon	-	-	4.8	-
flask	-	4.3	9.5	-
jar	-	-	-	-
jug	-	13.0	4.8	-
plate	-	-	-	-
drinking	-	-	-	-
tableware	-	4.3	4.8	-
no-class	11.1	13.0	23.8	-
Totals	100.0	100.0	100.0	100.0
Counts	18	23	5	21

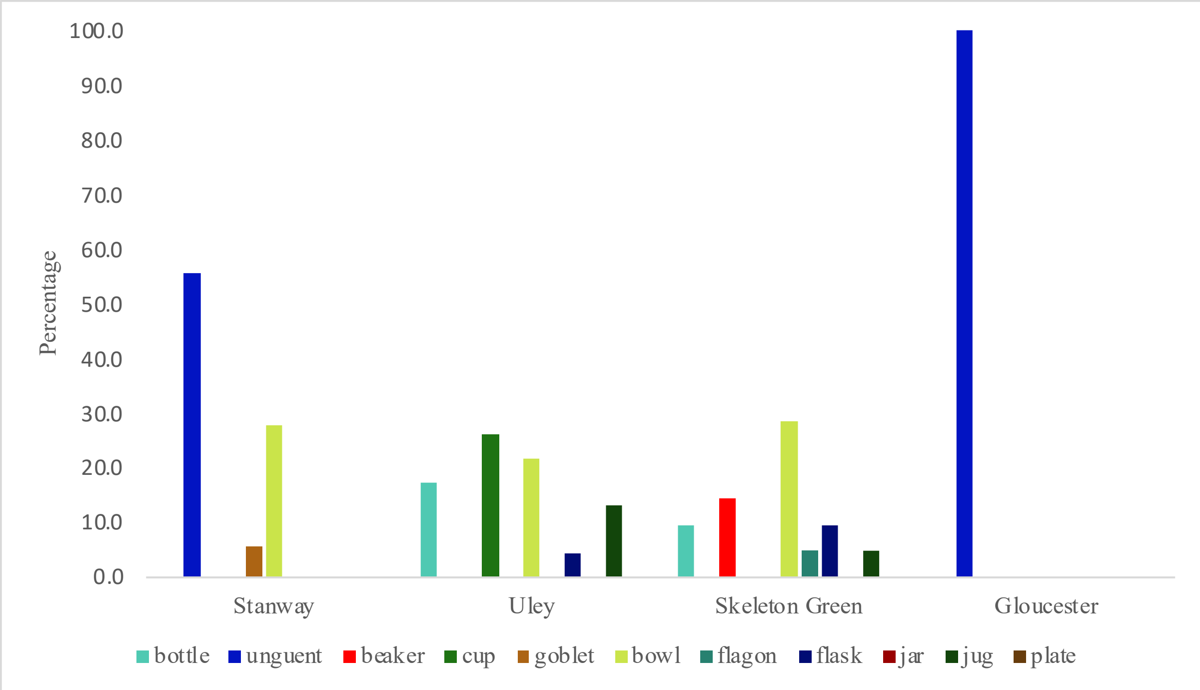
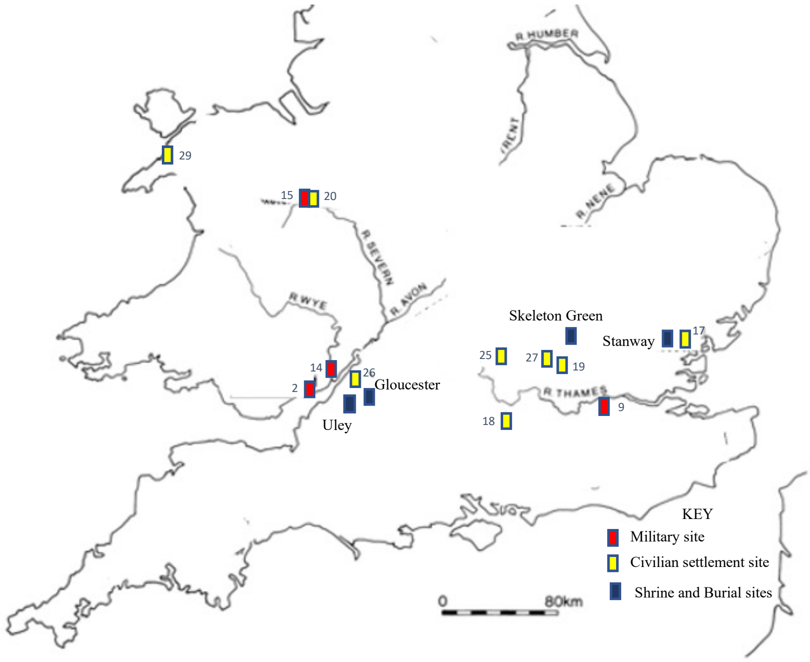


Figure 5.50 Glass Type Percentage Counts for Shrines and Burial Sites (to 500 CE)

There evidence from these sites is of glass vessels fulfilling a secondary purpose as physical containers or as symbols of life and remembrance, with the precise motive unknown. Most of the items are common vessels used in everyday life. The large container bottles, beakers and jars were frequently used to hold ashes and could have been left for reasons of personal association. The small unguent containers are thought to have been used for the contents as scents or perfumes; these were the only type of glass artefact found at Gloucester.

The geographical locations are shown in Figure 5.51.



Military Sites	Civil Sites
2. Caerleon	17. Colchester
9. London	18. Silchester
14. Usk	19. St Albans
15. Wroxeter	20. Wroxeter
	25. Barton Court Farm Villa
	26. Frocester
	27. Gorhambury Settlement
	29. Graeanog Ridge

Figure 5.51 Locations of the Selected Study Shrines and Burial Sites

The profiles vary across sites with Uley and Skeleton Green having similar profiles, but not geographically close. Skeleton Green and Stanway are geographically close but with different glass type vessels present. The patterns of vessel types on the shrine sites appear to reflect local practices.

5.6 Summary

The analysis of the settlement sites confirmed that the consumption of glass on sites can be defined by site glass profiles of the patterns of glass vessels in urban large cities, towns as industrial settlements, rural civil settlements, and Roman army military bases. The site profiles were based on the comparative analysis of the data tables, graphs, and the correspondence analysis plots of the sites. These have been demonstrated to be compatible tools that together have been used to define site profiles based on percentage proportional distributions of glass types and forms for the settlement types – large city, military fortress and fort, town-industrial settlement, and rural farmstead.

The analysis of the Colchester inner-city Culver Street and Balkerne Gate sites showed associations with the buildings of Roman veteran communities. The evidence of glass bowl and bottle type associations from barracks may be an indication of communal drinking versus jar, cup and jug associations from tribunes' houses. By also relating these areas to the overall city profile, the similarity between Colchester and Wroxeter site profiles was also seen through this connection with veteran communities. The differences in the other city site profiles of Silchester and St Albans could be due to the different origins of those cities, with no archaeological evidence of military or veteran origins and so the consumer markets differed from Colchester and Wroxeter. The implication being that patterns of difference between them could from the origins of the cities as tribal capitals.

The chronological changes in the material record for Colchester from the 1st century reflected the impact of the Boudican revolt with reduced glass forms and a reduced proportion of bowls on all the individual sites immediately after the event and with changes in the subsequent centuries. The patterns of changes from the 2nd century suggest a levelling of proportions through to 500 CE, and the profile returned to the pre-61 CE vessel type range and proportions.

The research confirmed the site profiles for the fortress sites were similar to the large cities with broad ranges of glass types and associated glass forms. These were indications that trade and material culture was based on urban economics by the large cities and the fortress sites with the latter supplied by the military transport network. This supported the hypothesis that the large cities were important to the trading economy.

The profiles of the forts varied largely associated with the proximity to roads, rivers, and urban settlements. The profiles for the rural settlements were also different with the range of vessel types in proportion to the distance from a city and to a transport route (river, road, sea). As an example, the site profile for Gorhambury only 1km from St Albans represented a high-status farmstead (villa) with a broad range of glass types; Graeanog Ridge was an isolated farm and had a single bowl fragment. The presence of glass on all of these different site types is an indication of the reach of the trading networks across the regions. Glass was valued as a material and the presence also reflected the acquisition of glass across a wide range of communities with differences in wealth, origins and cultures. The patterns of glass on the shrines varied significantly and reflected both local ritual practices and local social cultures.

The following chapter addresses what the distribution of glass was across Roman Britain and what that can that tell us about the movement of glass into and around Roman Britain.

6 TRADE AND DISTRIBUTION OF GLASS

6.1 Introduction

This investigation seeks to gain insights into the capability of the glass industry to make, move and trade glass products and through that to better understand Roman socio-economics that drove the glass trade. Here, 'trade' was defined as the exchange of glass products for money, through reciprocity or redistribution (Hopkins, 1995; Temin, 2013; Grønlund Evers, 2017). As discussed in the Literature review (Chapter 2), there is a broad consensus that there was a market economy for products traded over long distances throughout the Roman period (Horden and Purcell, 2000; Wilson, 2009; Hopkins, 2017b). This included staples such as grain, wine, and olive oil together with luxury goods and a range of manufactured products, including pottery, ceramics, and glass.

To achieve the research aims, four approaches to the data were made use of. The first approach investigates the regional distribution patterns of glass vessels. The expectation is that there would be a high proportion of the glass in the large city administration centres given these would have been the residences of the elite and wealthy of Roman Britain. Glass vessels were valued as items of status and as such, the distribution patterns could reflect the consumption patterns across different site types.

The second approach is to assess the patterns of trade across the regions. The organisation of the trade to satisfy the markets consumption in glass could be understood through the occurrence of vessel types across the region. The hypothesis is that trade would have been organised by merchants and traders operating out of the main population centres. The distribution of glass vessel types across the region would be an indication of the trade into Roman Britain following the conquest.

The third approach is to expose the supply networks into and within Roman Britain using the evidence from glass-working centres and the patterns of distribution of glass in trading and supply centres. This includes any potential differences between the military and civil supply destinations. The commercial realities of the supply of glass will also be explored.

The fourth approach is to examine whether the trade of glass into Roman Britain could have been driven by social and economic differences across the region. This includes revealing any associations of glass types with the geographic and social landscapes of Roman Britain.

6.2 Regional Distribution Patterns

This section includes the analysis of the distribution of the selected glass corpus to identify whether there were distribution patterns that revealed any north-south or east-west differences. This distribution analysis shows that the corpus distribution was skewed towards the large cities, military fortresses and some industrial settlements with similar distribution profiles.

The distribution of the corpus is shown in Figure 6.1 that shows the density of the corpus and the site locations against the geographical landscape and the significant sites named. This shows the areas of high distribution density zones as the north-east military supplied zone that includes Castleford, Piercebridge and York, Carlisle to the west of Hadrian's Wall, the large city areas in the south of England and Wroxeter in Wales.

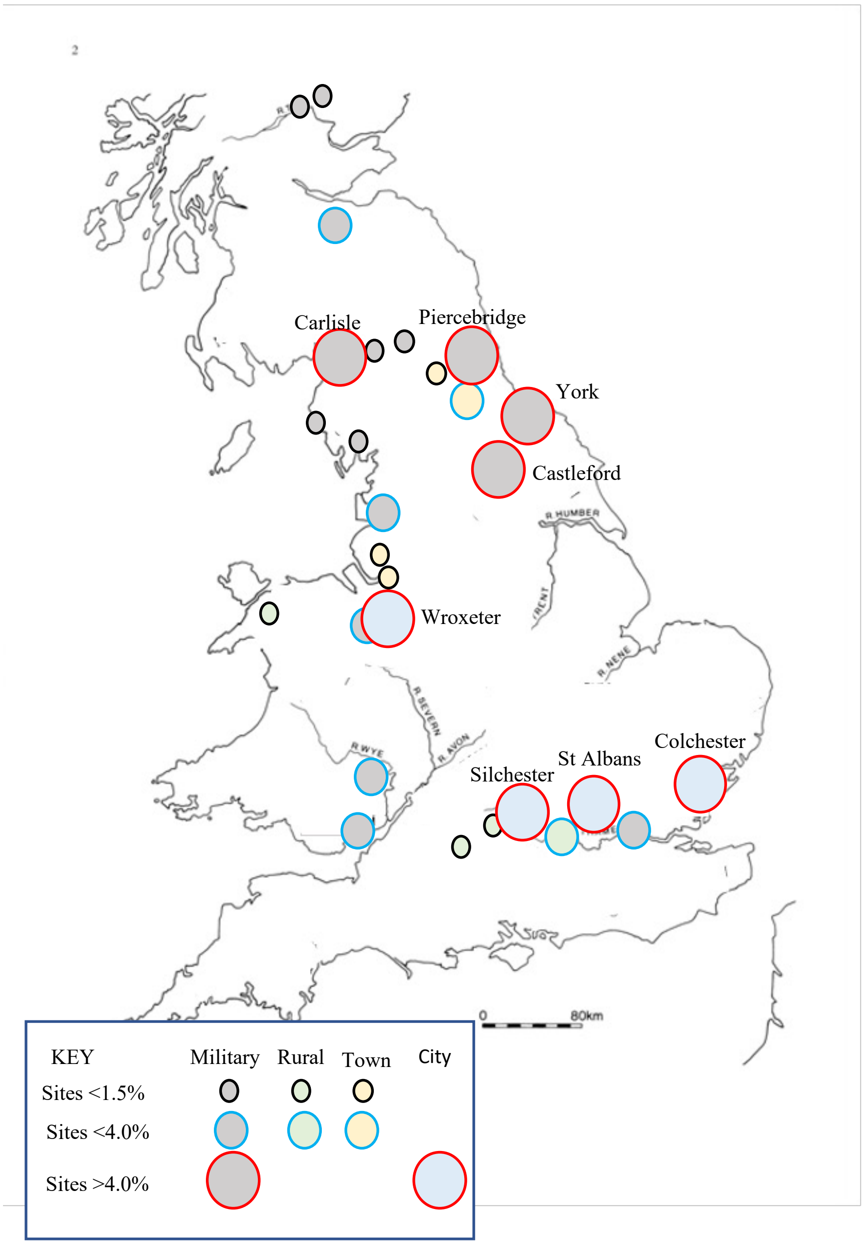


Figure 6.1 Glass Type Corpus Distribution of Percentage Counts

The major roads are shown in Figure 6.2.

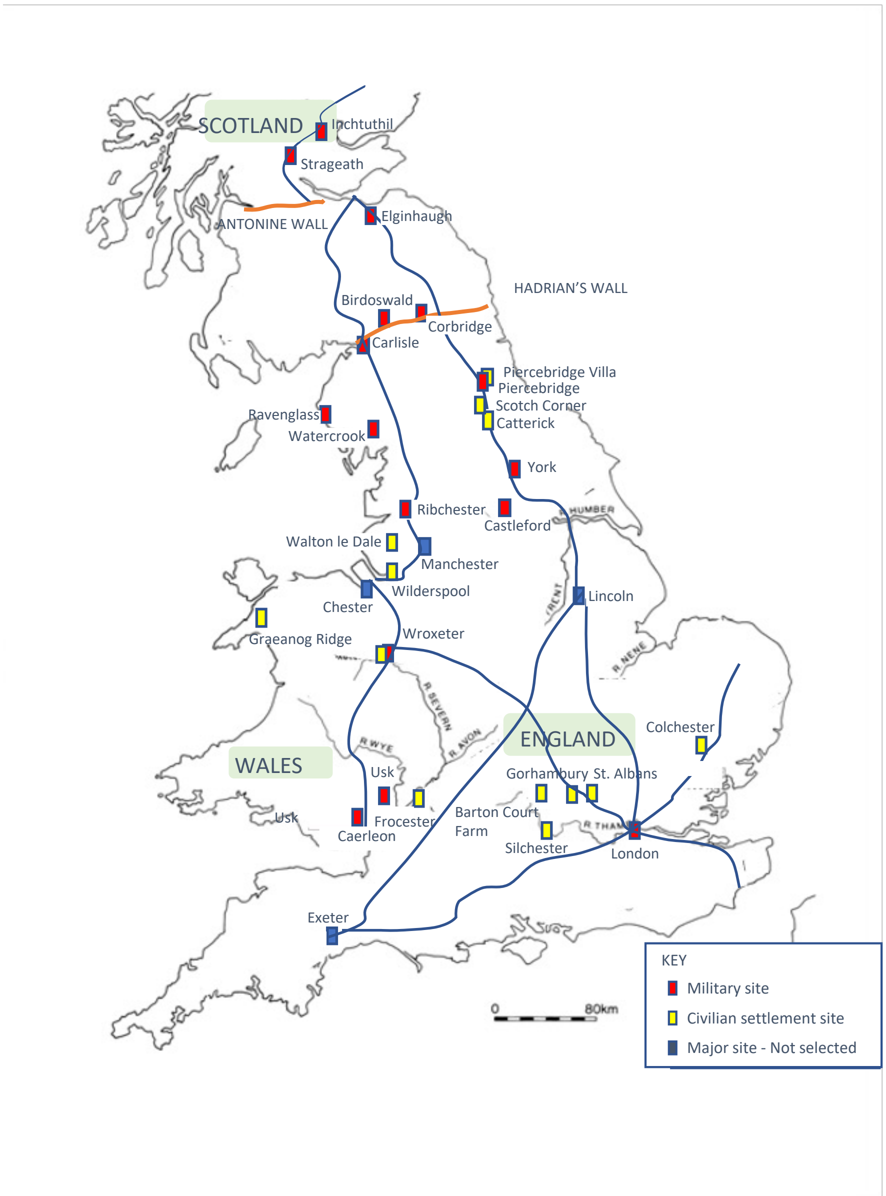


Figure 6.2 Corpus Sites with the Main Roman British Roads

This shows that the main Roman road networks emanated from London. The details of the corpus distribution and road system across Roman Britain are shown in Figure 6.3 based on the data presented in Tables 4.78 to 4.79.

Figure 6.3 Roman Britain Sites Showing Corpus % Distribution - to 500 CE

The high proportions in the large cities were expected as these would relate to the status of the cities and the prosperity of the consumers. As these large cities were all regional administration centres, in all likelihood traders would have operated from them to meet the demand for glass vessels across those administration regions. Access to transport connections and market size would have been very important for any trading with settlements, which is most likely why the southeast of Roman Britain was a significant region for glass consumption and the location of the large cities were in that region. Wroxeter was a high distribution density city connected by Watling Street (Margary, 1973 Road 1) to London and further south to the coast. The construction of Watling Street was most likely established for the fortress at Wroxeter and so would have provided a road transport route via London and to the south coast.

Carlisle is on the western end of Hadrian's Wall and there was a fort at Stanwix that was 1km to the north of the fort. The military settlement at Carlisle had an unusually high bottle composition and a high proportion of vessels and based on the evidence of a significant and unusual amount of metalwork including militaria, the role of the fort at Carlisle is likely to have changed into a supply centre in the 2nd century CE (Howard-Davies, 2009, p. 687; Zant, 2009, p. xv). The west coast routes included the major road (Margary, 1973 Road 7) that followed the same line as the present-day M6 motorway. This road linked Manchester with Carlisle through Ribchester on the west of the Pennines. The two high density distribution sites on the west coast were Ribchester and Carlisle. These were connected to the other forts and industrial settlements by a parallel secondary roads network to the main road that ran from Warrington through Preston and into the Lake District.

The other high distribution sites are Piercebridge, Castleford and York on the north-east of England. The York legionary fortress would have had an administration function in the region that continued with the development of the city at York as a *colonia*. The other two sites were fort and *vicus* settlements and there may have been supply-side reasons for their high percentage distributions. Piercebridge in particular is interesting as this was a garrison town in the 2nd / 3rd century with the fort occupied in the mid 3rd century CE, in the period of consolidation of the Roman occupation, and was in the vicinity of Catterick an established supply centre for that region. Dere Street (Margary, 1973 Road 8) follows the line of the present 'A1' from York north to Catterick, Corbridge and Elginhaugh in Scotland. Ermine Street (Margary, 1973 Road 2) ran north from London, through Lincoln to York. These routes ran from London north and east of the Pennines. Castleford was a mixed infantry and cavalry auxiliary base. The extramural activity at Castleford during the 2nd century was significant albeit less understood but is known to have included manufacturing and repair activities (Cool and Philo, 1998, p. 358). These sites all appear to have had associations with supply and trade activities.

Catterick was a substantial site in the north-east and known to have had supply associations with the military forts on Hadrian's Wall (refer to earlier Chapter 4). Scotch Corner was also known as a supply centre from the Iron Age and was superseded by Catterick in the 2nd century. The reduced range of vessel types for Scotch Corner in all likelihood reflected the chronology of occupation, versus that of Catterick that has a profile similar to a city. Catterick had evidence of production of pottery and metal goods. The hypothesis here is that these industrial settlements were manufacturing and supply centres and not high density sites of consumption.

The range of vessel types at Walton-le-Dale is similar to Catterick, although the density of finds was much less. The occupation period from the late 1st century into the 2nd century CE would have been a factor. The road and sea distances from London, the south coast and the Continent to locations on the west coast of England would also have been material. The transport of supplies along the west coast would have used established bases such as the permanent fort at Ribchester, strategically located at the west of a Pennine route, a major north-south road and at a crossing of the River Ribble where is became navigable (Buxton and Howard-Davies, 2000, p. 3). The Mersey estuary and Wilderspool could have served Walton-le-Dale as a port (Hinchcliffe and Williams, 1992, p. 171). Wilderspool was the production site for a particular form of pottery, the Raetian mortaria, that was well-known on Hadrian's Wall and on the Antonine Wall (Hinchcliffe and Williams, 1992; Tyers, 2014). There was the possibility of these west coast industrial settlements being part of a military supply network for west coast forts including Ribchester, Ravenglass and Carlisle as major nodes in this network. Indeed, based on the design of the Walton-le-Dale site and some objects with military association, it seems that the structural archaeology was an industrial centre with possible military connections (Gibbons and Howard-Davis, 2001, pp. 19, 123). These west coast sites also suggest that industrial centres were manufacturing and supply centres and not themselves high density sites of consumption.

Figures 6.4, 6.5 show the distribution of vessel types for civil settlement and military sites.

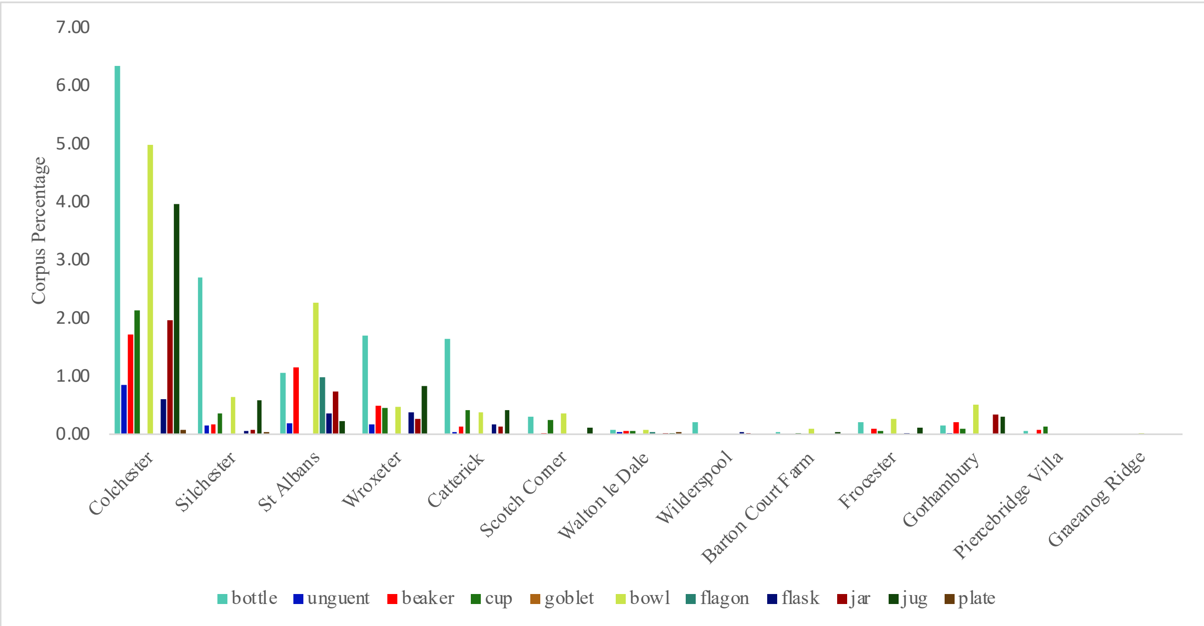


Figure 6.4 Civil Settlements Corpus % Vessel Types Distribution – to 500 CE

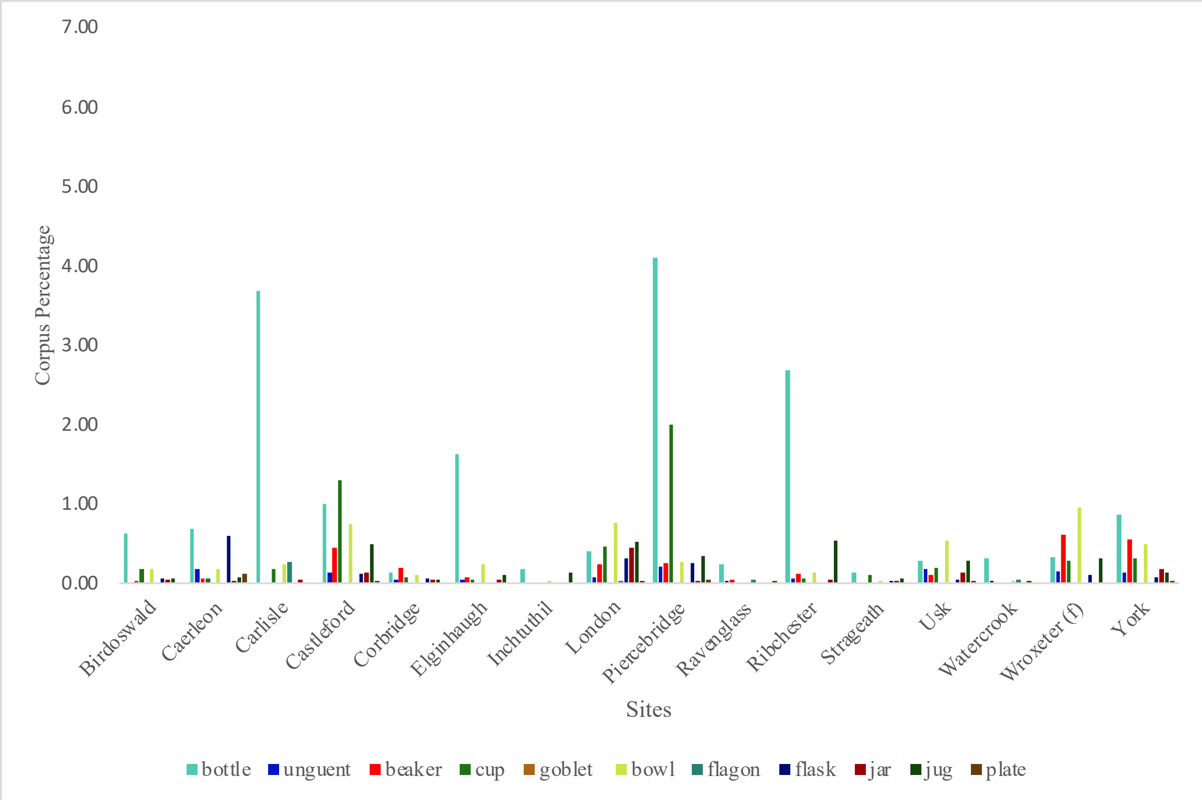


Figure 6.5 Military Sites Corpus % Vessel Types Distribution – to 500 CE

The dominance of the bottle proportions is visible for all military sites, the large cities and the industrial settlements. The bottle, drinking vessel and bowl type proportions are common differentiating features between settlement types (Chapter 5). The following sections include the analyses of the patterns of trade based on these vessel types,

6.3 Patterns of Trade

6.3.1 Trade in Drinking Vessels and Tableware

The import trade in glass into Roman Britain was driven by the movement of people as soldiers and civilian colonists into the new settlements established in Britain from 43CE, all bringing different material cultures from their places of origin across the Empire. This was accompanied by an expansion of trade in goods and development of infrastructure in Roman Britain in the 1st century CE (Schofield, 1993).

The supply of glass vessels to civil settlements or military bases could have been made by merchants trading and shipping or by a military supply organisation. In the case of the delivery to military sites, a military controlled distribution organisation would probably have been in place for 'standard issue' glass vessels as part of shipments to supply materials, weapons and equipment (Bowman, 2003; Grønlund Evers, 2011). There has been evidence of traders operating on behalf of the military organisation through quartermaster networks (Grønlund Evers, 2011, pp. 14–24). Another way of moving glass would have been as individuals' own possessions having been acquired previously, with glass vessels carried around from site to site with the individual owners (Cool, 2022, p. 10).

The Roman glass-working process was very manual, using glass blowing or casting glass techniques, which would result in variations in the rim and body dimensions of the vessels produced. As presented in Section 4.7.2, the patterns of glass vessel dimensions for drinking vessels and bowls have revealed consistent glass vessel shapes distributed across Roman Britain. The technique of glass blowing into moulds would have determined the size of the body of the vessel but forming the neck and rim of the vessel was subject to the skill of the artisan (Allen, 1998; Stern, 1999b, p. 446). The relative consistency of rim and body dimensions across each of the vessel types, suggests glass production was based on the glass industry making vessels to a 'standard mental template' across northern Europe. While the shapes appear to have been standardised, there were examples of groups of smaller versions of cups and beakers found at Colchester and in the York fortress with larger drinking vessels on all the other sites. The smaller drinking vessels found at York in the fortress *praetentura* buildings (Blake Street) dated to the 2nd-3rd centuries CE and in the Colchester Culver Street site associated with veteran buildings and for similar dates (Cool and Price, 1995; Cool *et al*., 1995). The finds at Colchester could have been as a result of personal travel movements, but the more extensive pattern at York suggests a supply trading distribution pattern. This could also have been an indication of a local glass-working centre at York making the smaller versions just for that market. In Chapter 5 (Section 5.4), these shape differences were considered to have been from a material cultural preference.

The consistent pattern of variance across the rim diameters and body widths of the vessel types across the sites and geographical locations would suggest that the glass-working industry made glass drinking vessels and tableware that were traded and distributed to the markets more than likely by traders that operated from the large cities. These patterns were signs of industrial-scale production by established glass-working centres as opposed to the operation of many small workshops. This hypothesis is evaluated later in this chapter.

6.3.2 Trade in Bottles

The most common glass fragments recovered from archaeological excavations were of large glass containers. Amphorae were containers for the bulk transport of liquids, usually of Mediterranean origin such as olive oil, wine, or fish sauce (Peacock and Williams 1986). The distribution routes of products bottled in glass containers cannot be confirmed at this point, but there is evidence that other product distributions included local, regional, and long distance movements (Cool, 2006; Foy, 2017). It is likely that the large glass container would have been used to transport wine or oil as an alternative to pottery vessels and preferred due to the glass being non-porous and transparent, with the contents visible through the glass. These large containers would have been transported with contents to the markets following the same routes as for the similar pottery container content trade.

Based on the distribution of large containers, the large cities of Colchester, Silchester, St Albans and Wroxeter would have all been centres of consumption of the contents, which probably would have been oil and wine. The other locations of high distribution were the industrial settlements, the fortresses and many of the forts. The industrial settlements could have been part of a supply network to provide bottles to local contents producers. Early Roman commercial correspondence (Tab. Vindol. 343) recorded requests by the military fort at Vindolanda for supplies of leather and goods from Catterick. Bottles with contents could also have been distributed from Catterick to Piercebridge (10 km distance), and north to Birdoswald, Carlisle, Corbridge, Elginhaugh and Strageath, and south to Castleford, York with Catterick being a staging supply centre for bottles and local producers.

A small sample from the quay site on the Roman foreshore dated to the 1^{st} - 2^{nd} century included several cylindrical bottle fragments and a square bottle fragment (Miller *et al*., 1986). The location of this waterfront quay site close to the Plantation area suggests imports of bottle glass. There was little evidence for bottle distribution at London and given that London was a trading centre, it was possible that shipments of large glass bottles could simply have passed through. Another possible explanation for the low bottle counts was that the bottle fragments were recycled as glass waste at the operational glass-working centres in London. The evidence from the Basinghall site was that smaller vessels such as beakers and cups were made on the site and the proportion of bottle fragments recycled as cullet was not a significant (Wardle 2005: 42). The bottle finds for London will be discussed further in this chapter.

The presentation of large container dimensional data in Chapter 4 (Section 4.7.3) showed that the variation of bottle body widths across the civil and military sites could be grouped as large, small-squat, and tall-narrow sized bottles based on the body widths of greater than 120mm, between 60-120mm and less than 60mm respectively. During the 1st to 2nd centuries, the predominant bottle shapes were the square or cylindrical blue-green glass mould-blown containers, many with trademarks on the bases (Allen, 2010). They were made in different sizes as large bottle, small-squat bottle and a tall-narrow bottle forms associated with the contents (Isings, 1957 forms 51a, 51b; Allen, 2010). The cylindrical bottle shape tended to have body widths greater than 120mm as the large size bottle group, and the square bottle shape more associated with the small-squat size bottle group.

The simplified graph of Figure 6.6 shows there was a predominance of the small-squat bottle size on the civil city sites of Colchester and Wroxeter, and for the York fortress. The large bottle size was seen at Silchester and the Elginhaugh and Piercebridge military sites. The evidence from Ribchester and Castleford could represent bottles across both the large and small groups.

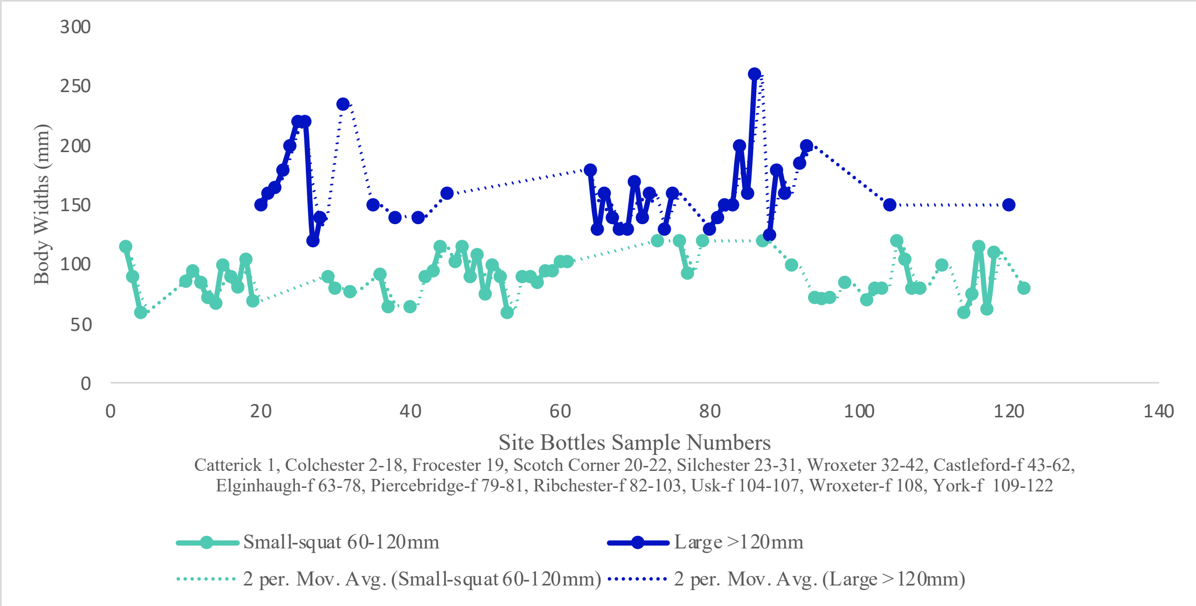


Figure 6.6 Bottle Body Width Diameters (mm) – Small-squat and Large Sizes

(Graphical Moving Average and Best-Fit Data Trend Shown. Small-squat Cv =0.2, Large Cv =0.2)

The distribution of square and cylindrical bottle forms is presented in Figure 6.7.

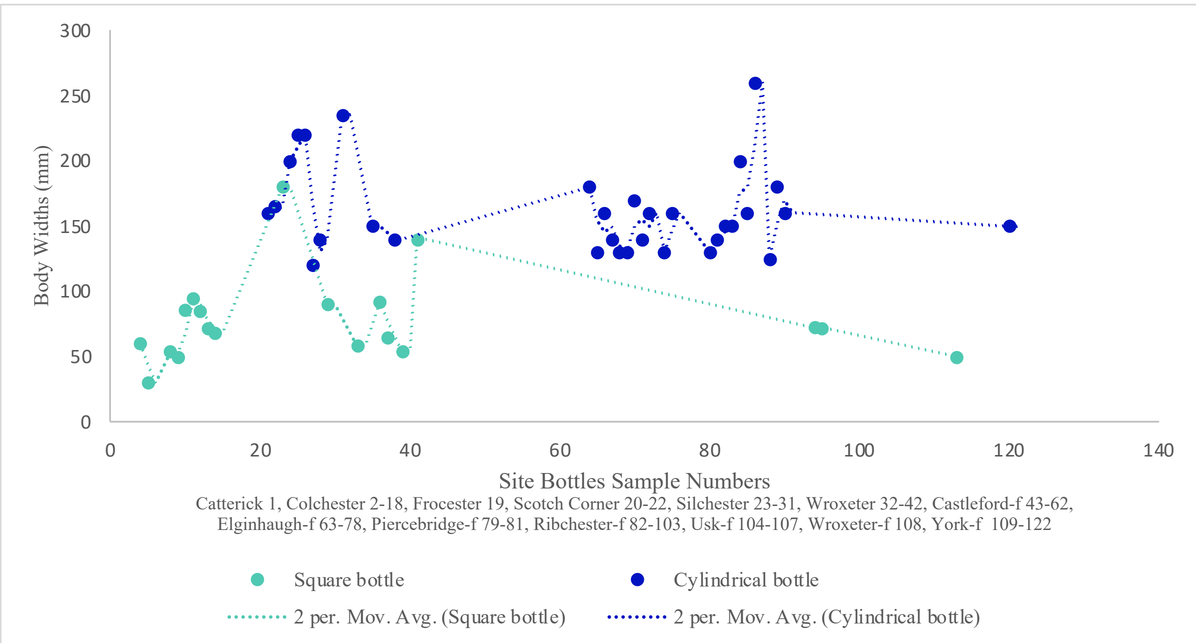


Figure 6.7 Square and Cylindrical Bottles Body Width Diameters (mm)

(Graphical Moving Average and Best-Fit Data Trend Shown. Square Cv =0.4, Cylindrical Cv =0.2)

This indicates that while both bottle shapes were present on both civil and military sites, there was a pattern where only cylindrical bottles were at Silchester, Elginhaugh and Piercebridge as the cylindrical bottles tended to have a body width greater than 120mm. The body width ranges for the square bottle are given as 50-150+mm and for the cylindrical bottle as *c.* 80-250+mm (Price and Cottam, 1998, pp. 191, 194). Not all the bottles in the corpus had body width measurements and so to check if these are indications of a broader pattern will require more data. The distribution of the cylindrical bottles would have been related to both the glass-working origins as they were mould-blown and more than likely the contents given the cylindrical bottles tended to have the larger body width that could have been associated with particular products.

The volumetric size of the bottles is another perspective that is relevant to the trade in bottle contents. To roughly estimate the volumes of the bottles with body width measurements required an estimation of the original heights, wall thickness and body widths of the identified bottles (refer to Appendix 3 for the calculation details). The estimated heights of the original bottles were not noted in any of the catalogue excavation reports and the wall thickness measurements were not consistently recorded and therefore were not used for these rough estimates. Plots of height versus base for the large and small square bottle groups were taken from the glass report for Colchester to make the calculations with those details presented in the Appendix (Cool and Price, 1995, pp. 180–181). The bottle volumes in millilitres were calculated and are shown in the following Figure 6.8 for the tall-narrow and small-squat bottles and Figure 6.9 for the large bottles. The graphs show the sites as site bottle sample numbers.

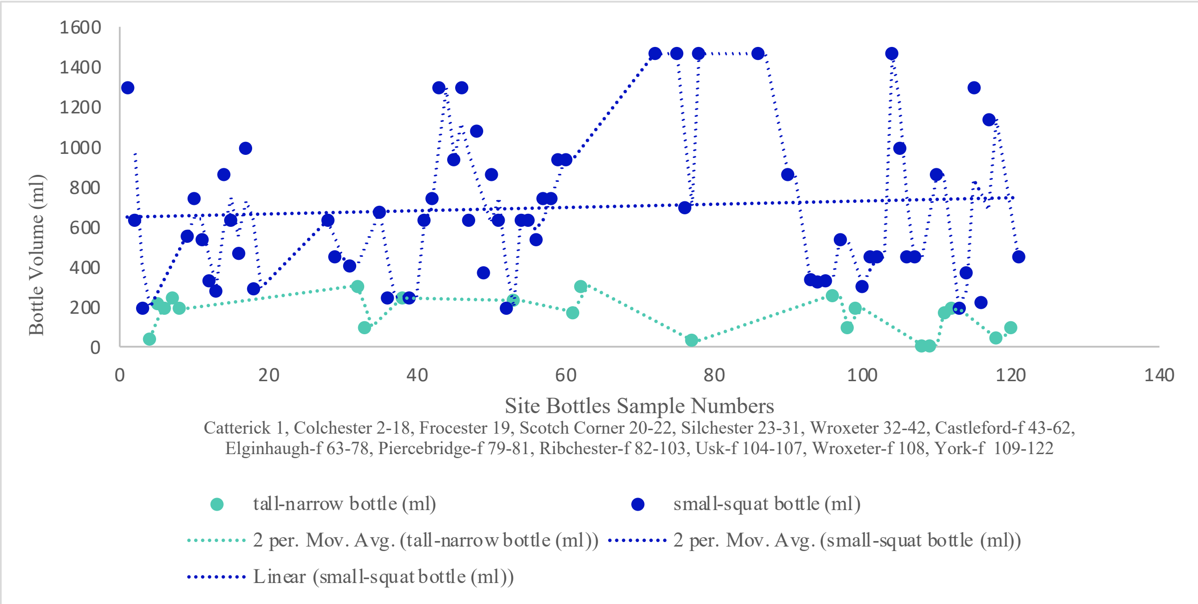


Figure 6.8 Tall-narrow and Small-squat Bottles Volumes (ml)

(Graphical Moving Average and Best-Fit Data Trend Shown)

The small-squat bottle group estimated volume ranges were between *c.* 240-1500ml with the bottle mean of *c.* 700ml that coincidentally is close to the current standard wine bottle volume of 750ml. It is postulated that these sizes of bottles with contents could have been transported as packs of six bottles in wicker baskets (Koster, 2006). There have been suggestions that scratch marks on the sides of some square bottles were the result of the carriage and reuse of the bottles (Cool and Price, 1995). An image of the square bottle with a protective sleeve is shown in Figure 4.110. The tall-narrow range of bottles had estimated volumes of up to c 300ml and with an average of *c.* 150ml. This group of bottles could have been in the group of small unguent bottles and bath-flasks and they more than likely shared a common functional use relevant to the size, probably as portable accessories.

The tall-narrow bottles were seen across most of the civil and military sites. Roman unguent bottles were found on 16 of the 32 study sites that included large cities, rural high-status farmsteads, industrial settlements, and military sites. The main sites were Colchester, St Albans, Wroxeter, the fortresses at Usk, Wroxeter and York, and the Castleford and Piercebridge forts. These were all settlements of or close to high population areas with most of them established in the mid 1st century CE. Small containers, unguent bottles, would have been easily transportable and they were associated with scents used in rituals and with medicinal products (Derrick, 2021, pp. 60, 190). In a study of unguentaria, the chronological use of these small containers in Roman Britain was found to be mainly *c.* 60–125/150 CE (Derrick, 2021, p. 01). Before this period, the use of unguentaria was limited to the large cities, Colchester and St Albans. The decline in the use of these small containers through the 3rd and 4th centuries was thought to be associated with the gradual shift to social practices that did not require unguentaria (Derrick, 2021, pp. 187–188). The 3rd and 4th centuries were periods of social change in Roman Britain as discussed in Section 2.7.3 ‘Co-existence’. Small containers, such as pottery vessels, were also in the archaeological record.

The large bottle group volumes are shown in Figure 6.9.

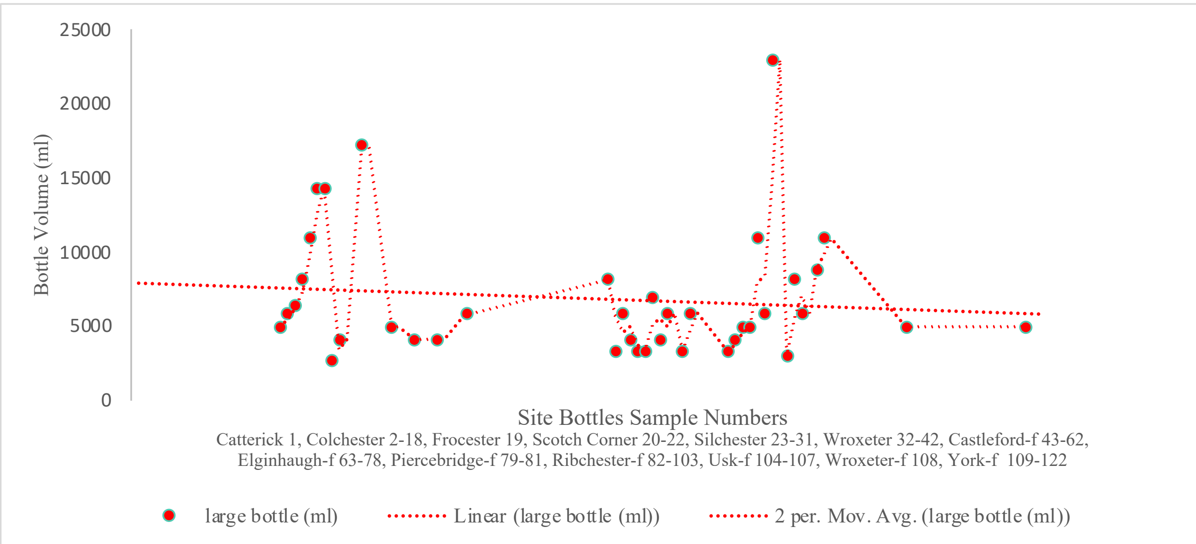


Figure 6.9 Large Bottles Volumes (ml)

(Graphical Moving Average and Best-Fit Data Trend Shown)

The large bottle group had a range of between *c.* 2700-23000ml and with an average of *c.* 6800ml. These large bottles probably would have had a functional use to transport the contents and as a container to dispense small amounts from the large volume. Pottery amphorae were used as large transport containers, although they were less portable than glass containers due to the size and weight, even when empty.

The organisation of the tall-narrow container trade appears to be similar to that for the drinking vessels and tableware in that they were found on the majority of the civil and military sites. This suggests a model where traders operating from city trading centres distributed these small unguent bottles and bath-flasks across a wide range of settlements without any apparent restrictions to the type of settlement.

In contrast, the organisation of the large container bottle trade had differences to that for the drinking vessel and tableware trade. Of course, the first difference to note is that this trade was of the contents. From the evidence, it appears that the particular types of the large containers, the cylindrical or square bottles, were in some cases traded to particular locations. However, the dimensional data volume is much less than that for the site bottle forms and this apportionment to settlements could be based on insufficient data. The pattern of both cylindrical and square bottles being found on both civil and military sites would have been due to supply-side distribution connections. The supply networks will be reviewed in the next section.

6.4 Supply Networks and Glass-Working

This section explores the supply networks with glass vessels produced in glass-working centres and moved across transport routes to the regions and settlements in Roman Britain. The end-to-end glass trade process starts with the conversion of raw materials into glass blocks that were re-melted in glass-working centres to make vessels (Larson, 2019). The supply network for this study includes glass-working centres and the transport routes to the consumer locations where the glass was finally deposited. During the 1st century CE, glass-working centres were established in the north-west Provinces (Allen, 1998). The initial introduction of glass vessels into Roman Britain would have been through imports from the Continent. That traded distribution would have been to the main markets, the new Roman cities and the military sites. Although there were glass-working centres in London and a few in Britain, the assumption was made that the majority of glass was imported through Britain's coastal ports.

The proximity to transport connections would have been crucial to glass-working sites to ensure both the receipts of supplies of glass for remelting and access to trading routes to the markets. These glass-working centres needed to have the means to collect and sort raw glass and recycled glass and produce and despatch the finished glass products. The next section considered the information from excavations made in London that could also be relevant to how other glass-working centres operated in Britain and on the Continent.

6.4.1 Glass-Working in London

The trade in glass vessels would have been a mix of the outputs from local glass-working centres with imports from the Continent. The following analysis considered this trade mix based on the archaeological evidence from glass-working in London. Glass workers left evidence of their presence in London from the late 1st century until the end of the 2nd century (Wardle, 2015a, p. xv). This was the time when London was developing as a port and a trading centre for goods entering Roman Britain (Hingley, 2018). This assessment of glass-working in London provided the basis of a model for how the glass industry was organised in Roman Britain.

The key glass-working requirements for glass workers are a furnace, a source of fuel for the furnace, supplies of glass and space to store glass feedstocks, produce, and despatch vessels. The glass production industry was more complicated than that for pottery manufacture as glass can be recycled and reworked into new or repaired objects (Sainsbury, 2018). This could have been one of the reasons for much less glass fragmentary evidence from archaeological sites than for pottery. Cullet, which is broken glass, was used as a feed material for glass-working to recycle and rework the glass into vessels and objects, such as beads and bangles. Remelting glass was carried out at lower glass melting temperatures than for glass-making from raw materials, and it was free of contaminants (Cool and Price, 1995). Recycling also helped with the need to obtain glass feedstocks and there is evidence that this was common in Roman Britain, with in some cases cullet a significant source of glass for glass workers (Cool and Price, 1995; Wardle, 2015a). The organisation of the collection of glass to provide cullet would have probably been local to the glass-working centre and part of the supply network for glass.

The presence of glass-working in different parts of London has been recognised archaeologically. Glass workers were active in King William Street London in 60-70 CE (Bayley, 2015, pp. 33–43). There were excavation sites in the Upper Walbrook and the Cheapside areas of London that have provided better archaeological evidence of glass-working in the 2nd century CE (Bateman *et al*., 2008; Shepherd and Wardle, 2009; Howell, 2013;

Dunwoodie *et al*., 2015; Wardle, 2015a). The archaeological material records from these sites have provided insights into the glass workers' production methods through the evidence of the material feeds into the glass-working process and vessel types that can be attributed as being produced at the sites. These were representative of glass-working centres with established trading routes to and from London.

The archaeological evidence from these sites had the following overall characteristics. The finds included: 1) evidence of furnace fragmentary materials, or in some cases actual evidence of *in-situ* furnaces; 2) glass-working residues that can include moils from removing the glass blow-pipes from the vessels, threads and trails possibly left from making glass on glass decorations; 3) bulk glass for remelting that can be new glass ingots or old glass from broken vessels as cullet, and 4) heat-affected distorted glass fragments as the residues of accidents or heat-related problems. Each of the glass-working sites had some of these characteristics. The characteristics most relevant to this study were of vessels made at the site, glass delivered as cullet, new raw glass and any glass-working residues.

The Upper Walbrook sites were in an area of the city to the east of the Cripplegate fort and just inside the line of the future wall of London, and so on the periphery of the city at that time. This was an area with a supply of water, good access to roads and an absence of domestic buildings that probably encouraged the craft industries to be located there. The Upper Walbrook area included in this study were the Moorgate sites (Perring *et al.*, 2010), the Guildhall Art Gallery: Roman Amphitheatre (Bateman *et al*., 2008) and 35 Basinghall Street (Wardle, 2015a). The relevance of the glass characteristics from each of these sites are now discussed to understand more of the glass-working process and the relevance to the produced glass products.

The evidence from 35 Basinghall Street suggests that this site was used as a dumping ground for glass-working materials, probably as cullet for nearby glass-working furnaces. The Basinghall assemblage included glass fragments from the glass-working process itself. It is useful to remind ourselves of the glass-working process so that the materials can be put into context. The first point to make is that glass-working involves remelting glass that has already been made from the raw materials of silica (sand), soda and lime in many large high temperature glassmaking furnace sites, that took advantage of the naturally occurring sources of sand and soda in the Egypt and the Levant regions (Freestone and Gorin-Rosen, 2002; Degryse and Schneider, 2008). There is evidence that glass blocks or ingots of raw glass made from those regions was transported across the Mediterranean regions as the feed material for the glass-working process that uses remelted glass from smaller lower temperature glass-furnace sites located across the Empire (Freestone and Gorin-Rosen, 1999; Freestone, Jackson-Tal and Tal, 2008).

These are the two sources of supply into the glass-working process. The raw glass feed material was supplemented with glass from broken glass vessels and objects that were collected for recycling back into the glass-working industry sites. The recycling process was, by the end of the 1st century, established and organised across Britain, with return and reward incentives in place (Freestone, 2015). There was evidence that large cities would have had these collection systems in place (Freestone, 2015, p. 34). There was also evidence that significant quantities of glass for recycling was transported over large distances using river and sea shipments. A typical example is of the *Iulia Felix* wreck discovered in the northern Mediterranean Sea having raw glass, recycled glass and new vessels in an 18 tonne shipment (Silvestri, 2008). The supply of new raw glass would have arrived from the Continent. The supply of recycled glass to London in addition to local cullet, would most likely have included the collections of broken glass from St Albans and Colchester which were large cities local to London, with good road connections into the Upper Walbrook area that could have allowed frequent deliveries to the glass-working centres. The supply of raw glass material was scarce in Roman Britain and recycled glass was a common and important practice in glass manufacturing in the north-western provinces (Price and Cottam, 1998; Jackson and Paynter, 2016).

The charging of the glass furnace with glass involved the ancient glass workers sorting the glass into batches of different colours that could be assigned to the production of vessels. Most of the glass cullet at 35 Basinghall Street was dated to c. 160/170-180 CE, identified as the natural blue-green glass with also significant amounts of colourless glass, and smaller quantities of yellow-brown and green glass in the cullet dump (Wardle, 2015a, p. 36). A deposit of 12.4kg glass as cullet for recycling was found in a pit and that included 4.9kg of thin-walled vessel glass, 1.3kg of the thicker wall bottle glass and 1.5kg window glass (Wardle, 2015a, p. 42). There was also a further dump of individual vessel glass fragments that amounted to over 6kg with many glass types identified. There was, however, no means to associate the feed material types with the production of the glass types at the glass-working centre. The assumption was that the cullet represented the glass vessels and objects used locally, based on the hypothesis that access to the local waste glass would have been more readily available than large bulk shipments from other sources.

Furnace glass residues came from the tank or pot that contained the melted glass in the furnace or crucible that was used for glass-working. These would have been recycled with the cullet into a batch of glass. There were threads and trails in the assemblage that came from pulling thin strands of glass from the furnace to test the viscosity and quality of the glass melt. These were examples of the skill of the ancient glass workers to check whether the conditions were right to start glass blowing; checks that are carried out by today's glass workers. Quality control of the glass batch produced glass wastes, that confirmed the glass workers' practices as skilled in removing foreign items. The management of the furnace itself has been revealed through the furnace wall samples, some with glass attached (Taylor and Hill, 2008; Jackson and Paynter, 2016).

Gathering glass on the hollow blowpipe for glass blowing, transferring semi-finished vessels from the blowpipe to a solid pontil attached to the base of the still hot vessel, and forming the rim of a vessel would have generated small pieces of glass tooled wastes as the glass was fashioned to the desired shape. Decorating a glass vessel with trails also created strands of waste glass. Removing vessels from the solid pontil also created identifiable glass wastes known as moils and pontil-pads. The removal of the finished glass object from the pontil was carried out by scoring and tapping or using drops of water at the end of the pipe to separate them. These processes created individual moil shapes that could be used to suggest the size of the vessel made. As each moil represented a complete vessel, they were categorised into types based on the size of the pontil mark that provided indications of the size of the vessels fabricated (Wardle, 2015a, pp. 62–64). The survival of few moils with large pontil marks suggested that bottles were not the main product made in these workshops. All of these types of glass waste were present in the assemblage and not only confirmed the glass-working processes but that most of the vessels produced were small vessels such as flasks, jars, beakers, cups, and lids.

There were few catalogued vessels (three accession lines) that were specifically associated with being made in the Basinghall Street area and it was difficult to separate them from the majority that were vessels associated with the cullet dump (Wardle, 2015a). The combined area and cullet vessel accession lines assemblages (drawn from (Wardle, 2015a) were analysed for the site vessel type profile compared to the Romano-British corpus and displayed in Figure 6.10.

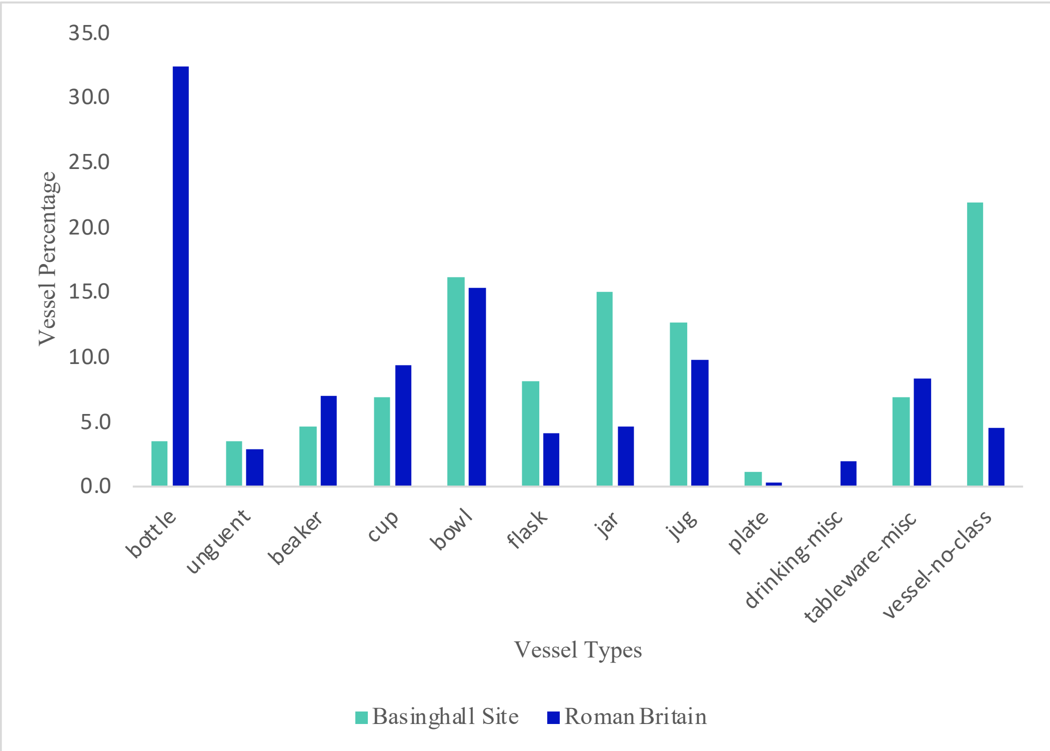


Figure 6.10 London Basinghall Glass Types Percentage Counts Dated Mid 2nd Century CE and Compared to Romano-British Corpus to 500 CE

This shows Basinghall with a similar pattern for the Romano-British corpus vessel types noting that the large container bottle percentage is lower. The extent of the region for collecting glass for recycling was not known. The recycling catchment area for London could possibly have included Colchester, St Albans and also Silchester given the road connections between these large cities and London. A comparison of the site profiles for Colchester, St Albans and Silchester with the Basinghall site profiles is shown in Figure 6.11.

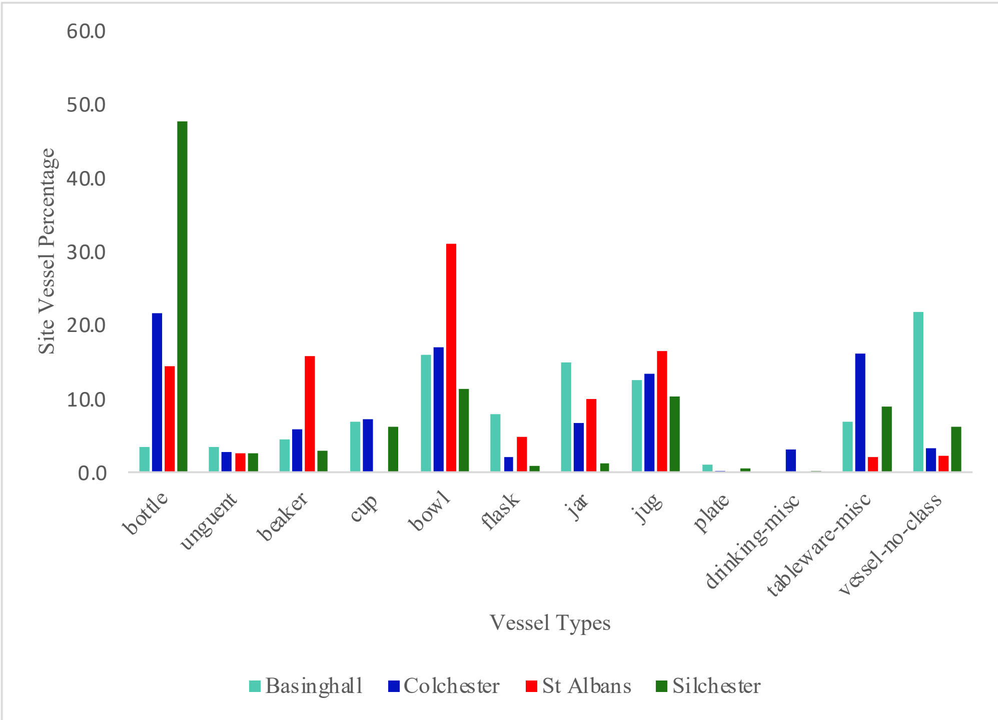


Figure 6.11 Site Glass Types Percentage Counts to 500 CE
Comparison London Basinghall with Colchester St Albans and Silchester
(Amended with flagon replaced by jug for St Albans)

The cities were possible cullet collection catchment cities. The profiles show similar profile shapes for Basinghall to the cities except that the large container bottles were much lower in proportion in Basinghall, London. The evidence from the various types and sizes of the moils and pontil-pads from Basinghall Street suggests that the glass workers produced mainly small containers such as flasks, and tableware jars, jugs, drinking vessels. These types of vessels could be made using glass from a small melting furnace and making thin-walled vessels from what could have been a limited supply of raw glass and cullet.

The Guildhall: Roman Amphitheatre revealed a significant amount of glass-working debris comprising *c.* 50kg intended for recycling and a further *c.* 50kg of furnace fragments, but with no *in-situ* furnace (Bateman *et al.*, 2008). The catalogued accession line vessel evidence for the site included bottles that was based on a summary table that refers to 72 bottle fragments out of a total 374 vessel fragments (Bateman *et al.*, 2008, p. 201 Table 6). Based on this record the profile for the Guildhall Yard cullet-dump was compared to the Romano-British corpus in Figure 6.12.

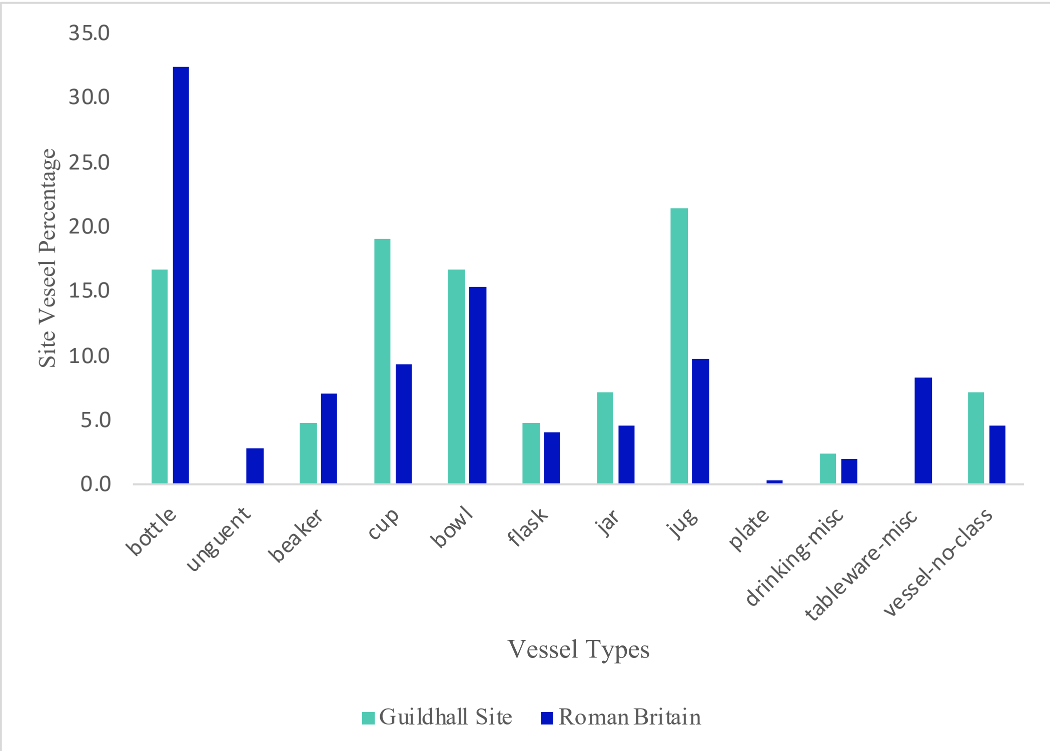


Figure 6.12 London Guildhall Glass Types Percentage Counts to 500 CE

This shows the London Guildhall cullet-dump with a similar pattern to the Romano-British corpus vessel types noting again that the large container bottle percentage is lower than for the corpus. Comparisons of the Guildhall cullet-dump to the Basinghall Street cullet profile and the site profiles for Colchester, St Albans and Silchester as possible cullet collection catchment cities are available in Figures 6.13, 6.14 that display vessel type and site perspectives.

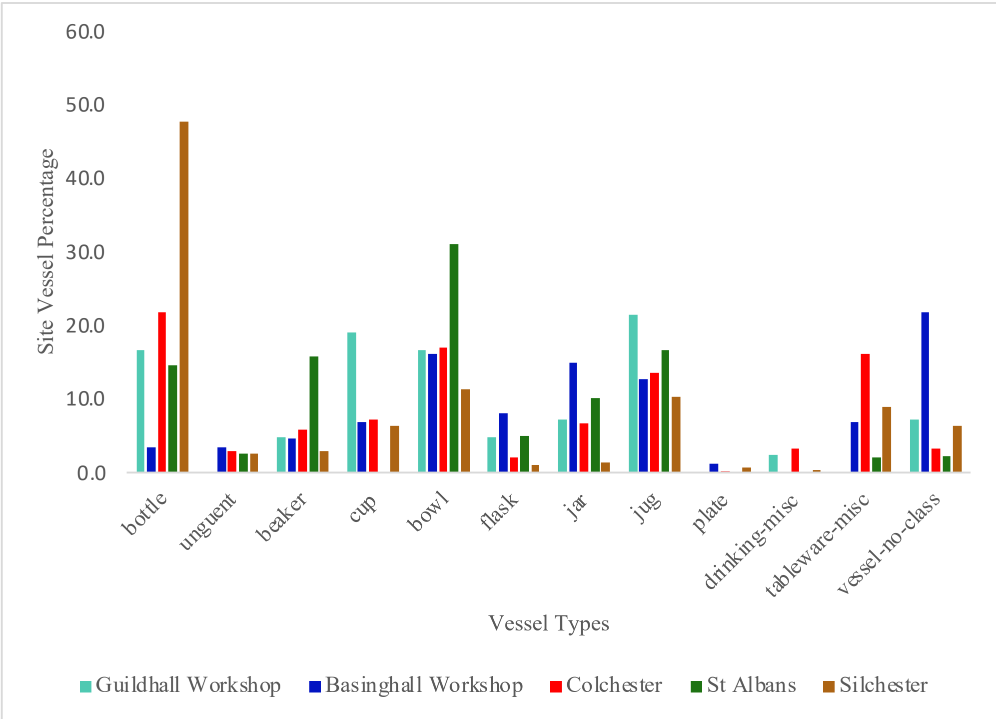


Figure 6.13 Site Glass Types Percentage Counts to 500 CE

Comparison London Guildhall & Basinghall with Colchester St Albans and Silchester

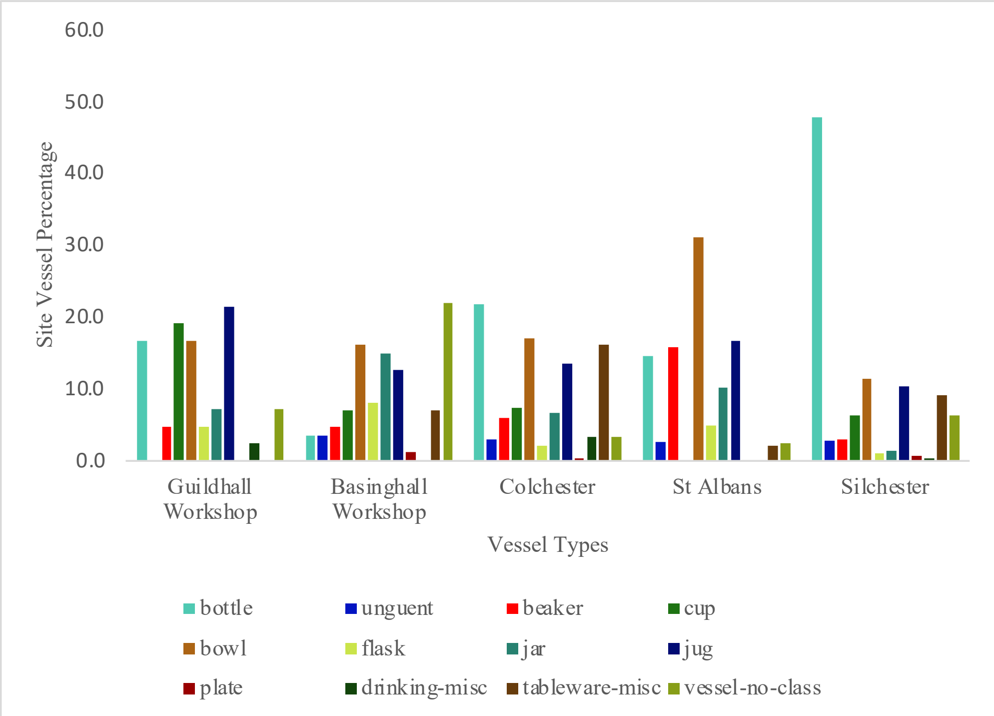


Figure 6.14 Site Glass Types Percentage Counts to 500 CE

Comparison London Guildhall & Basinghall with Colchester St Albans and Silchester

(Amended with flagon replaced by jug for St Albans)

The Guildhall Yard cullet dump contained fragments of a broad range of vessels and window glass that was similar to the range of vessel types for the Basinghall site and the cities close to London. This was an indication that the cullet could have been collected from those areas. It was not possible to identify glass associated with the output of the Guildhall Yard workshop itself without further detailed analysis of the composition of the glass (Bateman *et al*., 2008, p. 144). This is an issue not just associated with this site, but a general accepted recognition of the difficulty in tracing the provenance of vessels back to a workshop (Cool and Price, 1995; Jackson and Cottam, 2015). The glass-working process wastes that included moils, threads, pontil ends in this case could not be diagnostically associated with glass vessel types. However, the moils were the waste glass from the end of the blowing irons and there were records in some cases of the diameter of the blowing iron, none of which were sized from bottle glass-working.

While recycled bottles were in the glass cullet, there was no diagnostic evidence to confirm that bottles were included in the range of glass vessels made from the workshop.

There have been excavations at 20-28 Moorgate and other Moorgate sites that have revealed glass-working furnaces and associated glass residues that indicated glass-working based on re-melting recycled glass (Seeley and Drummond-Murray, 2005). The glass-working production waste residues was limited but there were indications that small blown vessel types such as jugs and open vessels were produced there. The majority of the vessel glass from the Bow Bells House site in Cheapside was not identified as a glass type (c. 58%) and while this made numerical comparisons impracticable, they were broadly consistent with the overall proportions of glass across Roman Britain (Howell, 2013, pp. 51–56). The waste glass finds also reported suggests there was a glass workshop in the Cheapside area and the fragments of moil suggest the production of cups, beakers and lids (Howell, 2013, pp. 56–57).

The commercial viability of the glass-working centres was discussed in Section 2.6.3. The quantities of glass as cullet can be used to assess the production of a small glass-working centre. The standard weight of glass drinking, and tableware vessels was 150-350 grammes (Larson, 2019). A skilled glass blower could make five common square mould-blown bottles in an hour and smaller drinking and tableware vessels in three minutes (Taylor, 1997; Larson, 2019). This suggests that when glass-working, a small furnace would have needed to remelt *c.* 60 kilograms of glass a day, and that is of the same order of magnitude as the glass cullet found at glass-working sites in London (Bateman *et al*, 2008, pp. 142–146; Wardle, 2015a, p. 42).

Large bottles were made as mould blown thick walled containers (e.g. bottle 5mm versus tableware 1-2mm wall thickness). Bottles also would have been made as the mass production of large containers for content producers. London Basinghall did not appear to produce bottles in any significant quantities. It is possible that the Guildhall workshop did produce bottles, but the sizes of all the recorded London workshops were not physically large enough to support significant glass outputs (Perez-Sala and Shepherd, 2008). Yet, as the profiles of the large cities and military sites illustrate, the bottle consumption market in Roman Britain was significant and reflects the demand for the contents (e.g. oil, wine) and supplied in glass in the 2nd-3rd centuries CE. Further planned study of these cullet assemblages may yield more insights.

6.4.2 Glass-working on the Continent

The Roman city of Aix-en-Provence in Gaul was chosen to represent a large city on the Continent that was similar in characteristics to Colchester as a city. Aix-en-Provence had two 2nd century CE workshops and with river access and it would have been close to the Mediterranean supply lines of raw glass and glass cullet from the area (Foy, 2017; Foy *et al.*, 2018). The comparison with London included the evidence from both the glass workshops and the city itself for approximately similar dated periods. The Aix-en-Provence glass-workshop site vessel profile is shown in Figure 6.15 as a comparison with the Romano-British corpus using the evidence from an excavated glass workshop in Aix-en-Provence (Foy *et al.*, 2018, p. 112).

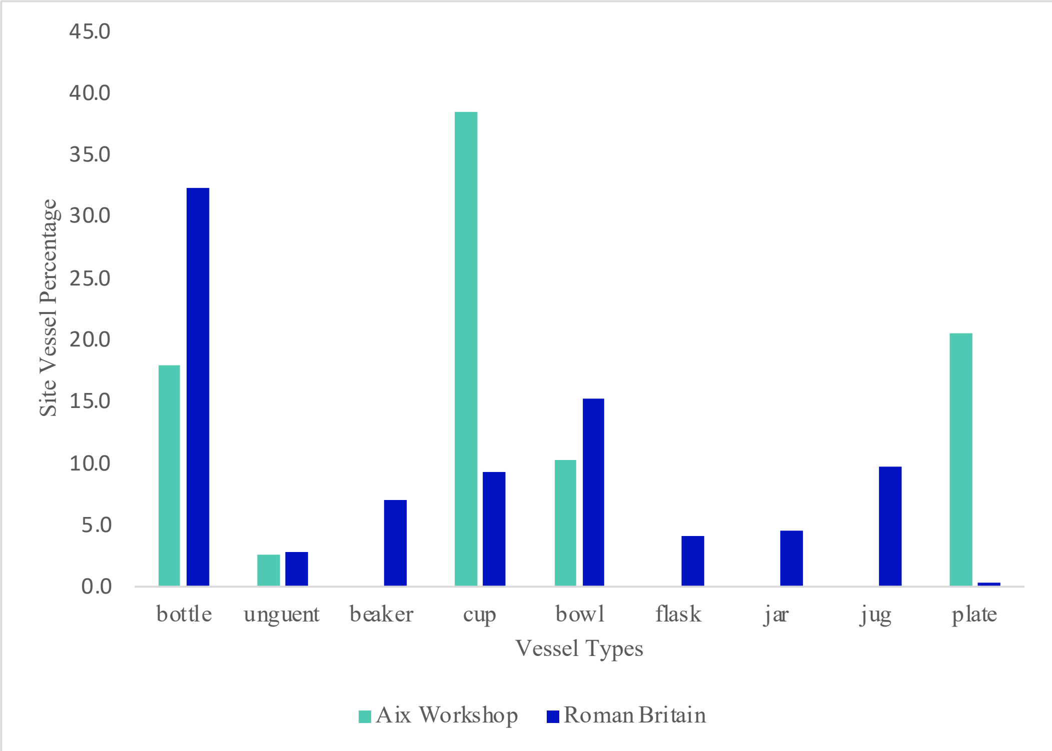


Figure 6.15 Aix-en-Provence Workshop Assemblages Vessel Types Percentage Counts Dated 2nd Century CE Compared to Romano-British Corpus to 500 CE

The main differences between the Aix-en-Provence glass workshop type profile and the Romano-British profile were the missing beaker, flask, jar and jug types. The range of tableware presented for the glass workshop was just the bowl and plate types. These represent the glass feed materials as cullet that would have been collected from the local region. The comparison with the glass workshop and the city Aix-en-Provence is an indication of the likely products from the workshop with the recycled cullet. This is shown in Figure 6.16.

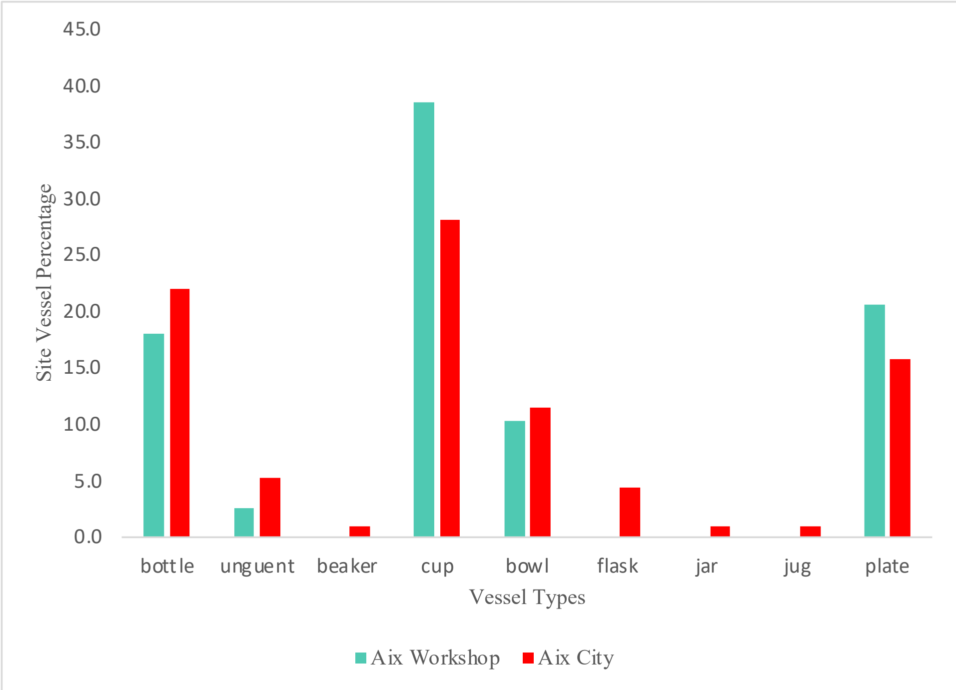


Figure 6.16 Aix-en-Provence Workshop, Aix-en-Provence (City) Vessel Types Percentage Counts to 500 CE

Source of data: (Foy *et al.*, 2018)

This graph shows that both the Aix workshop and the city have relatively similar percentage profiles of glass vessels, with the city Aix revealing signs of the beaker, flask, jar and jug types that were missing from the Aix workshop. The closeness of the percentage vessel types between the workshop and the city Aix does suggest that these represent the output from the workshop.

The cities Aix and Colchester were equivalent large Roman regional administration cities and both with large glass sites' samples available to study. The broadly similar profiles are shown in Figure 6.17, noting that the beaker and tableware proportions differ. These differences may be regional differences or due to the respective scope of the excavations. The qualitative score for Aix-en-Provence was calculated from the types and forms as 20, that is in the range for a large city.

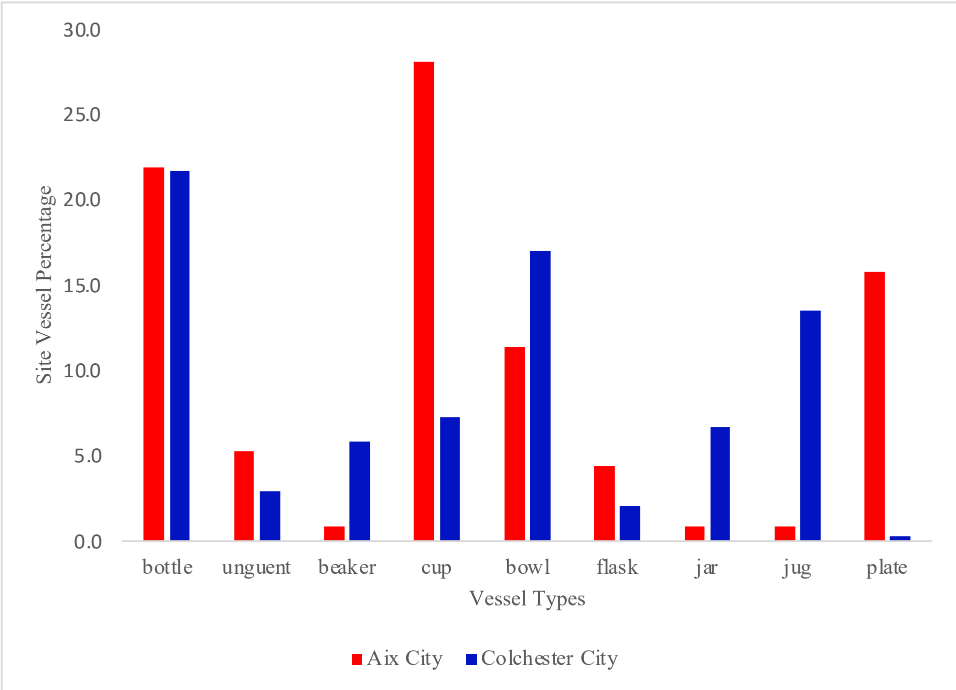


Figure 6.17 Aix-en-Provence (City) and Colchester (City)Vessel Types Percentage Counts to 500 CE

The bottle proportions in all these profiles are significantly higher than for the London glass-working workshop. This further suggests that bottles were probably imported into Britain rather than produced in Britain. Further study of the sources of new glass and cullet for operating glass-working centres across these regions could reveal insights into the working practices of these glass workers and the broader trading relationships.

6.4.3 Glass-Working in Roman Britain

There were many known glass-working locations in Cologne, Bonn, Nijmegen and Reims that in the 1st century CE could have been the origin for glassware imported into Roman Britain

(Grünewald and Hartmann, 2014). As discussed earlier in Section 2.5, there is evidence of glass-working in Roman Britain at London, Mancetter, Leicester, York and Colchester. London had significant glass-working and glass production waste residue areas and this will be assessed in a later section (Shepherd and Wardle, 2009). Other sites which have produced evidence for glass-working include York with glass frit and crucible fragments (Jackson *et al.*, 2003), Silchester with furnace and crucible fragments (Clarke *et al.*, 2007) and St Albans (*Verulamium*) with glass crucibles (Frere, 1984). Furnace materials have also been recorded at Wilderspool with remains of melted glass (Hinchcliffe and Williams, 1992, p. 16), at Caistor-by-Sea that is on the coast near to Colchester (Cool and Price, 1995). There was glass evidence from Wroxeter that referred to a hearth, glass cullet and some glass fragments partly molten and glass blobs with sand adhering which could be possible glass-working but could also have been glass melted by a fire (Houghton J., Bird H. and Ellis, 2006). These are all indications of a relatively small but expanding glass industry to produce glass for growing markets in Britain in the first two centuries of Roman occupation.

6.4.4 Transport Routes

The possible origins and transportation of the glass bottles were then considered to understand the transportation of bulk glass vessels to and within Roman Britain, representing the supply network from the glass-working centre to the consumer.

Large glass bottle containers were common finds and used for transporting and storing most probably wine and oil. They became popular during the 1st century CE with the ability of the glass industry to made 'standard' bottles using the mould-blowing process. An outstanding question is whether the large containers travelled long distances full or empty. The expectation is that content producers of oil or wine would have used glass container suppliers from the region, without long distances involved to first-fill the large containers (Foy, 2017). Wine and oil were commodities produced on the Continent. There were many glass workshops on the Continent and it is likely that some would have been geared to mass producing bottle containers using the glass mould-blowing technique. The hypothesis is that large bottle containers would have been produced and transported in bulk quantities to regional wine or oil producers, filled with the contents, for then onwards distribution to markets that would have included Roman Britain. It makes sense that transporting bottles empty as bulk loads would not have been as commercially profitable as if they were used as containers to trade the contents as wine or oil. They were both standard commodities that would also have been transported in pottery containers.

To understand the commercial mindsets of the Roman manufacturers and traders, the ancient pottery industry can provide relevant context on the transport routes of large containers. The pottery industry achieved market penetration across the north-west and western Mediterranean regions of the Roman Empire, including Britain (Fulford, 2009). The evidence of amphorae found at the remote Roman fort and *vicus* at Ravenglass is an indication that the contents, highly likely to be wine or oil, were traded and transported over long distances (Hunter-Mann, 2015). An amphora fragment was found at an army camp near York again illustrates that there were lifestyle goods associated with the military and that the contents assumed to be wine was part of that way of life (Bidwell, Croom and Hodgson, 2018). The observation that Roman Samian ware was traded and found as far away as in Scotland outlines the use of the ancient trade and transport routes (Terreaux, 2022).

As has earlier been discussed, the academic study of amphorae can inform us as to the transport routes of agricultural products such as wine and oil that have been analysed as traded commodities based on the evidence of particular amphora types (Panella and Tchernia, 2002). There is evidence that various commodities including amphorae, ceramics and glass were produced in large quantities at centralised production sites and traded over long distances (Wilson, 2009). There are examples of large Samian pottery kiln sites in Lyon (10 BCE), La Graufesenque (10 CE), Martres-de-Verre, Lezoux (100 CE) and Rheinzaben and Trier (*c.* 150 CE) (Mees, 2018). The pottery process at these kiln sites would be comparable to the secondary glass-working process and sites, at which finished products were made from the conversion of raw materials. The pottery industry production was on a much larger scale from that of the glass industry, but there could have been process and organisational similarities including the co-location in craft industrial sites.

Amphorae were the main type of transport container used from Roman ports in the Mediterranean region (Wilson, Schörle and Rice, 2012). The increase in trade using amphorae was seen from the maritime wrecks between 125 BCE to 175 CE. This was associated with the rise in Gaul of the use of imported amphorae containing wine and the rise in usage of drinking vessels and tableware in that period of time (Paterson, 1998a). The physical remains of pottery amphorae have enabled academics to map the distribution patterns with their most likely contents to Roman Britain (Panella and Tchernia, 2002). The contents were generally understood to have been mainly wine, olive oil and salted fish products (Wilson, Schörle and Rice, 2012). The reuse of amphora packaging would have extended the product life and distribution of some amphorae, with the provenance impacted (Pena, 2007). This reusability would also have applied to the large container glass bottles. These amphorae distribution patterns could give a perspective on the trade to markets where there was a consumer demand for such imported foodstuffs. Based on the distribution of amphorae, there was a market for wine across Roman Britain that included consignments of Gallic wine to Wroxeter (Cool, 2006, pp. 131–137). The distribution of bottles found in Roman Britain could have been associated with the consumption of wine, oil and fish products on locations that were more likely to have adopted a Roman lifestyle. The evidence of marks sometimes found on bottles at the neck below the rim is thought to have been from ties used to secure the stoppers of cork or wood that were sealed with pitch or wax (Allen, 1998, p. 34).

The glass-working origins of glass bottles has not been discovered. However, bottle markings may offer clues. Glass bottles were usually made by blowing glass into moulds, with the body diameter determined by the mould and the neck and rim free-formed by the glassworker. A manufacturer of glass bottles would be expected to produce bottles of similar body diameters in production runs using the same mould. The part of a glass bottle that could reveal glass-working provenance is the bottle base as the base of Roman bottles commonly have manufacturers mould markings. Two bottle base marking patterns found at Catterick and at Skeleton Green, some 350km away that were very similar are shown in Figure 6.18 (Partridge, 1981, p. 269; Wilson, 2002a, p. 228).

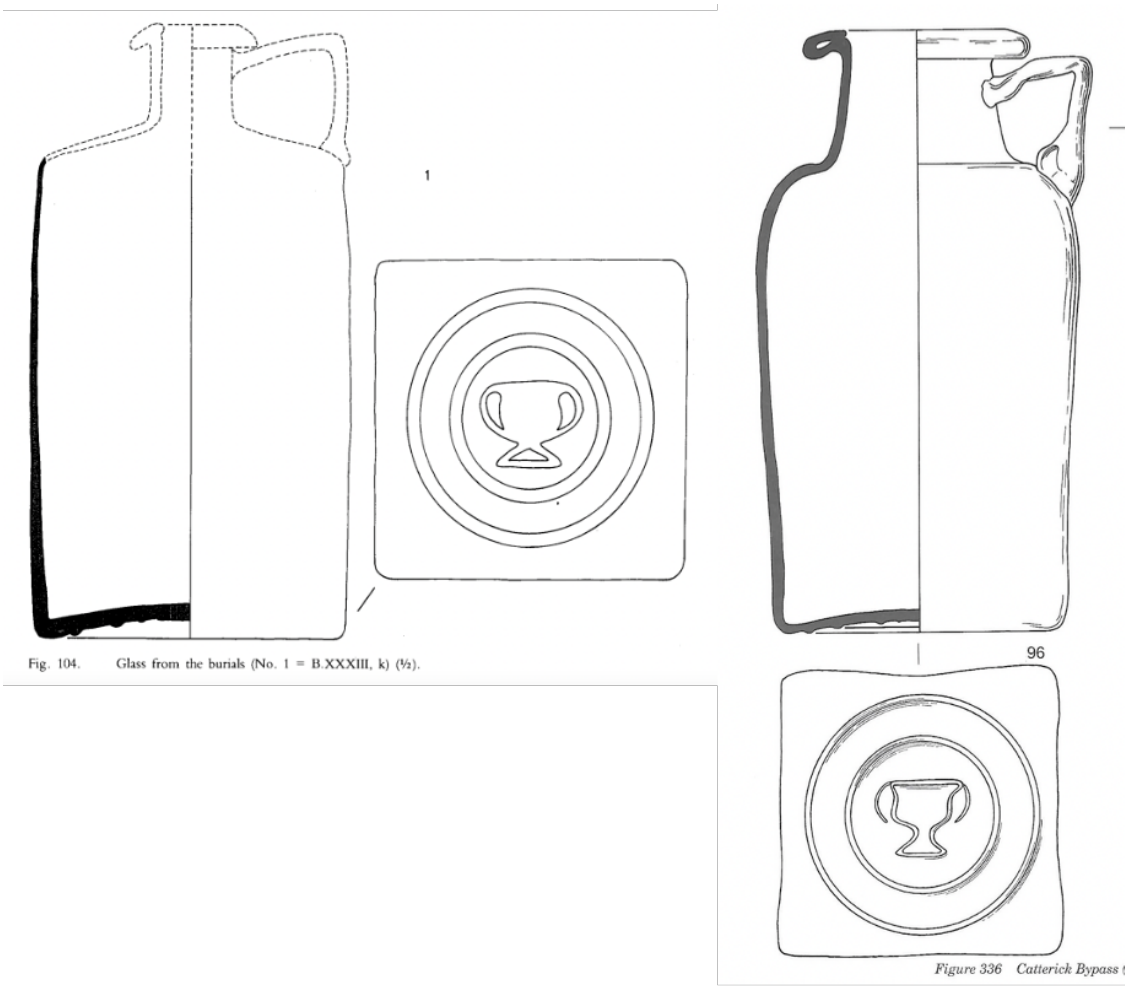


Figure 6.18 Glass Bottle Base Mould Markings from Skeleton Green and Catterick
Sources: (Partridge, 1981, p. 269 Fig. 104; Wilson, 2002a, p. 228 Fig. 336)

These suggest that the same glass bottle producer could have been possible. In any case, base mould-marks could be a way to unlock the distribution patterns of bottles (Cool, 2022). In this paper, Cool made the connection between two separately excavated bottle fragment bases in Roman Britain from Carlisle associated with the fort, from the Rocester fort *vicus* and a fragment of a stone mould from the Bonn fortress. The implications from this will be further discussed in Chapter 7 (Section 7.5).

Insights into the transport routes of the commodities are provided from ancient shipwrecks. There are many wreck sites near Cyprus with geographic trading connections to the Levant, the Black Sea, and the Aegean Sea with the evidence of multi-commodity cargoes (Leidwanger, 2017). The Levanzo I wreck found off the coast of Sicily was enroute from Tunisia to Italy with a cargo of grain, fish-products, oil, glass tableware and construction goods (Royal and Tusa, 2012). Mediterranean wreck sites have revealed quantities of raw glass, cullet and vessels for trade at Corsica (Fontaine and Cibecchini, 2014). These examples are not uncommon and provide a perspective of the transport routes and trading connections that existed around the Mediterranean and into the northern provinces. The trading routes for pottery, whether tableware vessels or container, would have been similar also for glass as the markets were the same. It is worth remarking on whether the markets were military or civil and if that made a difference to the way trade was distributed. This is much more nuanced than a simple state controlled or private commercial arrangement, with the trading arrangements based on physical geography, commodity, market, and transport logistics (Tchernia, 2016a; Mees, 2018). Characterising a site as military when considering tableware is not always possible given most military bases were closely associated with civilian settlements, geographically and socially. This depends on the locations of the interventions with the Caerleon fortress baths site a case in point.

The challenge facing the traders would have been the transportation of glass, particularly in the first decades following the invasion. The evidence of transportation from the Mediterranean regions suggests that glass was moved distances greater than *c.* 20 miles (i.e. one day travel) primarily by sea and river with roads used only where necessary based on cost-time considerations and load carrying constraints (Greene, 1986; Broekaert and Zuiderhoek, 2020;

Flückiger *et al.*, 2022). The Roman army built the road transport infrastructure needed to supply the military occupation of territories as the military moved west and north into Britain, and that would have also spread Roman material culture.

Given the scale of the Roman glass industry operations, it was possible that the manufacture and trade in glass would have followed the pottery industry manufacturing approach, geared to mass production and distribution (Erdkamp, 2020; Terreaux, 2022). This hypothesis does not include the continued limited production of high quality elaborate glass objects, such as for example the Portland vase, that were traded to targeted consumer markets (Freestone, 1990). The production of glass vessels was carried out across the Roman Empire by remelting the raw glass blocks and using casting and glass-blowing techniques that crafted the glass into the various vessel designs that were the traded glass products of the glass industry (Jackson and Paynter, 2016). There was archaeological maritime evidence of the distribution of glass blocks, glass vessels and broken glass for recycling across the Mediterranean (Nenna, 2015; Foy, 2017; Silvestri *et al.*, 2018)y, 2017; Silvestri *et al*., 2018). There was also evidence of significant trade from the Continent of distinctive glass forms that would have been transported via the sea connections from the Rhine to Roman London (Cool and Price, 1995, p. 227). These imports could have been to other ports particularly on the east coast of Britain, including the River Ouse for York, and the River Swale for Catterick. It cannot be a coincidence that these locations in the north of England with high glass distribution had road river and sea transport connections to London and the Continent.

The sites in these areas had a significant presence of bottles together with the northern military sites at Carlisle, Castleford and Birdoswald. The distribution of vessel types for the military bases and industrial centres were analysed using correspondence analysis that creates a statistical dataset to show the likely associations between the locations and vessel types. The output of the correspondence analysis performed on the data is shown in Figure 6.19 in which an association between location and vessel type is reflected as close points on the plot relative to lines to the origin and the grouped associations are marked.

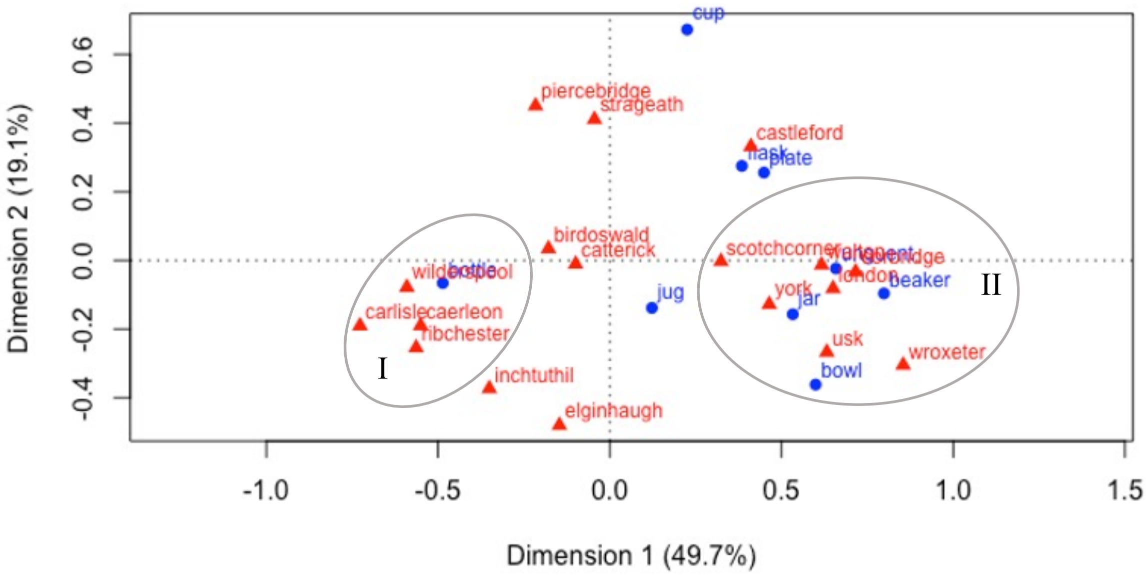


Figure 6.19 Correspondence Analysis (Grouped) of the Corpus Distribution Roman Military Sites and Industrial Settlement Sites Vessel Types Percentage Counts to 500 CE

The association of bottles with Wilderspool, Carlisle, Caerleon and Ribchester is presented with those sites in the same quadrant and shown as group I. These are all in the west of Roman Britain and could represent the west to north routes defined by bulk bottle transports by land but also possibly by sea. The group II sites show Scotch Corner, London, Usk, York, Walton le Dale and Wroxeter had the close associations with beaker, bowl, jar, jug and unguent vessels. The other locations had more of a single type proportional association.

The east coast routes were likely to have been used for trade from the Continent to London and more than likely further up the coast for transport loads that shared capacity with supply shipments. These east coast routes included the military supply lines to Hadrian's Wall and Scotland with Catterick and Scotch Corner probably supply distribution hubs. The west of Britain routes could have included shipping routes to supplement the road network (Margary, 1973). These routes would have been particularly relevant to the settlements between Wilderspool to Carlisle with possible sea and river access (Wild, 2002). The fort at Ravenglass was situated inland at the estuary of the rivers Esk, Mite and Irt and the most likely purpose was to control and protect the transport routes inland to Penrith and Ambleside rather than defend the coastline.

The supply networks described above would have been part of the supply routes between the Mediterranean regions and northern Europe. There was archaeological evidence that the flow of goods northwards between the 1st and 3rd centuries was significantly greater than for the pre-Roman period (Fulford, 1992). Fulford showed that the territorial expansion of the Empire was associated with increased use of the sea and the Rhone, Saône, Moselle, Rhine and Loire rivers in Gaul. Trade between Gaul and Britain would have extended these modes of transport. The logistics of using such routes is understandable given the ability to move large loads much more easily over water than over land. The cost-effectiveness is an issue to now discuss.

6.4.5 Transport Modes and Costs

The connectivity of the Romano-British transport network from London and other ports, particularly those on the east coast, would have varied based on geography, the distances between network nodes and the transport routes to market destinations. These principles were applied to a simplified distribution model that assessed the likely transport routes used in Roman Britain. The simplified distribution model used a transport network based on the roads of Roman Britain (Margary, 1973), the river and sea routes, and a basic framework of freight-rate differentials between using roads, river or sea transport. Several transport scenarios were modelled for the transport of glass from London to Elginhaugh in Scotland, that picked up the distribution of glass at selected nodes in the transport network. The model used a simple algorithm to calculate routes optimised for distance or time for the road, river sea modes of transport. The freight-rates applied to the modes of transport were based on reference data (Greene, 1986; Franconi, 2014).

The use of coastal ships in the Mediterranean has been well documented with ships of various sizes between 150-450 tonnes and 350 tonnes most common for the coastal trade, moving between ports from Egypt, the Levantine to the Aegean Sea and further to Italy and southern France and Spain (Casson, 1971; Duncan-Jones, 2009; Temin, 2013; Hopkins, 2017a). The Cap Corse 2 1st century wreck and the later West-Embiez wreck that was dated to the 2nd century were examples of several wrecks found on the Mediterranean coast with cargoes of glass blocks, vessels and glass for recycling (Fontaine and Foy, 2007; Fontaine and Cibecchini, 2014). These reinforced the long-distance bulk trade in commodities such as wine and oil from the western Mediterranean to Britain as seen in early Roman Silchester (Fulford, 2021, pp. 36–39).

River boat transport was also recognised as a means of transporting goods with the fortress at Caerleon on the River Usk able to be supplied by sea and river (Mason and Macdonald, 2010).

There are examples of river boat transport used for the supply of glass including the wreck found on the edge of the Saone at Lyon with raw colourless glass, that was traced to workshops further north at Besançon and with a link to the West-Embiez wreck noted earlier (Fontaine and Foy, 2007). The remains of these ship and boat wrecks are traced through the remnants of cargoes of pottery, glass and ingots that would be stored in the lower levels of the vessels with the more perishable goods stored above the bilges (Casson, 1971). River shallow draught boats could carry cargoes of up to 150 tonne (Casson, 1971). No vessels of this type have been found in Britain, but examples from the Netherlands are well-known, including a flat-bottomed river barge of 2nd century from Woerden. Unusually, this was found in the river channel with its last load of grain, the analysis of which showed that it had been imported from Belgium or northern France (Broeke, Enckevort and Willems, 2009, pp. 156–8).

Both sea and river transport increased significantly with the *Pax Romana* that stamped out piracy and extended trade across the Mediterranean and lowered the cost of moving goods by sea more than by land (Temin, 2013). There are relative cost estimates of river and road transports compared to those by sea, and they show that all broadly were the same with river 5-10 times and road 28-42 times that of the cost of sea (Duncan-Jones, 1974; Greene, 1986; Franconi, 2014). These proportions were comparable to those in the seventeenth century (Greene, 1986, p. 40) .

Road transport would have included using road oxen-drawn carts of nominally 1.0 tonne capacity in comparison with river boats for up to 150 tonne and sea shipping for up to 1000 tonnes (Casson, 1971; Greene, 1986). The load capacities would have been a commercial consideration dependent on the type and quantities of goods being traded, and probably more so than for the cost of freight. The academic view is of organised trade with the stakeholders being the state for the collection of taxes, the shipping agents for the transport logistics and the traders motivated by the movement and sale of goods (Kessler and Temin, 2007). The evidence in the 1st and 2nd centuries CE was of organised transport networks across sea, river and road with institutions and networked organisations providing the coordination, communications, and commercial arrangements to support the physical movement of goods (Temin, 2006).

In order to bring a perspective of this to this study, a simple model of the Romano-British transport network was developed. The details and workings are described in the methodology Chapter 3 and details of the model calculations are in Appendix 2. The aim of the model was to better understand the challenges of physically moving goods across Britain and identify the alternatives within the network of roads, rivers and sea. It was based on the network of major Roman roads that link London north and east to York via the Eastern Way North to Elginhaugh via Dere Street. London was the transport network hub from the south to the east via Watling Street that linked Wroxeter with London and further south to Richborough (Philp, 1981, p. 99). The Western Way North from Wroxeter to Carlisle continued north to Elginhaugh. The main transport routes from London to Elginhaugh are illustrated in Figure 6.20.

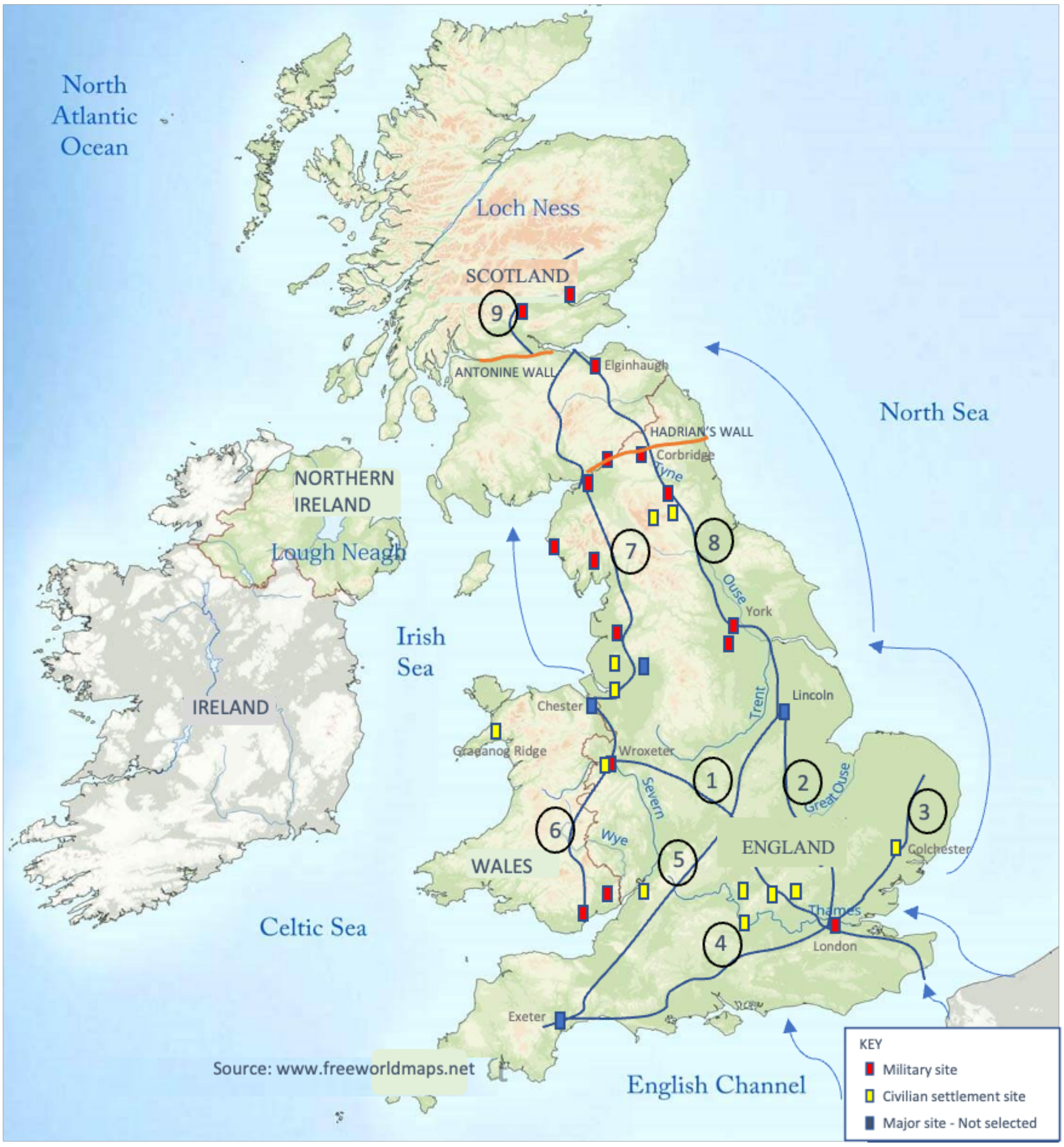


Figure 6.20 Main Transport Routes from London to Elginhaugh

This model was used to work through transport scenarios with the options to travel by land, or sea/river for each of the various node-node arcs. The model assumptions were based on using the Roman roads node to node distances with specific roads identified (Margary, 1973); and the different costs of transporting goods by road and river relative to shipping by sea (Duncan-

Jones, 1974; Greene, 1986, pp. 39–43; Franconi, 2014, pp. 57–64). It is based on a much-simplified version of calculating the Roman effective distance (Flückiger *et al.*, 2022).

The model outputs indicated that the most cost-effective journeys would be by coastal shipping because it could have been over fifteen times more costly to move goods by road, or the journeys would take fifteen times longer in time. The sea journeys have been estimated as 300 miles for London to York and then 300 miles to Elginhaugh. Travel by road from London to York using Ermine Street was 198 miles, and from York to Elginhaugh was a further 187 miles. However, the road cost equivalent distances are respectively 5558 miles and 5243 miles as the cost of road is 28 times greater than by sea (Greene 1986:40). These figures are based on a load of one tonne that can be carried by a team of oxen or mules and a wagon on a road. With the coastal shipping alternative, these loads could have been significantly exceeded and the glass used as ballast reducing the actual cost even further (Casson, 1971). To counter these figures, the capital cost of a ship would have been significant in comparison to an oxen-drawn wagon, and there were risks of shipping loss and seasonal restrictions that could make the advantages of shipping over road transport overstated (Casson, 1971; Duncan-Jones, 1990; Temin, 2013; Hopkins, 2017a).

The network model shows that the optimum means of transport of goods would have been by river and sea. This does not necessarily mean that these modes of transport were used preferentially to road transports. However, the selected sites all had access to river and seaports. The east coast locations would have access to the ports on the Continent and this would explain the importance of London as a Roman port for military and trade given the internal access road routes. This also reinforces the earlier point that shipments would have been arranged as connecting journeys each with the appropriate means of exchange and state sponsorship by the elite controlling the overall trading patterns.

6.4.6 Glass Imports

All of the glass consumed in Roman Britain would have been imported whether as finished products, containers with contents, and raw glass for Romano-British glass-working centres. The hypothesis from this study is that large container bottles would have arrived as imports soon after the Roman invasion and before any significant glass works were established in London, and that the supply of bottles originated from glass-working centres in Gaul or Rhineland and near the producers of wine and oil. These imports could have been the first-fill use of the glass containers that could have been reused as containers and at some point, became sources of recycled glass.

The challenge for all glass workers would have been to secure supplies of glass to be remelted. Regional differences in glassware became more noticeable after the 1st century when glass-working centres were established to supply markets in northern Europe (Follmann-Schulz, 2015). The archaeological evidence from glass in Roman Britain demonstrates that there were close links with contemporary finds in Gaul and the Rhineland (Price, 2006, pp. 42–8). This would have meant that the drinking vessels and tableware product ranges would have continued to have been imported into Roman Britain.

The evidence from the London glass-working centres suggests that the majority of the glass vessels produced were thin-walled small drinking vessels and tableware. The glass-working industry in Roman Britain was smaller and not as established as on the Continent. While the evidence of the long-distance movement of glass was evidenced from the maritime archaeology of wrecks (Silvestri, 2008; Cottam and Jackson, 2018), the logistics to supply the Romano-British workshops would have been more challenging for those not located at ports. The actual transport routes would have been based on ancient trade corridors (Temin, 2013). In south Devon, the excavation of the Iron Age and Roman port at Mount Batten Plymouth revealed this was associated with the trade in minerals between England and the Continent (Cunliffe, 1988). There are several similar examples recorded for the south coast and the east coast that are indications of trading routes via river and sea that would have been as established as known inland routes. The traders and military of Roman times would have taken advantage of these. This is an area where more detailed research of the trade and transport networks could identify a better understanding of the trading interconnectivity between transport networks.

6.5 Social and Economic Patterns

The influence of cities in the Roman economy was considered to be due to the political and social elites establishing connections between the administration and commercial institutions (Marano, 2015; Erdkamp, 2020). The establishment of the city as a trading centre would have influenced the economic and the social activities in the cities that through archaeology can be analysed (Morley, 2007b; Wallace, 2014). The high glass distribution sites included the large cities Colchester, Silchester, St Albans and Wroxeter. These cities all had similar broad ranges of vessel types which were indications of high economic prosperity. However, the shapes of the sites' profiles revealed differences that could have reflected the individual city origins. Colchester and Wroxeter had veteran origins and similar profiles, unlike Silchester and St

Albans that did not have veteran origins and different profiles. The differences in profile were indications of cultural differences between the cities' communities. The following examples from this study expand on these themes of economic prosperity and social culture by describing the essential roles of settlements from the distributions and ranges of glass types.

The legionary fortress at York was built at the end of the 1st century CE at the confluence of the River Fosse with the River Ouse. The civil settlement grew on the south bank of the River Ouse alongside the road leading from the rear gateway of the fortress and by 237 CE had become a *colonia* and the capital of Britannia Inferior (Wacher, 1998, p. 63). The fortress was a high distribution site and shared a similar range and profile of vessel types with the large cities of Colchester and Wroxeter. These were indications of economic prosperity and high social living standards that would have been associated the city role and status. The archaeological evidence for Castleford is of an auxiliary fort that appeared to be closely associated with the extramural settlement and activities of maintenance and repair. London could be described as a 'fortified town' with a primary role as a trading centre, that was economically central to the Romano-British trading network. Catterick and Piercebridge have been described respectively as an industrial supply centre and a 'garrison-town'. Both sites had military associations, were supply centres in the region and included signs of civil communities. As well as the role of suppliers to the military in the local economies, the existence of lead-mining in this area of the Pennines could also have played a part in the local economies (Tylecote, 1964). The relationship between the political institutions, the exploitation of mining sectors and the involvement of merchants, shippers and the importance to the Roman economy would have been relevant (Erdkamp, 2015; Zuiderhoek, 2015). It is highly likely that the mining exports could have been part of a supply-delivery network to and from the area.

In contrast, although the Carlisle fort was a high distribution site at the western end of Hadrian's Wall, the distribution and site profile were dominated by the bottle type and a reduced range of vessel type and form. These could have been indications of a trading centre but with a narrow material culture. However, the presentation of data for Carlisle (Section 4.3.5) picked up that the profile of vessel types could have been defined by the archaeological deposition areas in the fort barracks. Indeed, the presence of decorated pottery ware at Carlisle and the presence of Raetian mortaria from Wilderspool (Section 6.2) testify more to the social culture and status of Carlisle as a trading centre (Wilmott, 2012, p. 323). These material finds suggest that Carlisle could have been a strategic supply redistribution centre for the region.

Rural settlements in Roman Britain were agrarian farmsteads reliant on local trading centres and transport routes. The study sites revealed variable distributions and reduced ranges of vessel types as indications of lower economic prosperity relative to the cities and which was in proportion to the geographic distance from large city administration and trading centres (Taylor, 2013). The villa at Gorhambury had the highest site score (16) and was just 1 km from St Albans. The most remote farm at Graeanog Ridge had just one vessel, a bowl. What is also interesting is that all the rural settlements had signs of glass, including the most remote farm. The price to own glass was high in proportion to annual incomes (Stern, 1999b; Larson, 2019). Yet, it seems that the value of glass was high to all the study settlement communities and that included having ownership of glass objects. The market value of glass vessels was discussed in Section 2.6.2 with glass taking its place alongside pottery vessels as common drinking vessels, tableware and containers. The value of ownership was probably associated with identity, the display of status or for symbolic reasons (Revell, 2016).

This theme also emerged from the glass assemblages found at shrines which seemed to reflect local customs and rituals. All of which suggests that the value of ownership was for social interactions whether domestic, communal or ritual. Further investigation of other materials on the above sites and further sites could corroborate whether this hypothesis is a general finding.

6.6 Summary

The first analysis approach was to investigate the distribution of glass vessels for patterns of consumption across different site types for Roman Britain. The distribution pattern reinforced the hypothesis that the large cities were centres of trade with glass an indication of the material culture and prosperity of the large cities. Other sites with high distribution were military sites including the Wroxeter and York fortresses, the fort at Piercebridge and the nearby industrial centre at Catterick that was known to have been part of the military supply network. This strongly suggests that the role of the military in the economy was significant particularly in those areas. The importance of road, river and sea access was also seen as a major factor for high distribution. The large cities are all in close proximity to main roads.

The second approach was to assess the patterns of trade across the regions. This showed that the trade of the beaker, cup, bowl and jar types was generally seen across all the site types and regions of Britain. There was an indication that the cups from York were a smaller size than at Colchester, Castleford and Piercebridge. This could have been caused by local glass-working or intentional glass vessel distribution directed to York. The absence of the cup type in St Albans was also noted and discussed in the previous chapter. While the distribution of the large and small containers was observed on the majority of sites, the more detailed dimensional analysis of glass containers revealed three groups: large bottles, small squat bottles, and tall narrow bottles. The tall-narrow bottles were found on most sites. The data analyses suggest that the distribution of bottles was directed to both civil and military locations.

The third approach was to explore the supply networks from the glass-working centres to the trading centres in Roman Britain. This analysis was based on a detailed analysis of the London glass-working centres that surfaced the possibility that the products made were primarily thin-walled small drinking vessels and tableware. With also the evidence of glass-working in Roman Britain being of small-scale glass furnace sites, the assumption is that the majority of glass vessels would have been imports from the Continent. It was common practice in the north-western provinces to recycle glass and use with raw materials in glass-working. This practice was relevant particularly in Roman Britain as there were shortages of raw glass (Jackson and Paynter, 2016, p. 82). The analysis of the transport routes for glass were based on the probable routes for large container glass bottles as bulk transports to Britain. Given the majority of the military sites and the large cities were high density bottle destinations in Britain, it is highly likely that military transport systems would have been used to import into Britain. A simple transport network model showed that load carrying with cost and time considerations could have led to multi-mode transport routes between locations using road, river, and sea.

The fourth approach was to examine whether the distribution across sites could have been driven by the social and economic differences across the region. The areas of economic prosperity included the large city administration centres that had the highest density of glass vessels reflecting the role of these cities as trading centres. The investigation considered the relationship between glass distribution and centres of possible production and supply of goods into regions. This highlighted that the Catterick – Piercebridge area could be seen as an industrial supply and trading complex with established road transport connections on the east of the Pennines and also sea routes directly with the Continent and with London. This north-east region together with Wroxeter were the high density vessel destinations in Britain close to mineral mining areas that would have been important to the Roman economy and the local economies.

Even though glass vessels were high cost objects, they appear to have been valued across social groups and regional boundaries as represented by all the settlement types, suggesting that there was not a social barrier to the acquisition of a glass vessel. This is also reflected with the use of samian pottery and was reinforced with the discussion of the use of glass vessels as ritual and burial objects.

7 CONCLUSIONS

7.1 Introduction

This research presents new insights into the capability of the Roman glass industry to make, move and trade glass products and with a better understanding of the Roman socio-economics that drove the glass trade. The main contributions to the body of knowledge are set out with reference to the research questions. The responses to the first group of questions were concerned with the insights of the socio-economics of the settlements in Roman Britain.

1. The characteristic profile of a site, the associations of the glass vessel types and the context

The site profiles for the cities Colchester, Wroxeter and the York fortress were similar in shape with broad ranges of vessel types and forms. The early military and veteran origins of each of these locations could have been the foundations for similar material cultures, i.e., network connections and consumption patterns. In contrast, the site profiles of the cities of Silchester and St Albans, while similar in the range of types, were different in the shape of the profiles. Silchester never had been a military site and there was no firm evidence of a military base at St Albans, again supporting the association between city, veteran origin and material culture. The industrial centres had wide variations in the site profiles with no consistent range or type compositions, except for similarities between Catterick and Walton-le-Dale that both had military connections (Gibbons and Howard-Davis, 2001; Wilson, 2002a). The rural sites show even wider variations in site profiles with the range of types in proportion to the proximity to a large city. All of these sites' profiles are thus defined by the range of vessel types and forms, their origins and an association with trade rather than the type of settlement.

2. The ability to distinguish between a military and civil settlement can be mainly seen through the range and proportions of the bottle, beaker, cup and bowl types.

The military sites had high proportions of bottles. The auxiliary forts showed much more variation in the ranges of vessel types with the Corbridge, Castleford and London forts broadly similar to each other. These forts were on main transport routes. There were individual differences in vessel type proportions for the forts that could have been associated with the role of the site in the economy. The association of bottles with the Wilderspool industrial centre possibly represented the site role for bulk bottle transports. The Castleford and Wroxeter sites had close associations with beaker, bowl, jar, jug and unguent vessel types and with the Roman lead-silver mining areas. These examples illustrate the complexity and variety of the ranges of vessel types associated with both military and civil settlements that are at a detailed typological level (Cool and Baxter, 2016). The pattern of glass types on a site could be a sign of the role of the settlement in the economy.

3. It is not possible to show how glass was actually used on the settlements, but the patterns of glass types associated with the settlement type and context could be indications of different social groups and consumption trends.

Higher bowl: bottle ratios were in evidence for rural settlements and fortresses but the reverse for the cities, industrial centres and forts. There was an indication that the cups from York were a smaller size than at Colchester. The bottle: cup ratios in the tribune houses area in Colchester were lower than on the other Colchester inner-city sites. The bowl and bottle associations in the inner city barracks building have also been evident in rural settlements possibly suggesting communal drinking and eating (Cool, 2006, p. 235). The city perimeter Balkerne Lane site jug and flask associations and high proportion of bottles could have been related to taverns close to the main gate. All of these patterns could have been related to social drinking and dining practices.

4. The patterns may be seen as consumption trends & social changes, or evidence of the supply and distribution of vessel types.

The presence of unguent bottles, bath-flasks and glass windows were associated with bath-house social practice (Zienkiewicz, 1986; Mason and Macdonald, 2010). Trends of particular bottle forms on sites may have been signs of material cultures of settlement communities. There were tall-narrow, small-squat and large bottles generally distributed across most of the sites in Roman Britain. Most civil and military settlements included the tall-narrow bottles with a mix of the small-squat and large bottles. The tall-narrow bottles would include the unguent bottles, bath flasks and small flasks, all of which were seen as lifestyle accessories (Fleming, 1997, 1999; Cool, 2002; Derrick, 2021). These patterns of difference could also be an indication of selective trading distribution of these vessel types

5. The fashions for vessel types, forms and colours appeared in Roman Britain and on the Continent in similar time periods.

The chronological changes of shapes and colours at Colchester could be seen to encapsulate the changes in fashions for glass across the Roman Empire into the 2nd century with the increased demand for colourless vessels and into the 3rd century for drinking vessels (Cool, 2006, p. 149; Fell, 2020, p. 459). These trends were seen on the Continent (Cool and Price, 1995; Fleming, 1999; Bidegaray *et al.*, 2018). There is also the impact of the availability of glass shapes and colours that could have been driven by the glass industry ability to manufacture and supply glass.

6. The economic, social and supply activities and trends in Roman Britain appear to have been geared to the large cities as administration capitals for the elite and to the legionary fortresses that served a similar administration function.

The city and fortress sites' profiles have shown the broadest ranges of vessel types and forms that were reflected in the site scores and aligned with the role of those locations as regional Roman administration centres. The evidence of the variable and reduced ranges of vessel type in the industrial centres and rural settlements was consistent with supply and supporting trading network roles of those settlements in the economy. This also supports the use of glass as a socio-economic indicator of activities and trends.

These insights of the socio-economics of the settlements have revealed that while there are indications of a Roman material culture, there was not a single 'Roman' social culture evident across the geographies and settlements.

The second group of research questions were associated with the production, movement, and trade of glass into Roman Britain.

7. The distribution of glass in Roman Britain showed high density distribution zones in the north-east of England, Wales and the large city areas in the south of England.

All of the locations in these zones had access to main Roman roads, river and sea transport routes. The use of river and sea transportation would have been particularly important for the zone that included the north-east fort at Piercebridge and the Catterick supply centre. This zone had sea routes to the Continent and the south coast and main roads south to York and London and the possibility of the River Swale ford near Catterick being a transhipment point between river and road (Wilson, 2002a, pp. 459–460).

8. The movement of glass into and around Roman Britain was investigated.

The distribution patterns reinforced the view that glass was used and moved into all parts of Roman Britain (Cool and Price, 1995, p. 7; Jackson and Paynter, 2016; Sainsbury, 2018). The import of glass vessels into Roman Britain was significant particularly in the 1st and 2nd centuries CE (Allen, 1998, p. 11; Fleming, 1999, p. 54; Davis and Freestone, 2018). The archaeological maritime evidence of the distribution of glass blocks, glass vessels and broken glass for recycling across the Mediterranean has been well attested (Nenna, 2015; Foy, 2017; Silvestri *et al.*, 2018). The evidence of significant trade from the Continent of distinctive glass forms transported via the sea connections from the Rhine to Roman London was recognised from the identification of 'imported forms' (Cool and Price, 1995, p. 227). The means to transport heavy loads including glass around Britain was modelled and that highlighted the importance of the river and sea routes. It cannot be a coincidence that the locations in the north of England with high glass distribution had road, river and sea transport connections to London and the Continent. The movement of glass also recognised that recycling of used broken glass from Roman settlements as feeds to glass-working centres was significant (Sainsbury, 2018). The scale of recycling to London glass-working centres cullet dumps was seen as an integral part of the glass-working process (Wardle, 2015a). There were a few cases where recycling was not carried out (e.g. Ribchester waste disposal) and these stood out as exceptions. There was also evidence of recycling of glass for reuse (e.g. the glass windows from Elginhaugh) that highlighted the value of glass (Hanson *et al.*, 2007).

9. The role of glass manufacturing in Roman Britain and on the Continent was examined.

The role of glass manufacturing in Roman Britain included producing mainly blue-green and also colourless glass vessels from the late 1st century CE (Cool and Price, 1995, p. 226). The scale of glass-working on the Continent was much larger and the trade in glass wider than the local industries in Roman Britain (Hanut *et al.*, 2005; Fünfschilling, 2006). The review of glass-working wastes from London considered the output to have been mainly producing thin-wall light vessels which was consistent with sources that the glass vessels produced in Britain were blown rather than mould-blown which would have been imported (Cool and Price, 1995, p. 43). This suggested that manufacturing and trading with the Continent across the north-west provinces was interconnected with the exchange of ideas and materials and with much of the glass in Britain imported from the Continent (Cool and Price, 1995, p. 227; Allen, 1998, p. 11)

There were a few recognised glass-working sites in Roman Britain (Cool and Price, 1995, p. 226; Shepherd and Wardle, 2009; Wardle, 2015a). These were located near to the large cities of Wroxeter, Colchester, and near York and London, and all with access to main road transport routes. Based on an analysis of the glass feed materials and wastes associated with the glass-working centres in London, the production from these workshops was mainly light thin-walled vessels with the heavy thick-walled bottle containers being in a minority. The majority of the military sites, and the civil large cities and industrial settlements have evidence of glass bottles. The distribution of bottles actually reflected the trade in the contents as wine or oil. In contrast with Roman Britain, there were significant numbers of glass workshops on the Continent with furnace capacity to make bottles (Cool and Price, 1995, p. 227; Wedephol, Gaitzsch and Follmann-Schulz, 2003)

10. Glass was transported on the Continent mainly by river and sea transport.

Maritime archaeology has revealed the long-distant transport of glass as part of the cargoes of ships across the Mediterranean (Casson, 1971; Fontaine and Foy, 2007; Fontaine, 2014; Fontaine and Cibecchini, 2014). Although there is epigraphic evidence that trade was organised between the Continent and Britain, there is little information that confirms the scale and routes of the transports during the Roman era. This study suggested shipping would have been common particularly for heavy goods, and that would have included glass. The transports to Roman Britain would more than likely have followed military routes, using shared space on ships and vehicles, managed by agents on behalf of merchants and a military supply organisation.

11. The relationships between the glass workshops in Germany, France and the implications for Roman Britain were investigated using the trade of the container bottle.

The analyses outputs suggested that there would have been glass industry relationships between the Continent and Britain for the movements of raw glass, cullet and finished glass products that would have connected the glass workshops to military and civil destinations. It was highly likely that this would have involved relationships between the glass producers and the shippers, institutions and traders that would have been managing heavy goods shipments and distributions to locations across Roman Britain. It is very likely that there were glass industry commercial connections between glass-working centres in the Continent and in Roman Britain.

These insights from the analyses of trade, transport and distribution have painted a picture of a glass industry that was driven to meet a new market demand by expanding trade routes into Britain to the Roman centres of administration using military supply routes and with interconnected distribution systems. The following sections present the hypotheses from the literature review with discussions on the economy, social and material cultures, trade and distribution, glass production and transport systems. This chapter then closes with the learnings from this study of research data management, the author's own conclusions and further work opportunities.

7.2 The Economy

Given trade was driven by the urban consumers and the military, the distribution of glass across Roman Britain would be expected to be dominated by the large city sites. The large cities of Colchester, Silchester, Wroxeter and St Albans did indeed dominate the glass corpus distribution. The large city group site scores reflected the range of glass types and forms that are an indication of the consumers' appetite for glass during the Roman era. The variations in the large city glass profiles could have reflected the different prosperity of the cities. Colchester, the first *colonia* and major administrative capital of the *Catuvellauni* / *Trinovantes* and had the highest score (30), Silchester (26) developed as a *civitas* and Wroxeter (23) the *civitas* of the *Cornovii*. St Albans, *Verulamium*, at (19) had the lowest score in the group that may reflect that many of the glass finds could not be identified and so were not reported (refer to Section 4.4.3). St Albans (*Verulamium*) was the tribal capital of the *Catuvellauni*, but when that tribe subsumed the *Trinovantes,* they took over their capital at Colchester (*Camulodunum*). *Verulamium* was initially a *civitas* capital and then early in the Roman rule became a *municipium* that was below a *colonia* but above a *civitas* capital in terms of status. This suggested that while the city was the formal capital in principle, the leadership did not rule from there and that status was reflected in the economy of the city. These city status assignments align with the sites' scores, validating glass as an indication of their economic status.

By the mid 1st century CE, the range of glass vessels had expanded to include not just special 'elite' vessels but also containers and practical vessel types (Cool, 1996, p. 30). This depended on the origins of the settlements, the material culture of those communities and the glass vessel form. Glass vessels were valued in some communities perhaps more for symbolic reasons rather than as objects of wealth and luxury. This should not understate the value in monetary and status terms of glass vessels relative to similar pottery vessels (Willis, 2011, p. 182). Erdkamp, Verboven and Zuiderhoek (2020b) noted the emergence of new shapes of vessels due to the increase in the use of glass-blowing and that these would have been attractive to a consumer market that wanted vessels different from *terra sigillata* or bronze but not as costly as silver or gold. The argument made was that the success of glass was due to the prosperity of the consumers and of the growth of the economy. The distribution of glass in the large cities supported this view of the demand for glass and the economy. There are however other high distribution sites that indicated that the economy was not just about the large cities.

The fortress sites also had broad ranges of glass types and forms with site profile rankings close to the range for the large cities indicating similar ranges of material consumption. This could also have been expected as the legionary fortresses would have been priority sites for the military supply organisations and as such would have been significant to the regional economies. The military fortresses were centres of administration of the entire legion that included the movements of soldiers, goods and money (Bowman, 2003). They were also a place of Roman citizens, a proportion of the elite or officers with habits associated with the use of material culture. The fortresses would have been stable markets for local products, food, beverages and craft products. They also would have been supplied with military equipment and weaponry, and the materials to sustain an army such as animals, clothing, food, drink and catering goods that would have been imported into the region. In addition to the military supplies, the soldiers would have been paid and together with the civilian communities (*vicus*), these fortresses would have been micro-economic units within a regional economy.

London had a glass site score in the large city range. London was geographically close to the iron mining regions in the south-east, but more significantly, the fort and town became an important trading area through the road, river, sea connections to the north and as a major conduit to the Continent. London became established as a trading destination for imports and exports (Hingley, 2018).

Catterick was associated with military connections from the layouts of the storage and industrial buildings and the few domestic buildings on the sites (Wilson, 2002a, pp. 471–2). Together with the earlier settlement at Scotch Corner and the Piercebridge fort, this area would have controlled the movement of people and goods north to Corbridge and south to York and London via road and sea. As an industrial production site, Catterick played a significant role in the economy of Roman Britain (Wilson, 2002a, pp. 472–3). The site glass profiles supported these general views.

This study investigated whether the exploitation of mineral resources that existed in Roman Britain could have influenced these local economies. The exploitation of precious metals would have been of interest to the state as the interest in precious metals was widespread (Hopkins, 2017b). Deposits of silver and lead were mined in the Pennines, Wales, and Kent and iron had been produced from deposits in the south-east of Britain (Wacher, 1998, pp. 218–9). The Pennine mining areas for silver and lead were in the localities of the forts at Castleford (71/4-400 CE) and Piercebridge (250-500+ CE), with also the York fortress and the industrial centre Catterick (80-400+ CE). The Wroxeter and Usk fortresses in the Wales and the Marches region were situated militarily strategically and would have been able to control any transports of extracted silver and lead deposits. All of these glass site scores were in the same range as the large cities and an indication of the importance to the economy of these areas associated with the wealth from mining.

The evidence from the industrial centres of Wilderspool and Walton-le-Dale, on the west of the Pennines, was that of the production of metal work and pottery with mainly industrial buildings (Hinchcliffe and Williams, 1992; Gibbons and Howard-Davis, 2001). These sites were industrial centres with the role as production and distribution centres for the west of Britain. They would have supported the economy through the production and the flow of traded goods. The glass evidence was mainly bottles at Wilderspool and with some evidence of glass-working on what was an industrial site that suggested glass vessels could have been produced or repaired. The patterns of glass distribution suggested that the west coast was mainly used for the movements of military supplies rather than for significant economic trade in those regions.

Given the high distribution of glass bottles across the military sites and the large cities, it is likely that the military distribution network was used for the movement of bottles containing oil and wine. The role of the state in funding military requisitions, collecting taxes and the revenues from the trade in mineral resources has been discussed as relatively restricted for long distance trade movements (Tchernia, 2016b). Having glass vessels as additional cargo with what was being officially shipped could have been a way to transport glass possibly as ballast and with reduced costs over long distances. Imports of goods to Roman Britain would have been by sea and river as outlined by (Greene, 1986, pp. 29–34). This study indicated that the use of maritime trade routes particularly to the locations to the east of the Pennines with access to the Continental markets for exports and that maritime-influenced imports could have made a difference to the economies of those regions. Catterick was located on the east of the Pennines between York and Corbridge and had a significantly higher percentage distribution of the corpus than Wilderspool and Walton-le-Dale.

While the role of the state could have been relatively restricted, the distribution of glass from this study suggested a network of interconnecting sub-economies (Bowman and Wilson, 2009). The regional economies were considered to have depended largely on the countryside generating surpluses above subsistence levels (Hopkins, 2017a). There were variations of the site profiles across the rural sites. The large villa farmsteads at Frocester and Gorhambury had the high rural scores that was consistent with archaeology of the buildings and the sizes of the settlements, and the broad ranges of glass vessels. The very low score of the farm at Graeanog Ridge reflected the remoteness of the farm. Roman property rights introduced into Roman Britain are thought to both have encouraged the larger villa farmsteads and protected the smaller tenant farmer so that all sizes of rural settlements could co-exist to the benefit of the state economy (Kehoe, 2015). The evidence of glass vessels validated this hypothesis.

The rural settlement sites' profiles illustrated the local trade movements rather than the major trade flows across the regions in that they were a part of an integrated overall economy. The rural settlements had more variable vessel profiles that was reflected in the ranges of site scores. As the data analyses showed, the more prosperous rural settlements were those closest to large cities as they supplied and traded with the large cities. This has been noted in the analysis of the settlement landscape for the southeast of Roman Britain that includes St Albans and Colchester as cities in a landscape of small towns and road-side settlements linked by a road system (Perring and Pitts, 2013, p. 27). They observed from analyses that the high-status villa farmsteads were concentrated in areas close to river systems that crossed fertile land which were to the west of Colchester (Perring and Pitts, 2013, p. 33). This case study was however quite localised and nothing quite so sophisticated is seen elsewhere in Roman Britain. The territories to the north of Colchester were poorer arable land and were absent of these rural settlement types. The evidence from Frocester, Barton Court Farm and Graeanog Ridge reinforce the hypothesis that for farmsteads to have been able to generate surplus to trade and wealth, they needed to be close to a trading centre as a town or large city. It is doubtful that the study selected sites were representative of the whole of Roman Britain and further work is needed in the north of England for comparisons between rural, towns and military forts.

Transport by road was limited in load-carrying capacity (Greene, 1986). It was not surprising that the remote Graeanog Ridge farm in north Wales had few glass fragments including a single bowl fragment and undated fragments of Roman bottles on the site. The people possibly had little interest in glass, or rejected the associated material culture and were in an agricultural sub-economy. The implication was that large rural agrarian sites close to large city markets prospered from the sale of agricultural products and the exchange with goods traded from the large cities. However, the distribution of glass vessels did not provide evidence of the role of the landowners other than as consumers. There was no evidence that the farmsteads were used for glass-working or of glass stored for further distribution. The ranges and colours of glass vessels indicated diverse rural material cultures.

7.3 Social and Material Cultures

The demand for particular glass forms could point to consumer behavioural traits (Fleming 1999). The evidence of different patterns of glass types on each site suggested different social groups. The large city sites had broad ranges of vessel types including large bottles, small unguent bottles, drinking vessel beakers and cups, and tableware bowls, flasks, jars, and jugs used for dining, storage, and display. The analysis of individual areas of Colchester revealed associations between glass types and building structures. There were patterns of associations of beakers and bottles with veteran housing and associations of tableware types with more diverse communities. These comparisons at the individual site level for Colchester were also seen at

Wroxeter. Colchester and Wroxeter were cities founded from military fortresses with administrations more than likely based on the fortress communities. The vessel profiles of the military fortresses were very similar to the profiles of these large cities reinforcing this 'veterans' material culture. There were different patterns of associations of glass types at St Albans and Silchester and in both cases no evidence of an original military base has been found.

An illustration of the material culture of the early colonists can be seen from the evidence of pre-Boudican Colchester with colourful glass dining vessels in evidence (Cool, 1996). Hofheim cups, indented beakers and sports cups were common vessel forms seen on the Continent that arrived at Roman Britain following the invasion (Cool, 1996, pp. 149–150). Luxury glass vessels were considered to include millefiori bowls, facet-cut colourless glass and indented beakers (Rosenow and Rehren, 2014). Millefiori vessels would be seen as distinctive and rare on villa sites (Neal, 1974). The examples of millefiori in this study corpus were found in Colchester, St. Albans, Gorhambury and the temple at nearby Stanway. Facetted vessels and indented beakers imitating rock crystal were all recorded at Colchester. These vessels would have represented a new material culture of the new ruling class and symbolic of status and wealth.

Comparison of the city sites scores was based on the different ranges of glass types and forms. The glass vessel forms would have been recognised by the consumers for their shapes and could have been indications of different social drinking or dining practices. While we cannot be certain of the precise functional use of the glass types, glass type profiles were used to infer possible material cultures and social practices. The following examples illustrate this point.

There were beakers but no cup type finds in the assemblages reported from St Albans, whereas cups including the Hofheim cup, the cup with base ring, the cylindrical cup with the fire-rounded rim, and the ribbed cup were all present in Colchester, Silchester and Wroxeter. Glass cups were smaller in height than beakers. Cups could have been associated with the conical jug found in the three cities but not St Albans. The use of glass beakers could have represented a drinking vessel fashion for St Albans for the elite, possibly with pottery cups used for common social occasions.

Cool and Baxter (1999) suggested that closed forms such as bottles, flasks and jugs may have been less common in later Roman periods particularly in rural areas and that could have been an indication of moving away from Roman materials and cultures. The chronological profile of vessel types at Colchester showed a trend of fewer bowls, an increase in bottles and with the other types relatively stable over the centuries as shown in Table 5.8 and Figure 5.10. The data for the large cities of St. Albans and Wroxeter also reflected this trend. However, the dated evidence from Gorhambury indicated that the bowl continued as a significant glass type into the 4th century, and the majority of vessels at Frocester were bowls dated as 3rd-4th century CE. This suggested that even though these high-status rural sites were close to cities, they had different material cultures. This pattern of communities in close proximity but with social differences was also seen from the evidence on the shrines.

The following glass types illustrate the connection between glass and social cultures. Unguent bottles were associated with scents and found on most of the military sites. These were small personal containers popular during the 1st and 2nd centuries and could have signified social preoccupations with health and well-being (Derrick, 2021). Window glass was found on 62%

of the military sites and can be associated with bath-houses, that can explain the presence of unguent bottles and bath-flasks also commonly found on these sites.

From the analysis of the distributions of glass vessels reported from the selected sites, the evidence suggested social models that could have developed for social groups based on elitism and military associations of colonists, with the army and veterans using glass materials imported from the Continent. The advantages of glass as a material impervious to the contents, together with new closed shapes such as flasks and jugs, would have given glass a value associated with status and membership of a social group (Fleming, 1999, p. ix). The findings from this study were expected patterns of social lifestyles of 'Romanised' communities at the sites with access to the military traded network.

7.4 Trade and Distribution

There were many glass-working centres on the Continent, with more than 70 workshops excavated in France (Price, 2005), and more than 25 in Germany (Grünewald and Hartmann, 2014). During the 1st century CE, glass would have been imported until a glass-working capability was established in Roman Britain. The imports of glass bottles as containers of oil and wine into Britain would have been via the routes established by the military, and more than likely shared military transports. It was not possible to determine the original workshops for the majority of the glass vessels and therefore the author made the assumption that the trading routes for glass in the main followed pre-Roman routes, possibly Late Iron Age, and used river and sea transport modes as much as possible (Wilson, Schörle and Rice, 2012). Within Roman Britain, these trading routes would have also followed the main military invasion routes as the occupation moved west and north into Britain (Galestin, 2010). Glass bottles being a dominant feature on most of the military sites was a strong indication of the role of the military in the distribution of glass bottles and other vessel imports.

Roman commercial practices for the glass trade into Roman Britain were likely to have been based on Mediterranean practices with organisational roles and contractual systems (Broekaert, 2012). There was evidence of Roman commercial arrangements with codes for contracts, trader contracted shipments and general writing and inscriptions regarding how trading relationships were managed (Silver, 2007; Broekaert, 2012; Tomlin, 2018, pp. 281–310). The Vindolanda Tablet 343 illustrated in a familiar informal way how Roman military contractual arrangements were managed for goods ordering, movements and production were managed (Vindolanda Inventory No. 88.946). These commercial records generally provide insights into the detailed administration of military spend, taxes and inventories of stock (Cool and Price, 1995, p. 227). These commercial arrangements appeared to have been established like links in chains with state oversight of the spends (Bowman, 2003). Rathbone described shippers under regular contract for the state that were allowed to form *collegia* (‘associations’) to manage them (Rathbone, 2007, p. 311). This described the ‘loose’ role of the state in funding the army and that would suggest that commercial trading involved state, private and community stakeholders. A military-controlled supply chain network managed by commercial traders would have reinforced the interdependence between military and private enterprise. Morley considered the largest consumers of resources were the state and community institutions (Morley, 2007c, pp. 59–60).

There was good epigraphic evidence for trading relationships both from the Continent and in London (Tomlin, 2018, pp. 303–4). This includes evidence found on inscriptions on altars from Colijnsplaat, Cologne, Bordeaux, London, Southwark, South Shields and York that describe individuals travelling between the Continent and Britain and imply they could have been members of a *collegium* (Tomlin, 1998, pp. 302–9). Cologne has been recognised as a major glass working centre in the Continent and it is very likely that the trade in glass would have been included in such trading relationships.

The evidence presented confirmed that the glass industry was responsive to changes from the expansion into Britain and had the capability to meet the supply needs of the military moving north. The commercial institutions and practices would have been established to enable the trade and distribution of goods between the Continent using known trade routes.

7.5 Glass Production

Based on the composition of the glass-working wastes from London glass-working centres and the glass-working evidence from Roman Britain, this study assumed that the production was limited to producing small thin-walled vessels in the 1st and 2nd centuries CE (Seeley and Drummond-Murray, 2005; Wardle, 2015a). The evidence of the glass-working sites in Roman London revealed that they were limited to small single furnace sites in contrast to some Continental sites that had complex multi-furnace sites, such as at Lyon, Cologne and Augst in Switzerland (Wardle, 2015a, pp. 92–4). The fact that there were many glass-working sites in London during the 1st and 2nd centuries, but only one operational at any one time, also suggests that the glass-working capacities were confined to individuals as glass masters and constrained by the development of the city space. Based on this, the assumption was that the larger glass vessels, such as jugs and large container bottles, would have been mass produced on the Continent and traded as imports.

The staple commodities of oil, wine and the salted fish products (*garum*) were transported over short distances that would have included the trade between the Continent and Britain, with long distances defined as the transport from Egypt to Rome (Nenna, 2014; Foy, 2017). We do not know the precise contents of the large bottles; however, we do know that they were traded widely across the Roman Empire as a commodity container product similar to pottery amphorae. The most common form of amphora was the globular Dressel 20 which held 40-80 litres of olive oil (D P S Peacock and Williams, 1986). The maritime trade in amphorae containing oil and wine was significant and southern Spain was the source of Dressel 20 olive oil that was distributed to the north-west provinces as first-use stoppered containers (Parker, 1990; Greene, 1992). The use of glass bottles for only short distance transport container has been argued for given the prevalence of pottery for bulk movements (Fleming, 1999, pp. 62–63). However, evidence that mid 1st century CE bottles with identical makers marks found at the Usk fortress in Wales and the Xanten fortress in West Germany suggests long distance transport from the same workshop (Cottam, 2019, p. 398). The value of being able to see the contents of glass bottles could have been a factor that led to the significant popularity of glass bottle containers and possibly with some of them being used for premium products. The reuse of bottles could have been a possibility for local traded contents and storage. These are all ~~strong~~ indications that the majority of bottles found in Britain would have originated from the many Continental glass-working centres close to the Continental oil or wine producers.

Given the dominance of bottles on the majority of the military sites, the movement of such products would have been as military supplies to army bases in Roman Britain. The question whether the use of military transports for bottles also included the trade of bottles to civil sites, and in particular the large city sites, was examined. While both square and cylindrical bottle shapes were found to be present on both civil and military sites, there was a pattern of the larger cylindrical bottles at Silchester, Elginhaugh and Piercebridge. There is also a clear dominance of the smaller body width bottles on the civil city sites represented by Colchester and Wroxeter that have associations with veteran communities (as noted in Chapter 4). This showed that the management of military supply chains would have included transports to both military and civil destinations as combined loads on single shipments that could be split on arrival at the port of entry for separate onward transports. Further discussion of this aspect was hampered by the lack of substantive evidence for maritime trade outside of London (Tomlin, 2018, pp. 306–7).

Mass produced large container bottles were made to standard designs using the glass mould-blowing technology. The variations of the dimensions of the glass bottle evidence from across the sites, while all having similar vessel shapes, was an indication of the scale of the mass production of the industry in the first and second centuries that were the peak periods for the use of bottles. The mould-blowing process has already been noted in Chapter 6 (Section 6.4.4) with similar and unusual base designs recorded from different fragments found in Catterick and Skeleton Green (Partridge, 1981; Wilson, 2002a). The discovery of similar base fragment designs from the forts at Carlisle, Rocester and with the mould itself from Bonn has reinforced the need for further investigation of mould-blown bottle base comparisons to understand likely distribution patterns (Cool, 2022). In this paper, Cool made the connection between two separately excavated bottle fragment bases from Carlisle and Rocester in Roman Britain and a fragment of a stone mould from the Bonn fortress. She matched the unique designs and concluded that the manufacture of the glass bottles and filling prior to transport was from the Bonn fortress in Germany (Cool, 2022, pp. 375–9). The Bonn fortress was close to Cologne and the Hambach Forest that was a glass-working area (Jackson *et al.*, 2003; Fünfschilling, 2006; Nenna, 2014; Rehren and Brüggler, 2020). The military installations on the Continent were more established than for Roman Britain and a combination of commercial and distribution interests would have been more established there.

This reinforced the view that the military supply chain was fundamental to the distribution of glass bottles that started with glass-working in or near to a military base and in the proximity to the contents' producers. Glass-working centres in Roman Britain were at London (Wardle, 2015a), Mancetter (Hartley, 2020), and Wilderspool (Hinchcliffe and Williams, 1992, p. 16) all of which had military forts in close proximity that suggested that this arrangement of military and glass-working was common. In this study, the evidence of signs of glass-working residues, whether melted glass, glass-working wastes or glass furnace wastes was recorded for Carlisle, York, London, the Ravenglass fort (Hunter-Mann (2015): in the report narrative only) and the large civil city of Colchester all support this proposition.

7.6 Transport Systems

This trading model would have resulted in an interdependence between transport systems and trading routes. (Greene, 1986) described how shipbuilding techniques changed to enable the transport of larger loads over longer distances that resulted in the construction of artificial harbours built from Roman concrete that would set underwater. In this study, a model of transporting shipments of large and heavy loads was applied to movements from the Continent to London and many of the destination sites in Roman Britain, particularly the military forts and fortresses, having river and sea access. The most effective transport routes were calculated to have been by river and sea. In applying these assumptions to glass vessels, the transport of glass would have been a part of the total load. Maritime Mediterranean archaeology has revealed glass as part of the ships' cargoes, that included raw glass, broken glass for recycling and glass vessels although the journey origins and destinations are not known (Fleming, 1999; Silvestri, 2008; Fontaine, 2014; Foy, 2017).

These transports would have been complex multi-modal material distribution movements that indicated Roman traders were aware of the need to optimise loads and journeys to and from destinations. It is expected that such evidence of glass finds would be from the River Swale close to Catterick, the River Ouse for York, and the River Eden for Carlisle. These routes could all have been used for large heavy load shipments of metal, pottery, stone and glass goods. The Piercebridge formula of canal access to local rivers to optimise water transports, while not fully supported academically, raised the importance that water transport was significant to sites in the north-east of England (Selkirk, 1983; Anderson, 1992). Unlike the Mediterranean maritime archaeology, there has not been evidence of Roman glass from the Roman Britain coastline to validate these transport routes.

In contrast, the manufacture of pottery vessels was different from glass in that recycling of broken vessels was not possible (Greene, 1992). Academic studies have defined the typologies of pottery that allowed the provenance of assemblages to be determined (Peacock, 1982). A study of South-East Dorset Black Burnished ware (SEDBB 1) presented an analysis of the production and distribution of SEDBB 1 based on the evidence from 121 sites representing towns and rural settlements in Roman Britain (Allen and Fulford, 1996). The production of SEDBB 1 was in the Poole harbour area and the study found evidence in the South-West England and Wales, including Bath, Gloucester, Cirencester and Wroxeter. The evidence suggested a direct distribution route from Poole to London with evidence SEDBB 1 found in London including substantial amounts at the waterfront. Further north in Britain, SEDBB 1 was discovered in Lancaster, Manchester and significant amounts in Warrington (Wilderspool) dated in the 2nd century. Finds of SEDBB 1 were reported at Maryport that was a coastal fort *c.* 50km from Ravenglass and along Hadrian's Wall. The Continental distribution of SEDBB1 also included the Cherbourg and Boulogne ports and inland areas. These pottery distributions illustrated the use of established trade movements in Roman Britain, the trade with the Continent and the use of river and sea transports for the long distance movements.

Military campaigns would have been planned in two phases: (i) invasion in which territory is occupied, resistance is overcome and initial defences are set up, and (ii) pacification for which control of the population is established, infrastructure including roads and defences are constructed. For both phases, the pre-planning and management of supplies to the army would have been critical to a successful campaign (Wallace, 2014; Mees, 2018; Larson, 2019). The front-line advance of the army would have involved the construction of military forts and fortresses, requiring supplies of construction materials, fighting weaponry and armaments, armour and clothing, material for the army to live, and the movement of the army itself with soldiers and support units. This advance would have triggered a huge logistical exercise in ancient times. The frontier line of the army would have moved and have been resupplied using river and sea transport. Such routes would have ensured the secure transport of large heavy loads.

Following the invasion in 43 CE, the progression of the frontier of occupied territory from the south of Britain would have required supporting supply lines to the army. By the late 50's CE, the frontier had moved to Wroxeter, by 71 CE to Ribchester and York, by 72 CE to Carlisle, and Elginhaugh by 78 CE. This progress was measured by the establishment of the main military bases on the west and east coast. There were views that the advance troop movements would have used coastal routes into the north of England and Scotland (Anderson, 1992, p. 88; Ferraby and Millett, 2020, p. 94). The distribution of glass vessels on both the west and east of Roman Britain supported the importance of river and sea transports for military supplies, particularly for large loads of heavy materials with roads for inland and local movements of goods. The relevance for glass was that this material would have been a part of a large movement of supplies.

The later supply movements to the occupied territories would have been facilitated through the building of roads and additional military bases. This could explain the timing of the industrial centres of Wilderspool and Walton-le-Dale in the late 1st century CE, Catterick 80 CE, and the Corbridge fort 90 CE, all of which were part of a consolidation of a military supply network in the north of England in the 1st century. The building of roads was suggested as being from ports inland to destinations rather than the other way round (Margary, 1973, p. 497).

This development of the road systems can be illustrated with the relevance of the Aldborough and Catterick sites. Aldborough had sea and river access that would have allowed security of supplies, and although there is a debate about whether it was a fort, there was a range of military material present on the site at the time of the move to Carlisle by 72 CE (Ferraby and Millett, 2020). The later campaign into Scotland and Elginhaugh was likely to have resulted in the development of a fort at Catterick in 80 CE at the crossing of the River Swale and Dere Street. This fort was probably the early origins of the later fort and civilian settlement in the 2nd century that managed the administration of the region and was used as a secure and strategic supply base for Hadrian's Wall and could have had unrestricted river to sea access in Roman times (Wilson, 2002a, pp. xxi, 460). The glass evidence for these developments were the glass sites' profiles for Elginhaugh, Corbridge and Birdoswald that are all of a similar site score indicating good supply lines. Catterick had a similar site score to that of a large city that underlined the importance of that location to the military supply chain.

In comparison, on the west coast, supply centres would have been established as the military frontier moved north. The industrial centres at Wilderspool with furnace manufacturing facilities and Walton-le-Dale built to a military layout supported the main northwest coastal military bases at Ribchester, and Carlisle in the late 1st century (Hinchcliffe and Williams, 1992; Gibbons and Howard-Davis, 2001). Both of these sites declined after the 2nd century. The fort at Ravenglass was an example of a coastal port close to Carlisle. It was situated at the inland estuary on the waterfront and there were inscriptions found referring to the occupation of the fort by a naval unit associated with the emperor Hadrian in the 2nd century (Holder, 2004). A Roman road from the fort led north to Carlisle and east inland to Ambleside and Penrith. As such the fort would have provided security of supply to inland forces to maintain the military presence across the region. The difference between the military west coast routes and the more developed transport routes of the east coast locations was reflected in the patterns of glass distribution and the qualitative site scores.

7.7 Research Data Management

In this section the review of the collection and analysis of archaeological data for research are presented. It was accepted that the physical nature of the fragmentary evidence could have limited the original diagnosis of the original vessel type, and the reporting of the observed characteristics of colour, shape, marks, decorations, and measured dimensions. Excavation reporting has changed over the decades from being focussed on the narrative with abridged versions of the data from the finds to being much more of a combination of the narratives with comprehensive catalogues of detail that can be accessed by researchers. This trend is commended and open access to archaeological catalogued data should be encouraged to continue and even moving towards what could be an integrated database of assemblages' details.

It is often not appreciated just how little glass evidence surfaces, especially when compared with pottery. The identification of the glass types and the characteristics of the physical glass assemblages relied on a few academics with the experience and expertise to fulfil this critical role and this study was dependent on their specialist knowledge. The development of the study database has reinforced the value of categorising the catalogued accession line details into a relational database that could be used to identify patterns of glass characteristics related to features of archaeological context. Furthermore, if the catalogued glass data was defined as a standard set of data fields, this could be used by non-specialist glass archaeologists as a data collection template with value for subsequent specialist research. The dimensional analysis was limited by the available dimensional data from the material records. There is scope in revisiting archived samples to extend existing catalogues with samples not yet recorded, thus building the datasets with more content and with more reliability in the significance of the data.

7.8 Conclusions and Further Work

The aims of this research were to gain insights into the capability of the glass industry to make, move and trade glass products and through that to better understand Roman socio-economics that drove the glass trade. The first conclusion from this work is that glass can be a valuable archaeological indicator of the prosperity of settlements and insights of communities' material cultures. This was based on analysing the site profiles defined by the patterns of glass vessels on sites, the associations of vessels with deposition and site types, and using a developed qualitative ranking profile based on the presence of glass types and forms. The second conclusion is that the distribution of glass vessels across regions can be used to reveal transport routes for large heavy goods loads with the importance of the large cities as centres in trading networks, and of industrial centres as military supply centres. The role of the military supply network was considered to have been key to the trade of large heavy goods to both civil and military sites. This has also reinforced the possible greater use of river and sea for the movements of large cargoes into and around Roman Britain.

The study originally included the development of a SQL relational database with an analytical tool to select datasets for analysis. However, the dynamic development of the typology model did not allow the time to complete this. This could be further work leading towards the development of an open access integrated database of small finds.

This study could be extended with more sites and more data with not just vessel identification, but to include more observable and inferred characteristics of the original vessels. Early archaeology excavation reports tended to be light on the inferred dimensions and there are reports with ambiguous fragment colours. If there are archived physical samples, these could be revisited to issue revised accession catalogues. There are excavation reports with the catalogued details archived or not yet published long after the project was closed. Data for research is critical to catalogue early in the project so that those sections can be issued before the narrative sections as pre-completion outputs.

This research used glass as the material to investigate the Roman economy, the social groups and the trade and distribution management of goods over short distances. As well as more glass from excavation sites, the comparison with other materials, such as pottery, coins and metal work could reveal more about these topics for these and additional sites. There is scope to also make comparisons with the socio-economics of the Continent. This was a period in the history of Roman Britain that has components of economic change, social disturbance and trade and distribution challenges that has relevance today.

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APPENDICES

Appendix 1 Comparison of Vessel Proportional Quantification by EVE and Accession Line Counts

The Colchester estimated vessel equivalents (EVE) data for the period 60/1CE is shown in Table A1.1 as EVE and percentage EVE proportions (Cool 2006:178). These were compared to the study accession counts site data represented as counts and percentage proportions and the results shown graphically in Figure A1.1 that show the equivalence between the EVE and accession counts percentage proportions. The base data sets for the study corpus counts and the EVE estimates were sourced separately but both were from Colchester for the period to 61CE. Even though the base data had obvious differences, the similarity with the percentage counts and the EVE percentages indicates the common origins of the data and supports the use of the proportional data for quantitative comparisons.

Table A1.1 Colchester Site Vessel Counts, Percentage Counts c. 61CE

Comparison Colchester EVEs, Percentage EVEs to c. 60/1 (Cool 2006, p.178. Table 17.4)

Type	Counts	Counts %	EVE*	EVE %
large bowl	43	29.7	13.6	36.69
cup	14	9.7	5.6	15.11
jug	24	16.6	4.2	11.33
tableware-misc jug/flask	20	13.8	3.6	9.71
beaker	9	6.2	3.2	8.63
bowl (other)	11	7.6	3.2	8.63
bottle	17	11.7	2.24	6.04
cantharus	1	0.7	0.6	1.62
jar	4	2.8	0.55	1.48
amphorisk	2	1.4	0.28	0.76
Total	145	100.0	37.07	100.00

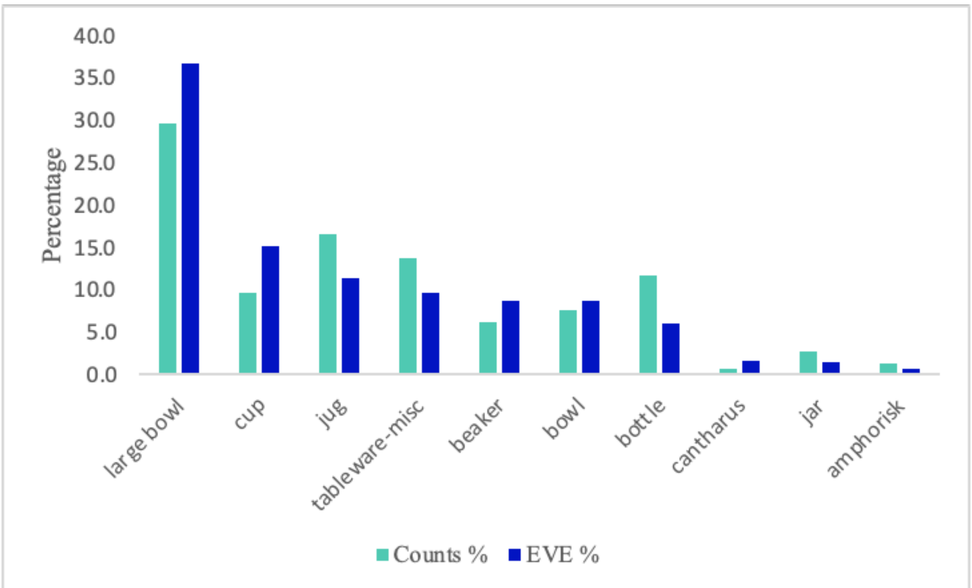
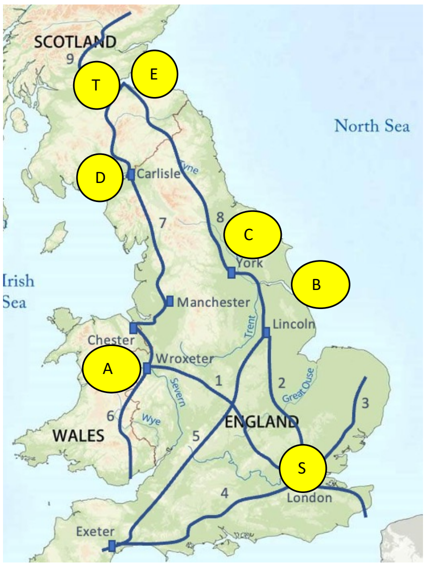


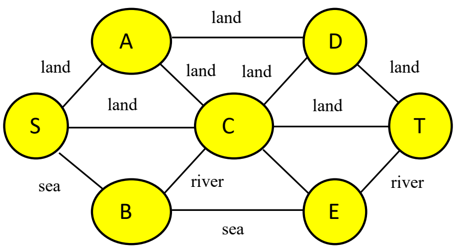
Figure A1.1 Comparison of Colchester Glass Vessel % Counts vs. EVEs c.61CE

Appendix 2 The Network Optimiser Model

A network model was developed based on using an algorithm solver in Excel to find the shortest path from one node to another node in an undirected network. The locations of the sites in the Roman Britain network are called nodes (S, A, B, C, D, E and T) and the routes in a network are called arcs (SA, SB, SC, AC, etc) as shown in Figure A2.1 and detailed in Table A2.1.

The Excel Solver is used to find the optimal solution for a particular scenario.





Node	Location
S	London
A	Wroxeter
B	York-coast
C	York
D	Carlisle
E	Elginhaugh-coast
T	Elginhaugh

Figure A2.1: Network Model Showing the Sites in Roman Britain

The Network Optimiser Model is a spreadsheet that uses an algorithm solver in Excel to find the shortest path from node S to node T in an undirected network. Points in a network are called nodes (S, A, B, C, D, E and T). Lines in a network are called arcs (SA, SB, SC, AC, etc).

1. To formulate this shortest path problem, the following process is applied:

a. Excel is used to find out if an arc is on the shortest path or not (Yes=1, No=0). For example, if SB is part of the shortest path, cell F5 equals 1. If not, cell F5 equals 0.

b. The Net Flow (Flow Out - Flow In) of each node should be equal to Supply/Demand. Node S should only have one outgoing arc (Net Flow = 1). Node T should only have one ingoing arc (Net Flow = -1). All other nodes should have one outgoing arc and one ingoing arc if the node is on the shortest path (Net Flow = 0) or no flow (Net Flow = 0).

c. The overall measure of performance is the total distance of the shortest path, so the objective is to minimize this quantity.

Explanation: The SUMIF functions calculate the Net Flow of each node. For node S, the SUMIF function sums the values in the Go column with an "S" in the From column. As a result, only cell F4, F5 or F6 can be 1 (one outgoing arc). For node T, the SUMIF function sums the values in the Go column with a "T" in the To column. As a result, only cell F15, F18 or F21 can be 1 (one ingoing arc). For all other nodes, Excel looks in the From and To column. Total Distance equals the sumproduct of Distance and Go.

Through defining scenarios and changing the parameters, the model can be used to identify the sensitivity of the outcomes Total Distance to the parameters.

The distances across the arcs are set as in the following Table A2.1. The solver calculates the flows across the arcs with a 1 indicating a flow in column Go. The net flows are shown to be S→A, A→D and D→T with a distance 12082 as shown in Figure A2.2.

From	To	Distance	Go
S	A	4053	1
S	B	9000	0
S	C	11116	0
A	C	4676	0
A	D	5243	1
B	C	49	0
B	E	9000	0
C	A	4676	0
C	B	49	0
C	D	3521	0
C	E	9000	0
C	T	5236	0
D	A	5243	0
D	C	3521	0
D	T	2786	1
E	B	9000	0
E	C	9000	0
E	T	49	0
		Total Distance	12082

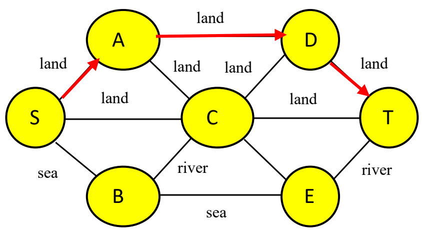


Figure A2.2: Network Model Arcs Distances and the Sites Arcs Schema

The system is set up to model the Roman road system as shown in the following Table A2.1.

Table A2.1: Network Model Routes between the Sites in Roman Britain

Arc	Route map	Road	Roman Route	Distance* Cost	Miles	Cost factor	Roads
S-->A	London-Wroxeter	1	Watling Street	4053	144.75	28.0	1d,1e,1f,1g,1h
S-->B	London-York-coast		sea	9000	300	1.0	
S-->C	London-York	2	Ermine Street	11116	198.5	28.0	2a,2b,2c,28a,28b,28c
A-->C	Wroxeter-York		via Chester-Manchester	4676	167	28.0	
A-->D	Wroxeter-Carlisle	7	Western Way North	5243	187.25	28.0	6a,701,70b,70c,70d,7c,7d,7e
B-->C	York-port - York		local river road	49	10	4.9	
B-->E	York-port - Elginhaugh-coast		sea	9000	300	1.0	
C-->A	York - Wroxeter		via Chester-Manchester	4676	167	28.0	6a,7a,7b,72a,72b,28c
C-->B	York - York-port		local river road	49	10	4.9	
C-->D	York - Carlisle		via Stanegate	3521	125.75	28.0	8a,8b,8c,8d,85a,85b
C-->E	York - Elginhaugh-coast		sea	9000	300	1.0	
C-->T	York - Crammond Elginhaugh	8	Eastern Way North	5236	187	28.0	8a,8b,8c,8d,8e,8f,8g,8x
D-->A	Carlisle - Wroxeter	7	Western Way North	5243	187.25	28.0	
D-->C	Carlisle - York		via Stanegate	3521	125.75	28.0	
D-->T	Carlisle - Elginhaugh	7	Western Way North	2786	99.5	28.0	7f,7g
E-->B	Elginhaugh-coast - York-coast		sea	9000	300	1.0	
E-->C	Elginhaugh-coast - York		via York-coast	9000	300	1.0	
E-->T	Elginhaugh-coast - Elginhaugh		local river road	49	10	4.9	

This shows all the arcs between S (the source that is London) and T (the terminus, in this case Elginhaugh). The road routes with the road number and distance in miles is taken from Margary 1973. A cost factor is applied based on whether the route is by road, river or sea. This is based on the differences in cost of transporting goods in Roman times by road relative to river and sea transports (Greene 1986). The cost factor of transport by river is 4.9 times that of a transport by sea, with road transport 28.0 times that of sea transport.

The assumption in these scenarios is of a 1 tonne load of glass transported to replenish stocks. This load is based on a glass worker making 200 glass vessels a day, with each vessel 150-350g weight as a bowl or beaker, cup (Larson 2019). In a week of continuous operation keeping the glass-working furnace running, this would amount to a mean of 1000 / week, 1.5 tonne / month of glass. This is assumed to be the working stock for such a glassmaking operation that could expect to be replenished with new glass stocks every month. A wagon on the road could carry a load of 1-2 tonne (Greene 1986). A coastal ship could carry 10-15 tonne of glass as ballast with the tonnage of coastal ships 200-400 tonne. The cost to make glass vessels was estimated based on the cost of glass, the labour cost, the energy costs with the margin based on the market value of the glass. The cost of the glass for a 150g vessel was 5.98 denarii, for a 350g vessel this was 13.91 denarii, with the market value of each vessel for the 150g vessel as 9.2 denarii and for the 350g vessel as 21.4 denarii (Larson 2019).
The glass-worker labour rate if based on an annual pay of c. 300 denarii a year would not add more than 1% to the cost (Vindolanda Inventory No. 88.946). There would have been fuel and additional labour costs that are not estimated but could have been high given the higher furnace temperatures required for glass-blowing versus simply casting glass into a mould

(Larson 2019). These additional costs would have impacted the margins for transport and any profit. The distances are based on the road distances (Margary 1973) as shown in the following Table A2.2. The model also includes sea distances that are estimated distances.

Table A2.2: Network Model Road Routes Stages in Roman Britain

(Margary 1973)

Road	Route	Miles	Source page
3a	London - Chelmsford	29.25	246
3b	Chelmsford - Colcheste	17	247
1a	Dover - Canterbury	14.5	35
1b	Canterbury - Rochester	25.5	42
1c	Rochester - London	28.75	51
1d	London - St Albans	19	170
1e	St Albans - Towcester	38.5	173
1f	Towcester - High Cross	28	183
1g	High Cross - Wall	25.5	289
1h	Wall - Wroxeter	33.75	291
57b	Leicester - Mancetter (c	16.25	290
6a	Chester - Wroxeter	38.5	296
7a	Chester - Manchester	34.75	300
701	Chester - Wilderspool	18	304
70b	Wilderspool - Wigan	12	367
70c	Wigan - Preston	16	368
702	Manchester - Wigan	16	369
7b	Manchester - Ribcheste	26.5	370
72a	Ribchester - Ilkley	32.75	371
72b	Ilkley - Tadcaster	25	-
70d	Preston - Lancaster	21	375
7c	Ribchester - Tebay	44	377
7d	Tebay - Penrith	18.5	385
7e	Penrith - Carlisle	19.25	392
4a	London - Silchester	44.5	84
41a	Silchester - Speen	12	130
41b	Speen - Cirencester	34	132
41c	Cirencester - Glouceste	16	134
53	Speen - Bath	40	135
5c	Bath - Cirencester	29.5	141
2a	London - Braughing	26.5	194
21a	St Albans - Braughing	17.5	198
2b	Braughing - Chesterton	49.5	204
2c	Chesterton - Lincoln	51.5	224
5f	Leicester - Lincoln	48.75	219
2d	Lincoln - The Humber	32	236
2e	The Humber - Barmby	Ferry	400
28a	Lincoln - Doncaster	32	410
28b	Roman Ridge. Doncast	29.5	415
28c	Tadcaster - York	9.5	416
8a	York - Aldborough	16	427
8b	Aldborough - Catterick I	23.25	428
8c	Catterick Bridge -Binche	20.25	429
8d	Binchester - Corbridge	27.5	439
82	Scotch Corner - Penrith	47.5	433
85a	Corbridge - Carovan	21	445
85b	Carovan - Carlisle	17.75	447
7f	Carlisle - Crawford	56	455
7g	Crawford - Crammond	43.5	466
8e	Corbridge - High Roche	23.5	476
8f	High Rochester - Newst	29.5	484
8g	Newstead - Dalkeith	27	486
8x	Dalkeith - Crammond	20	-

The following Table A2.3 shows all the arcs between S (the source that is London) and T (the terminus, in this case Elginhaugh). The road routes with the road number and distance in miles is taken from Margary 1973. A cost factor is applied based on whether the route is by road, river or sea. This is based on the differences in cost of transporting goods in Roman times by road relative to river and sea transports (Greene 1986).

Table A2.3: Network Model Routes in Roman Britain with Miles, Cost Factors and Distance-Costs

Arc	Route map	Road	Roman Route	Miles	Cost factor	Distance x Cost
S-->A	London-Wroxeter	1d,1e,1f,1g,1h	Watling Street	145	28.0	4053
S-->B	London-York-port		sea	300	1.0	9000
S-->C	London-York	2a,2b,2c,28a,28b,28c	Ermine Street	199	28.0	11116
A-->C	Wroxeter-York		via Chester-Manchester	167	28.0	4676
A-->D	Wroxeter-Carlisle	6a,701,70b,70c,70d,7c,7d,7e	Western Way North	187	28.0	5243
B-->C	York-coast - York		local river road	10	4.9	49
B-->E	York-coast - Elginhaugh-coast		sea	300	1.0	9000
C-->A	York - Wroxeter	6a,7a,7b,72a,72b,28c	via Chester-Manchester	167	28.0	4676
C-->B	York - York-coast		local river road	10	4.9	49
C-->D	York - Carlisle	8a,8b,8c,8d,85a,85b	via Stanegate	126	28.0	3521
C-->E	York - Elginhaugh-coast		river to coast and sea	300	1.0	9000
C-->T	York - Elginhaugh	8a,8b,8c,8d,8e,8f,8g,8x	Eastern Way North	187	28.0	5236
D-->A	Carlisle - Wroxeter		Western Way North	187	28.0	5243
D-->C	Carlisle - York		via Stanegate	126	28.0	3521
D-->T	Carlisle - Elginhaugh	7f,7g	Western Way North	100	28.0	2786
E-->B	Elginhaugh-coast - York-coast		sea	300	1.0	9000
E-->C	Elginhaugh-coast - York		via York-port	300	1.0	9000
E-->T	Elginhaugh-coast - Elginhaugh		local river road	10	4.9	49

(Cost factors based on Greene 1986: 40)

The model is used to assess the optimised route for any transport route scenario as the shortest ‘distance-cost’ from the starting point (S) to the terminus (T). The possibility that military transports are used for civil goods movements would have had cost implications that are not specifically considered, although the ‘distance-cost’ factor would represent time that would have also been in proportion to the cost. The model was also not used to simulate the differences in load carrying capacity with a standard load of 1te assumed for each journey. It can be used to test various scenarios by weighting particular routes that will change the distance for particular arcs. For example, if the route between Wroxeter and York was considered to be 'impassable' then the distance would be weighted to reflect that scenario.

The model assesses the optimised route for any scenario as the shortest distance from S to T. The possibility that military transports are used for civil goods movements would have had cost implications that are not specifically considered, although the distance-cost factor would represent time that would have also been in proportion to the cost.

The following scenarios were used as shown in Table A2.4.

Table A2.4: Scenarios for S→T Arc Routes, Cost Factors, Distance-Cost and Distances

	Solved Arcs	Detail	Cost Factors	Distance.Cost	Distance
Scenario 1	sea, river, land		1,1,1		
	S-->C-->T		sea:river:land	385	385
Scenario 2	sea, sea, river		1,1,2		
	S-->B-->E-->T		sea:river:land	610	610
Scenario 3	sea, sea, river		1,2,5		
	S-->B-->E-->T		sea:river:land	620	620
Scenario 4	sea, sea, river		1,5,10		
	S-->B-->E-->T		sea:river:land	650	650
Scenario 5	sea, sea, river		1,4.9,28		
	S-->B-->E-->T		sea:river:land	649	649
Scenario 6	land, land	sea routes n/a	1,4.9,28		
	S-->C-->T	east route	land	10794	386
Scenario 7	land, land	London - York n/a	1,4.9,28		
	S-->A-->D-->T	west route	land	12082	432
Scenario 8	land, land	as 6 + Carlisle n/a	1,4.9,28		
	S-->A-->C-->T	west to east route	land	13965	499

Scenario 1 equalised the cost weighting for river and sea. The optimised route was S→C→T showing the shortest distance was 385 miles by road.

Scenario 2 applied a cost factor of 1 by river and 2 by land. The optimised route was S→B→E→T as a sea and river route of 610 miles.

Scenarios 3, 4, 5 applied cost factors in increments to the recognised 4.9 by river and 28 by land. In each case the sea and river routes gave the optimised total distance. This suggests that Roman transports would have used sea in preference to land road.

Scenario 6 then weighted the sea routes to eliminate them and the optimised route was S→C→T but this time with a distance 10794 miles. This distance is 16 times the sea distance.

Scenarios 7, 8 give the routes northwest and northwest with a crossover to the east and both in excess of the most direct route.

The volume of glass that could have been imported to Romano-British glass-working centres is estimated as an order of magnitude calculation as follows.

The standard weight of glass drinking and tableware vessels was 150-350 grammes (Larson, 2019). A skilled glass blower could make five common square mould-blown bottles in an hour and smaller drinking and tableware vessels in three minutes (Taylor, 1997; Larson, 2019). This suggests that when glass-working, a small furnace would have needed to remelt *c.* 60 kilograms of glass a day. The amount of glass cullet found at Basinghall Street London was 12 kilograms (Wardle, 2015a, p. 42). If glass-working centres used similar quantities a day, then the movement of imported new glass to provide a month's supply to glass-working centres in Britain could have been *c.* 100 tonnes a year as an order of magnitude.

Appendix 3: Rough-cut Calculations of Large Container Volumes

The purpose of the large volume calculations was to provide some context to the use of the large bottle containers using the dimensional data available. The dimensions analyses indicated three main groups of bottle size: the large group of body width >120mm, the short-squat group of body width between 60-120mm, and the tall-narrow group <60mm body width. The dimensional analyses suggests that particular bottle size groups were specific to some sites. In order to understand whether this could have been related to the transport of large amphora containers or possibly for the use of bottles as containers for more of a local domestic use, the volume calculations were made.

The calculation of cylindrical and square bottle volumes was based on using the body width dimensions from the excavation reports accession line bottle dimensions. The wall thickness dimensions were not provided for all accession line details. In addition, the bottle heights were also not available. There is a correlation table in Cool and Price 1995: 181 as scatter plots of base width versus bottle height (Fig 11.4) Scatter plot of height versus base width of cylindrical bottles (Page 181). This scatter plot used to correlate a height for a body width.

Given the assumptions that were applied, any calculations would not relate to any individual bottle but to the groups of bottles with the only variable being the bottle body width. For this reason, the calculations are rough-cut approximations of bottle volumes in the groups. The standard calculation of a cylinder was used, ignoring wall thickness, by using the body width and the correlated bottle height.

Appendix 4: Dimensional Analysis Principles

The dimensions of the glass fragments collected from excavations are examined to identify whether the original glass was a vessel(s), object based on the part(s) of the original. If there is insufficient fragment material, this identification may not have been possible. The glass material is also examined to record the physical attributes. These can include the colour(s), the quality of the glass, any markings and decorations, the weight of the fragment, and the dimensions of the fragment (present height) with estimated dimensions of the original vessel rim (rim diameter RD), the body width (BW), the base diameter (BD) and the glass wall thickness (WT). These details, together with the archaeological context of deposition site and the chronology dating of the glass, are recorded as the excavation catalogue accession lines. These are the basis of the data used in this research.

The details of the identified parts, vessels and estimated dimensions of the original vessels associated with the accession lines have been analysed to establish if there are any patterns from the shapes and sizes of glass vessels that can indicate whether the trade in glass was produced targeted to regions or produced to build stocks of products that were traded. The complication in this is that the point of trade cannot be established. The patterns of glass from sites represent the geographical areas of consumption and the disposal of the glass as a loss or a deliberate disposal action.

The accession line data of vessel dimensions is not complete for every accession line or indeed in all reports. There can be many reasons, some of which are relevant to the confidence in the accuracy of the accession line catalogue reported dimensional data. Each accession line with dimensional data has been used in this analysis. Comparative trend analysis across sites, using moving average or best fit techniques, can have reliability issues with sample data sizes of less than ten, particularly also if the variability of the data is high as the selected sample data set could have been biased. The following examples from the study illustrate the principles adopted.

The Colchester beaker rim dimensions data is shown in Figure A4.1. In this graph, each of the accession line samples is a point on the graph. The data for Colchester has 40 samples, with the scatter range 29-110 that represents the upper and lower boundaries of the sample points. The moving average curve shown is calculated to show a smoothed line that highlights the possible outliers. The moving average curve is calculated for a point by using the next forward five points and the previous five points, hence why ten points are assumed to be the minimum for an analysis. The trend line is the best fit linear line that could fit all the data points and in this example is highlighted in red and has a range of 60-80.

Figure A4.1 Colchester Beakers Rim Diameters

(Graphical Moving Average and Best-Fit Data Trend Shows Cv=0.3)

The coefficient of variability is the standard deviation divided by the mean. The standard deviation is represented by the moving average distance range and the mean by the best fit line. It is a measure of the variability of the data in relation to the mean. The coefficients of variation are noted on each graph (c_v) with the higher numbers the greater the variability. A cv <1 is considered low variance and the data could be reliable. In Figure A4.1 the cv is calculated from the data as 0.3 using the formula cv = (standard deviation) / the mean and the data can therefore be considered low variance and reliable. The variation around the best fit line as shown by the moving average curve is a visible indication of this variability of the dimension on a graph. Another source of variance could have been the measurement method. The methods used by the excavation team would have been manual using radial charts that are simple but accurate techniques and would not be expected to result in manual estimation errors.

The graph of bowls (Figure A4.2) shows the dimensions of two main bowl types: the pillar moulded bowls (sample numbers 1-38) and thereafter blown glass bowls. The variation does not radically change across the sample range indicating that the variation could be assumed to represent the original vessel rim diameters and was not associated with glass-working technique, fragment identification or measurement errors. The cv for this data is 0.3 indicating low variance.

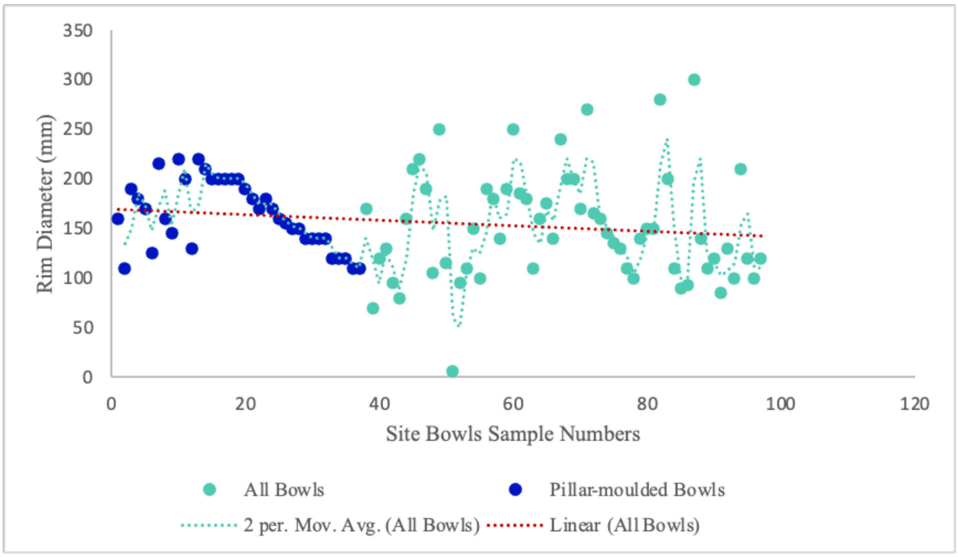


Figure A4.2 Colchester Bowls Rim Diameters

(Graphical Moving Average and Best-Fit Data Trend Shows Cv=0.3. Blue points are pillar-moulded bowls)

Figure A4.3 shows the beaker rim diameters for the samples from Wroxeter. The number of samples is 8 and the best fit line and moving average curve appear to be closer than the previous graph for Colchester, with the moving average a close distance from the best fit line. This however can be an illusion of variance as the data set could have been just part of a larger data set and more representative of the original vessels' dimensions. In this case the cv is 0.3 and so this data set is low variance as the visible line and curve show.

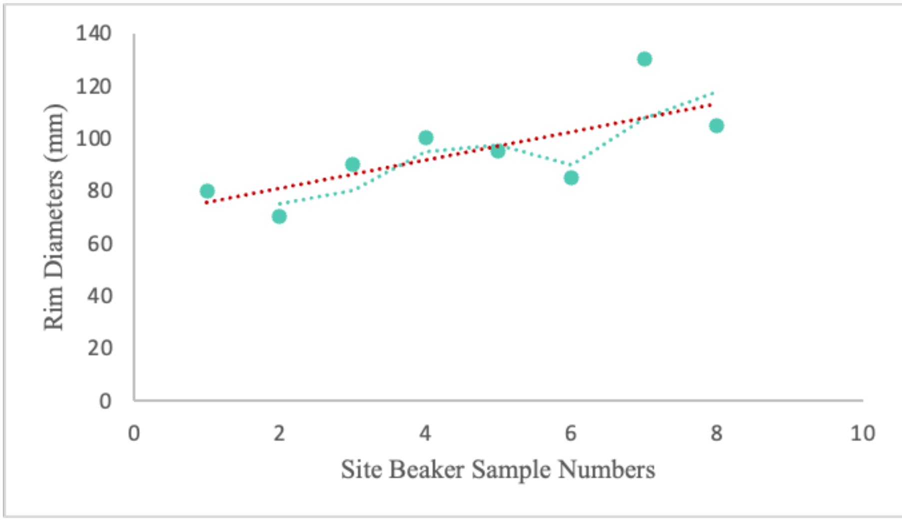


Figure A4.3 Wroxeter Beakers Rim Diameters

(Graphical Moving Average and Best-Fit Data Trend Shows Cv=0.2.

By focussing on the data sets with more than 10 samples, the analysis of the vessel types takes account of the variance of the moving average relative to the best fit line with sufficient data. A skilled glass worker would have worked to a design template and would have been expected to produce vessels to within a close tolerance of the template design dimension. It is assumed that significant variability therefore represents different vessel type rim sizes. The body width dimensions for glass mould-blown vessels would have been to a close tolerance to the glass workers moulds. A variance for this dimension therefore suggests different moulds and possibly different glass-working factories.

A seemingly random pattern of variance across the rim diameters and body widths of the vessel's types across the sites and geographical locations can therefore indicate that the glass-working industry operated 'make to stock' campaigns that were traded and distributed to the markets.

Appendix 5: The Structure and Use of Microsoft Excel as a Glass Database

The following details are of the data structures and use of the tables and graphs in Microsoft Excel based on the database design and managing the database in Sections 3.4.2 and 3.4.3. The data collected from the excavation reports was the catalogued accession line data of the fragmentary evidence that is in an unstructured text format. The design of the database was based on categorising the glass, location and period phase data into variables represented as columns in the data-frame and the fragmentary accession lines as rows. The data design incorporates the vessel hierarchy will be above the base level of glass type, such as bowl, beaker, cup or bottle in order to create sufficiently meaningful for site profiles that can reveal changes in glass colours, types, forms over time and space. The detailed considerations associated with using glass fragmentary evidence are set out in detail in this Appendix.

Data Design

As defined and described in the main text, the database was designed such that the:

- Rows of the database represented the glass accession lines with the glass fragmentary details for each unique site accession line
- Lowest unit level of quantitative measurement was the glass vessel type that included beaker, bottle, bowl, cup, flagon, flask, goblet, jar, jug, plate, pot, vase together with combinations of mixed types as drinking vessels, tableware and vessels with no-classification
- Glass forms were defined by the excavation records and included amphorisk, bath-flask, bulbous-jug, conical-jug, cylindrical-bowl, mercury-flask, pillar-moulded bowl, ribbed-bowl, tubular-rimed-bowl, almond-knob-beaker, arcaded-beaker, cantharos, cup-base-ring, cylindrical-cup-fire-rim, hofheim-cup, indented-beaker, modiolus, ribbed-cup, skyphos, sports-cup, amphora, cylindrical-bottle, frontinus-bottle, and square-bottle
- Accession line glass colour characteristics as recorded were included in the columns data as the fragment vessel part, vessel body shape and colours, rim shape, type and edge, base shape and base ring type, body and base markings, body glass on glass decorations, handle shapes
- Glass accession line location as the site, site location, site type and disposal place

- Glass accession line dating details with earliest, start, finish and latest dates

The above vessel data header details were based on the observed features of the fragments, and included:

- Colour types – polychrome, monochrome, translucent, opaque
- Glass colour – with fragment colours detailed based on common recorded colours. For two-part colours, the dominant colour is second, illustrated for with the most common natural colour being blue green
- Decoration colour – opaque white or yellow, translucent white or yellow as commonly observed decoration colours
- Body decoration as glass-on-glass decoration as applied blobs, applied trailing, etc.
- Body and base marking made on the glass from moulds (e.g. ribs) or from tooling (e.g. wheel cut lines, inscriptions, etc).
- Shapes of the original vessel defined by the fragment, including those for the main vessel parts of body, base, rim, neck-shoulder and handles. The shapes are defined based on commonly used terms including glass finish (e.g. rim out-turned and polished)
- Base ring type that reflected the vessel design and the manufacturing technology with how the base to a vessel was constructed

The location details included the subsite (context), the excavation site itself and the location as a place name. The following header data structures define locations as:

- Location type – whether urban or small town or rural associated with the status and significance as a trading or economic centre
- Site type – is designed to reflect the particular use of the area in ancient times, as civilian, military, industrial and will be categorised with sub-site
- Disposal site that details the context for the finds, with other finds and importantly the means of providing a date periods, as these date periods are specifically associated with the disposal site and so the key association is between disposal site and period phase

The database can be used to select datasets of accession line features at an appropriate level of detail to compare patterns of glass finds across sites, locations and regions and time.

The location of the find is the excavation subsite that provides the specific context for dating the materials. The location sites can be associated urban or rural settings, with dwelling houses and streets, military buildings, burial grounds or disposal pits and dumps. The location had geographic details that can pinpoint for mapping purposes, distances and possible connections between places.

Chronological details based on the context are usually expressed as a range of dates with sometimes earliest and latest dates, that will be termed the period phase and defined with a calculated mean date and the range duration for glass fragments represented as accession lines. Rather than fit the evidence to pre-defined period codes of dated periods, the principle of grouping accession lines as statistical clusters will enable analysis without losing chronological detail. The chronology includes the dating from the subsite context as a start and end period dates in some cases as ranges at each end, with a period phase range between the earliest and latest dates, a phase range of duration in years and a calculated median for the range. A period code that represents date ranges across regions as a dating convention is also generally assigned for excavation subsites. This period code is specific to the report. Several reference sources use project period codes as a means of reconciling records and date events between reference sources (Price and Cottam 1998; Cool 1995; Reece 1993, Perring and Pitts 2013). This is discussed in the body of the methodology. This approach will not be used in this study as the detail of the period phases will be used with that granularity maintained even with statistical grouping of data sets, thus making the use of period codes too blunt a tool for comparison.

The conversion of the data from an excavation report into a digital accessible format was manual and time consuming even when transposing data from pdf files into a master data-frame.

The management of glass archaeological data quality was maintained to ensure that all the data was correct, complete and controlled to reflect the original reported catalogued accession line content using links to the sites datasets and checks of the counts and proportions back to the master data frame.

Managing the Database Using Microsoft Excel

Each location could generate 1,000 – 10,000 accession lines of data for single or groups of fragments in assemblages. With between 20-30 data characteristics for each fragment, this could result in a total database of 20 locations of 600,000 – 6,000,000 data fields. While this is within the scope of using MS Excel as a database, the requirements for managing the database go beyond just keeping the data and managing changes to the data and include the integration of the data from each location and the interrogation and visualisation of the data for patterns and trends.

The structure of the data in Excel is shown in Figure A5.1. and is described below.

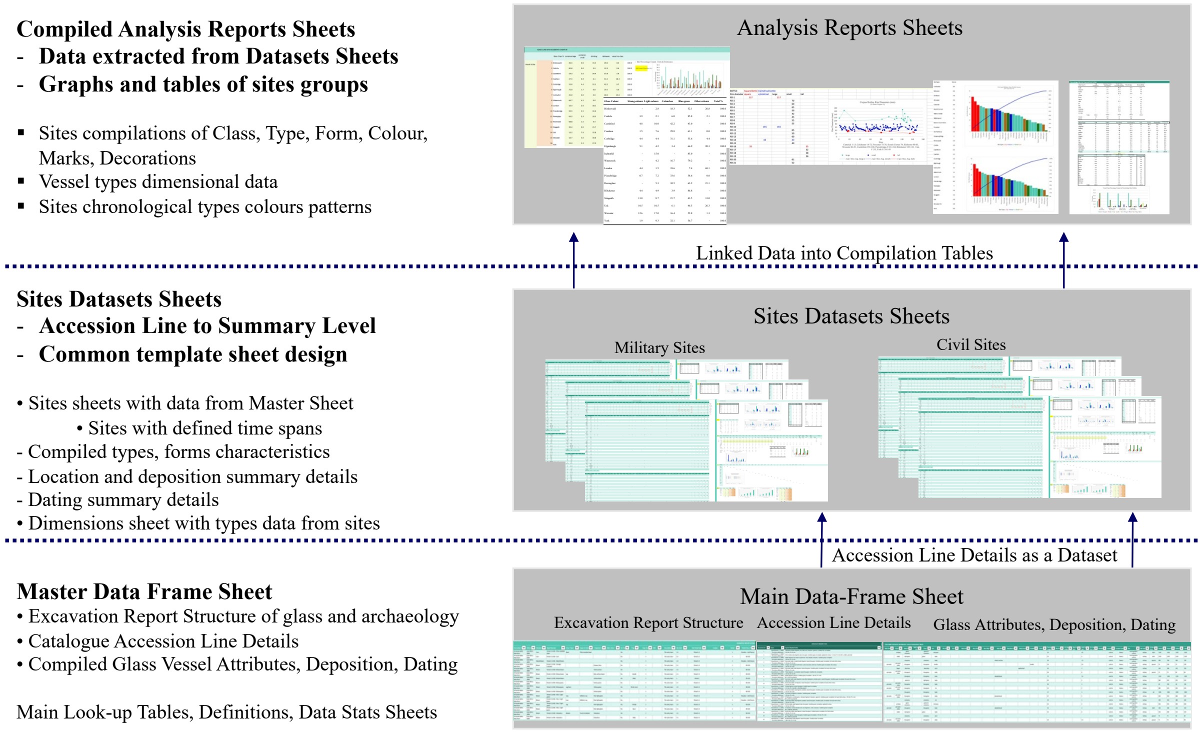


Figure A5.1 Microsoft Excel Accession Line Database Structure

The purpose of the Master Data Frame Sheet was to hold all the excavation report data records for the archaeology sites investigated. The Master Data Frame Sheet was in three sections:

1. Excavation report details of the glass fragmentary evidence based on the structure and narrative details in the report. This included glass vessel and glass object data and used the reports records

2. Accession line catalogue extracts that included a unique site-line number, the source of the data and the catalogue text record
3. Compiled glass vessel attributes including type, form, characteristics including colour, parts details, markings, decorations and dimensions, deposition and dating details

This *Master Data Frame Sheet* was used to as the source of all the datasets of sites and of the Romano-British Corpus that were separate dataset sheets in the Excel file. Any additions or modifications to the database were made to the master sheet and then extracted to the dataset sheet, thus maintaining the integrity of the master data. This also allowed for checks on the subsequent use of the sites data back to the master source.

The *Sites Datasets Sheets* held the extracted data of the sites and the Romano-British corpus held in separate sheets. These sheets were designed as common templates to hold subsets of the master data and compilations of the class, type, form, colour, markings, decorations of the accession line glass vessel data. The common template design meant that standard tables, graphs were generated based on the site summary data in each sheet. The common design also enabled selected data cells from site sheets to be more easily be extracted into compilation tables in Compiled Analysis Reports Sheets.

The *Compiled Analysis Reports Sheets* were used to collect and compile selected data from the sites for analyses and comparisons across sites and across the corpus and generating compilation tables and figures. The main compilation tables were generated from links back to the sites' datasets.

The management of the additions and changes to data from excavation reports was first made to the master data and then subsequently to the sites' datasets. This provided a process control of the data integrity from the source reports to the sites' datasets. In addition, checks of the data analysis tables were included as cross references back to the original master data.