
# Roman Planting Trenches in the East of England

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## ABOUT ARCHAEOLOGY ON FURLOUGH

When the spread of coronavirus COVID-19 forced the UK into shutdown in 2020, Archaeology on Furlough was set up to provide volunteer projects for archaeologists unable to work. Around 120 people registered via the website (www.archaeology-on-furlough.com), and most went on to be active participants in the eleven projects on offer. Participants included commercial field archaeologists and specialists, museum curators, retired archaeologists, and students unable to access laboratories or research facilities.

The projects undertaken by the volunteers involved collecting and analysing data on:

- Roman cultivation strips in the East of England
- gravegoods in the Iron Age, Roman and Anglo Saxon periods (Cambridgeshire and Oxfordshire)
- trauma in skeletons from the in the Iron Age, Roman and Anglo Saxon periods (Cambridgeshire and Oxfordshire)
- aurochs remains from Scotland, England and Wales
- Saxon houses from Scotland, Northern England and the Midlands
- henges excavated in Scotland, Northern England and the Midlands
- historic sheepfolds of the Lammermuirs Hills (Scotland)
- barrows and other Bronze Age sites on Dartmoor
- temples in Roman Britain
- decoration used in prehistoric Britain
- digital tablets for use in archaeological fieldwork.

Once completed, the grey literature project reports and datasets generated by the project teams will be made available via Cambridge University Library's Apollo repository (https://www.repository.cam.ac.uk/).

Projects were all conducted voluntarily, so that participants could comply with the requirements of the UK Government's Coronavirus Job Retention Scheme.

For many of the volunteers, Archaeology on Furlough was an opportunity to research unfamiliar topics, and discuss them with peers. For some, it was an opportunity to develop new skills, particularly research skills which they did not get the opportunity to use in their regular fieldwork. For a few, Archaeology on Furlough provided their first opportunity to write a report.

Archaeology on Furlough was also intended to provide support for archaeologists out of their normal workplaces. Volunteers used video conferencing and various message boards to keep in touch with one another.

Archaeology on Furlough was developed and coordinated by Rob Wiseman (Cambridge Archaeological Unit, Department of Archaeology, University of Cambridge).

## SUMMARY: ROMAN PLANTING TRENCHES IN THE EAST OF ENGLAND

Across eastern and central England, archaeological excavations of Roman sites have uncovered rows of parallel trenches which are usually interpreted as remains of cultivation systems. There are a number of different interpretations of them, including vineyards and 'lazy beds'. There are however solid arguments against both of these, and consequently their use remains disputed.

The goal of this project was gather a large sample of excavation reports, and analyse the trenches' characteristics, contents and relationships to other contemporary Roman features, in order to understand them better. The project team identified 52 sites with good or possible examples—over twice as many as the most recent survey (Lodwick in Allen *et al.* 2017). They comprised  mix of open area excavations and evaluations.

The trenches are typically 60–80cm wide, dug c. 25cm into the natural geology, and rectangular in profile. They were spaced an average of 4.5–5.5 metres apart, which suggests that other crops might have been grown in beds between the trenches. Most of the planting trenches were positioned close to watercourses, although they did not generally show signs of waterlogging, water erosion or irrigation. Their fills usually produce few finds or environmental remains. Pottery recovered from them typically dates from the late Iron Age through to the second century AD. Most appear to have been backfilled promptly after being excavated.

The limited environmental remains recovered from the trenches' fills are inconclusive. The small amount of charred grain recovered suggests field manuring using midden material, rather than crop-processing. Charred remains of cultivated beans (Fabaceae) and peas (*Pisum sativum*) were also identified on a handful of sites, along with one example of carrot (*Daucus carota*). Pollen samples identified three sites with cereal pollen, four with Brassicaceae (turnips, cabbages, along with wild taxa), and one unique site with *Vitis*, indicating cultivation of grapes. While the environmental evidence was limited, the balance of probability points to most of the trenches being used for raising vegetables and possibly herbs.

The 'planting trenches' show many characteristics of house gardens described by Roman authors, and excavated elsewhere in the Roman world. But many are substantially larger than the systems the Roman authors describe, and capable of supplying hundreds of people. Oddly, however, most planting trenches were not located close to either villas or towns, where they might have fed large populations. They were however very closely associated with roads: indeed, more than half were within one kilometre of a known Roman road.

One possible interpretation is that the planting trenches might have been established to support the Roman army during the first century of the Roman occupation, and positioned close to roads in order to provision troops on manoeuvre. Once civilian administration became established in the south and east of Britain, and the military moved north and west, most of the planting trenches fell out of use.

One recommendation from this project is that the term 'planting trenches' be adopted for these features. A major barrier the project team encountered gathering information on them was the large variety of terms in use, including *cultivation system/beds/rows/trenches*, *bedding trenches*, *planting beds* and *lazy beds*. The lack of consistent terminology made sites difficult to identify, and there are doubtless other examples not included in the gazetteer attached to this report.

### Project team

The volunteers who worked on this project were, in alphabetical order: Ashleigh Boulton, Clare Jackson-Slater, Emily Brewer, Joseph Losh, Michael Roberts, Rachel Fosberry, Robbie Luxford, and Rob Wiseman.

## INTRODUCTION

Over the last twenty five years, excavations across the East of England have uncovered fields of parallel trenches, dating to the Roman period. The trenches are typically shallow, with a rectangular profile. Their fills usually produce only sparse artefacts and environmental remains, if anything. While a few sites have seen detailed analysis, most are poorly understood.

The goal of this project was to gather examples of these features, collate their characteristics, and analyse their dates, contents and uses, in order to understand them better.

### Previous research

By far the best-analysed example of this class of features—and one that set the agenda for later interpretations—was an area of trenches covering 7.5 ha. uncovered at Wollaston, Northamptonshire, which was interpreted as a vineyard (Brown *et al.* 2001). The site produced evidence for grape pollen and potential root-balls in the trenches. Stakeholes or postholes were interpreted as the remains of trellising.

The first volume of the Roman Rural Settlement Project (RRSP)—which gathered data from c.2500 excavated rural sites in England and Wales—identified seventeen sites with parallel trenches. These were confined to eastern part of the 'Central Belt' of England and along the fen edge (Smith *et al.* 2016: 182–183). The RRPS volume noted "there is little environmental evidence associated with such features to help determine function, although it is likely that they are associated with growing horticultural crops such as cabbages, carrots etc. Other systems of parallel bedding-trenches with associated postholes have been excavated across 7.5 ha at Wollaston in the Nene valley, and had pollen evidence to support the existence of viticulture…" (Smith *et al.* 2016: 183). Chronologically, the 17 sites dated to the early to mid-Roman period, particularly the second century AD (Smith *et al.* 2016: 183) The RRSP's second volume expanded on this analysis, distinguishing 'bedding trenches' and 'vineyards' (Allen *et al.* 2017: 72–74 and 74–77), although noting that the archaeological distinction between them was blurred. The report also rejected to earlier interpretation of these features as lazybeds (where the trenches were drainage channels between raised beds), in favour of bedding trenches (in which plants are grown in the trenches). The report identified 12 sites with bedding trenches and 10 potential vineyards.

There have been a number of reviews of Roman horticulture in recent years, in both Britain (e.g. Van der Veen 2016) and more widely (e.g. Jashemski 2017), but the only trenching they touch on involves grapes (e.g. Van der Veen 2008, fig. 9b; Jasemski 2017: 133). Van der Veen does however highlight a number of constraints on their geographic distribution of horticulture in Roman Britain.

> Both fruits and vegetables are seasonal, perishable, and not easily stored for long periods of time or transported over large distances (unlike cereal grain and pulses). Large-scale horticulture or market gardening is, consequently, often found concentrated in or near large centres of population and on important transport routes. The current concentration of evidence for horticulture in central-southern and eastern parts of the country matches the distribution of towns and evidence for rural development and wealth (villas, corn-driers, large barns, and so on), suggesting that the logistics of this type of food production was a key factor in its geographical distribution. (Van der Veen 2016: 817)

### Roman sources

A number of Roman writers provided advice on the cultivation of vines, orchards and vegetables, all of which were grown in trenches.

In the mid-second century BC, Cato the Elder wrote a collection of notes on farming in the Sabine Hills west of Rome BC (*De Agri Cultura*, translated Hooper and Ash 1934). His advice involving trenches focused on olives, vines, figs and elm trees, but made no mention of vegetables (Cato 27, 28, 33, 40, 45 in Hooper and Ash 1934).

Varro wrote three books on Roman agriculture (*De Re Rustica*) in 37BC (Hooper and Ash 1934). He discussed orchards and vineyards, but not vegetables. His comments on trenching for planting were limited to the following:

> …for some crops you must make trenches or dig thoroughly or draw furrows, as when you wish to make an *arbustum* [a vineyard trellised on trees] or an orchard; for others you must plough or spade, as when you starting a grain field; for some the earth must be turned more or less deeply with the trenching spade. (Varro 1: 37)

The most extensive surviving handbooks on Roman farming were those written by Columella, who was active in Spain during the first century AD. He wrote twelve handbooks on agriculture (*De Rei Rustica*) as well as one on trees (*De Arboribus*) (Ash 1941, Forster and Heffner 1954/55) . They include two (Books III and IV) dedicated to vines, as well as one in verse and a second in prose on horticulture (Books X and XI).

The last major work on Roman farming was Palladius's *Opus Agriculturae*, written in the fourth or fifth century AD. The core of this work is a description of the farmer's tasks: one book for each month of the year. Palladius includes a discussion market gardening, along with the fruits, nuts and vegetables available to the Romans. Like Columella, he includes a lengthy discussion on vines and wine-making.

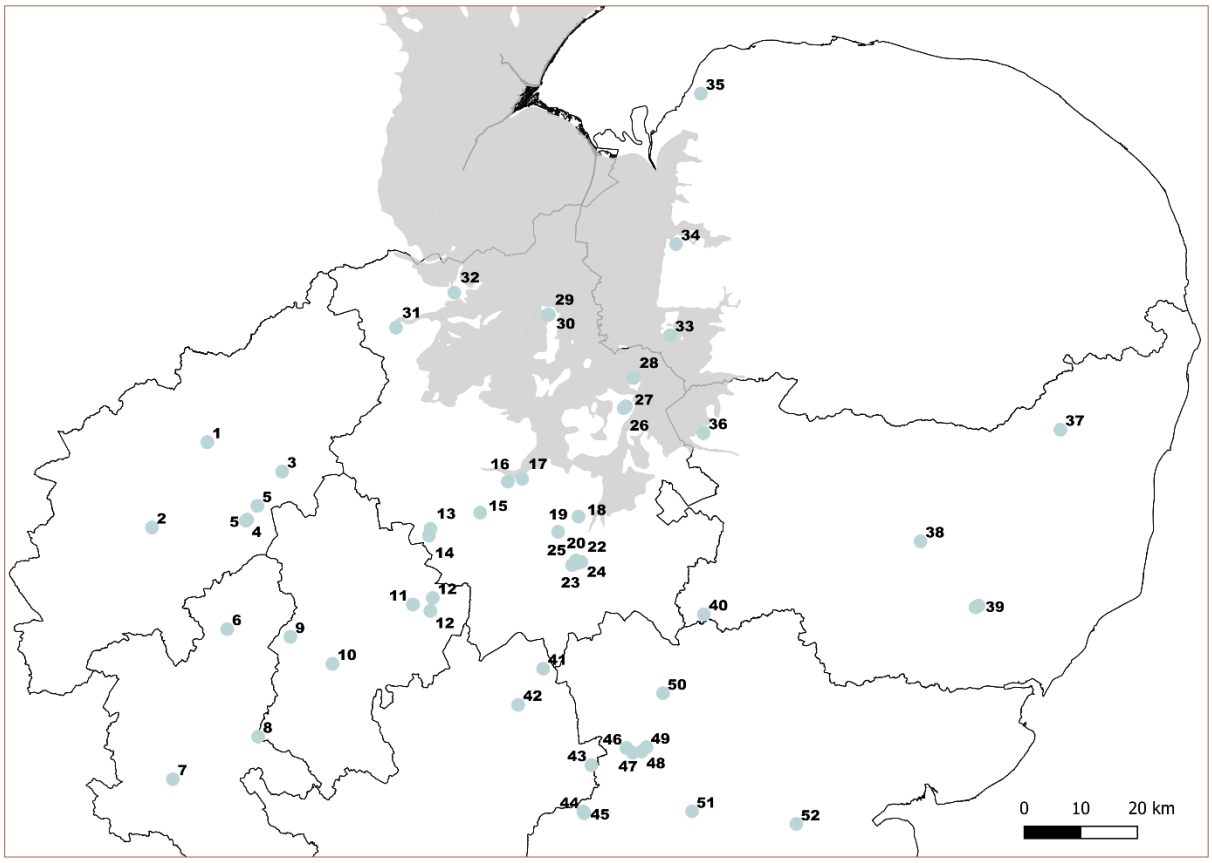
## COLLECTING DATA

The project's search area covered Norfolk, Suffolk, Essex, Cambridge, Hertfordshire, Bedfordshire, Northamptonshire and Buckinghamshire—counties where these features had been recorded previously. The project team searched the Archaeology Data Service (ADS) and Historic Environment Record (HER) for each county to find potential sites which could then be evaluated in detail. This initial search proved to be a frustrating task as there was no one term used to refer to these fields of trenches, but rather a myriad of phrases including *cultivation system/beds/rows/trenches*, *bedding trenches*, *planting beds* and *lazy beds*. A more fruitful source proved to be references in grey literature reports, which led the team to the bulk of sites finally included in the project database. This was far from an ideal search strategy, and certainly one that involved a lot of fruitless reading. A consequence for the project is that, while the search turned up over twice the number of sites than has previously been documented, it is not possible to be sure that all examples in the region were found.

To avoid misidentification of these features in the future, we propose that the term *planting trenches* is used consistently in place of the terms above, so examples can be tagged consistently according to the criteria that discussed in this report. The term *planting trenches* has been selected as it is not amongst those which have been used to date, but it accurately reflects what the function of these trenches appears to be.

In total, 52 sites with certain or possible examples of planting trenches were identified by the team. Their locations are shown in Figure 1 and key data listed in Table 1.

*Figure 1: Location of excavated planting trenches identified by the project team.*



Once the team had identified sites with planting trenches, they entered key data into a spreadsheet. Attributes recorded included:

- site location
- trench length, width, depth and profile
- trench spacing
- pollen/environmental data
- the presence of pottery, including any dates
- the presence of any other finds.

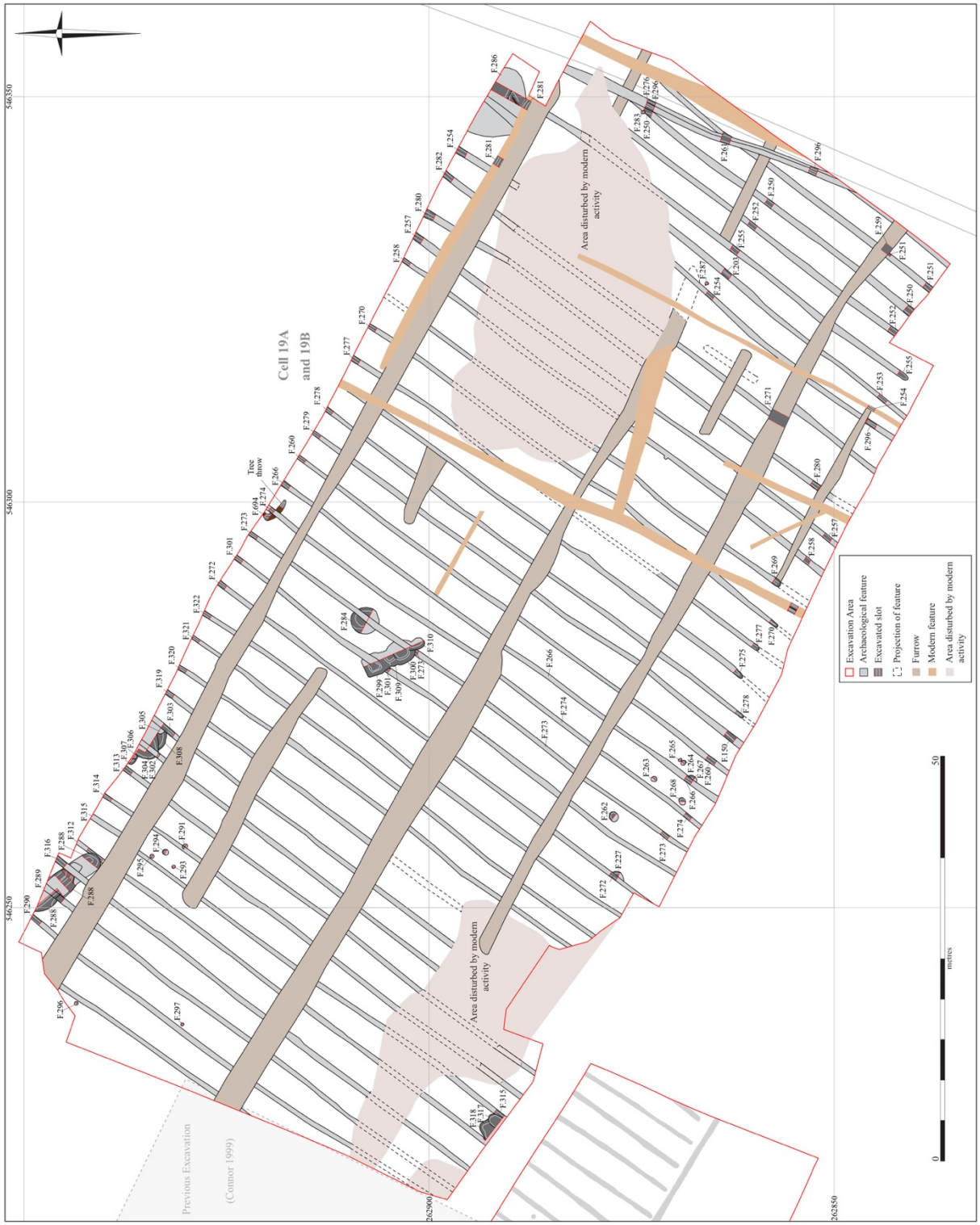
Once the spreadsheet had been finalised, GIS was used to map the sites, and carry out spatial analyses, which are discussed in more detail below. This included distance to Roman-era roads, villas, and watercourses. Geographic data was also used to extract data on soil types and underlying geology.

*Table 1: List of all the planter trenches identified by the project team.*

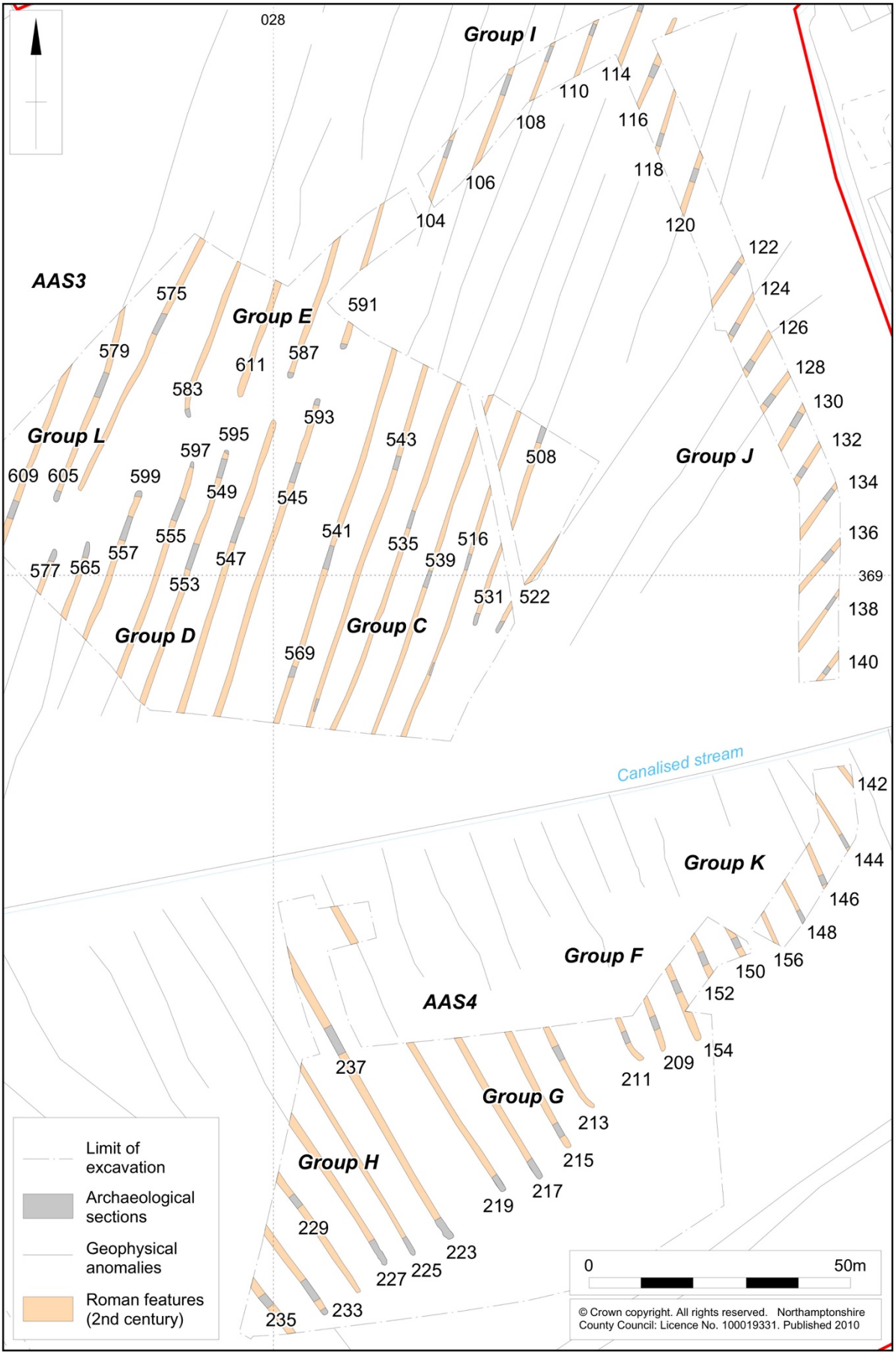
| Map no. | Site name | Reference | County | OS Grid ref. |
|---|---|---|---|---|
| 1 | Mawsley New Village | Hull & Preston 2002 | Nhants | SP 807 760 |
| 2 | South Meadow Road, Upton | Speed *et al.* 2016 | Nhants | SP 70914 60940 |
| 3 | Irthlingborough | Thatcher 2012 | Nhants | SP 939708 |
| 4 | Grendon Quarry | Jackson 1995 | Nhants | SP 877 623 |
| 5 | Wollaston 1, Northern Vineyard | Brown *et al.* 2001 | Nhants | SP 4898 2646 |
| 6 | Stanton Low | Woodfield & Johnson 1989 | Bucks | SP 842430 |
| 7 | Waddesdon Primary School | Kier & Ingham 2006 | Bucks | SP 7461 1652 |
| 8 | Stoke Hammond and Linslade Bypass | Moore *et al.* 2007 | Bucks | SP 89660 24030 |
| 9 | Home Farm, Cranfield | Abrams & Gregson 2005 | Beds | SP 9536 4163 |
| 10 | Tavistock Avenue, Ampthill | Brown 2010 | Beds | TL 0280 3687 |
| 11 | Land West of Kempston | Barker *et al.*2010 | Beds | TL 1700 4735 |
| 12 | Bedford Western Bypass, Kempston | Archer et al. 2008 | Beds | TL 2007 4621 |
| 13 | Love's Farm, St Neots | Hinman 2008 | Cambs | TL 201 607 |
| 14 | Wintringham Park, St Neots | Phillips & Hinman 2009 | Cambs | TL 1980 5950 |
| 15 | Papworth Everard | Atkins 2015 | Cambs | TL 2885 6356 |
| 16 | Low Fen, Fen Drayton | Mortimer 1995 | Cambs | TL 3375 6903 |
| 17 | Swavesey | Dickens & Collins 2011 | Cambs | TL 36290 69500 |
| 18 | Milton Landfill | Collins 2012 | Cambs | TL 4623 6288 |
| 19 | Site VI, North West Cambridge | Timberlake 2014 | Cambs | TL 4262 6017 |
| 20 | Clay Farm, Cambridge | Timberlake 2007 | Cambs | TL 458 551 |
| 21 | Cambridge Biomedical Campus | Phillips 2015 | Cambs | TL 46130 54914 |
| 22 | Bell Language School, Cambridge | Bush & Mortimer 2015 | Cambs | TL 4672 5487 |
| 23 | Addenbrookes Hospital, Cambridge | Phillips 2013 | Cambs | TL 462 547 |
| 24 | Addenbrookes Hospital, Cambridge | Phillips 2013 | Cambs | TL 462 547 |
| 25 | Clay Farm, Cambridge | Dickens & Slater 2008 | Cambs | TL 451 543 |
| 26 | Cam Drive, Ely | Phillips and Morgan 2015 | Cambs | TL 542 820 |
| 27 | Field D, North West Ely | Moan & Phillips 2018 | Cambs | TL 546 823 |
| 28 | Wisbech Road, Littleport | Bush 2010 | Cambs | TL 5592 8733 |
| 29 | Hundred Road, March | Hutton & Standring 2008 | Cambs | TL 4100 9850 |

| Map no. | Site name | Reference | County | OS Grid ref. |
|---|---|---|---|---|
| 30 | March Highways | Thatcher 2009 | Cambs | TL 4075 9848 |
| 31 | Peterborough Business Park | Mackay 2002 | Cambs | TL 1400 9620 |
| 32 | Eye Quarry, Peterborough | Pattern 2004 | Cambs | TF 2430 0240 |
| 33 | Feltwell Rd, Southery. | Emery 2007 | Norf | TL 6241 9486 |
| 34 | Watlington Road, Tottenhill | Town 2003 | Norf | TF 6345 1095 |
| 35 | Heachem | Albone *et al.* 2007 | Norf | TF 67820 37498 |
| 36 | RAF Mildenhall | Tester 2012 | Suff | TL 6831 7763 |
| 37 | Grove Farm, Linstead Magna | Cass 2009 | Suff | TM 313 782 |
| 38 | Cedars Park, Stowmarket | Ennis 2010 | Suff | TM 0660 5850 |
| 39 | Westerfield Road, Ipswich | Holloway & Brooks 2011 | Suff | TM 1685 4715 |
| 40 | Chalkstone Way, Haverhill | Craven 2007 | Suff | TL 6837 4560 |
| 41 | Cokenach Estate | Fletcher 2009 | Herts | TL 3998 3602 |
| 42 | Tylers Close Buntingford | Miciak 2012 | Herts | TL 3557 2964 |
| 43 | Whittington Way, Bishops Stortford | Williams 2008 | Herts | TL 485 190 |
| 44 | Mark Hall School, Harlow | Robertson 2004 | Ess | TL 4707 1082 |
| 45 | London Road North, Harlow | Clover 2015 | Ess | TL 4724 1053 |
| 46 | Stansted Airport | House 2012 | Ess | TL 5469 2203 |
| 47 | Barkers Tanks Site, Takeley | Roberts & Wilkins 2003 | Ess | TL 5580 2120 |
| 48 | Priors Green, Takeley | Germany *et al.* forthcoming | Ess | TL 574 214 |
| 49 | Frogs Hall East | Timby et al. 2007 | Ess | TL 5823 2216 |
| 50 | Sampford Road, Thaxted | | Ess | TL 6115 3170 |
| 51 | Chignall Villa, Chelmsford | Clarke 1998 | Ess | TL 6628 1086 |
| 52 | Langford Road, Heybridge | | Ess | TL 8468 0861 |

*Milton landfill (Collins 2012, reproduced with permission of the Cambridge Archaeological Unit)*



*Tavistock Avenue, Ampthill (Brown 2010: reproduced with permission of MOLA Northamptonshire)*



*Barker's Tanks Site, Takeley, Essex (Roberts & Wilkins 2003, reproduced with permission of Archaeological Solutions)*

## PHYSICAL ATTRIBUTES OF PLANTING TRENCHES

### Trench width

The width of the planting trenches averaged c. 0.6m to 0.8m, and variations were tightly clustered around this central range (Figures 2 and 3). The only site which noticeably extended outside this grouping was *Chignall Villa* which had trenches measuring up to 1.8m, although its minimum value was 0.5m, placing it within the typical values for these features.

*Figure 2: The width of trenches at individual sites*

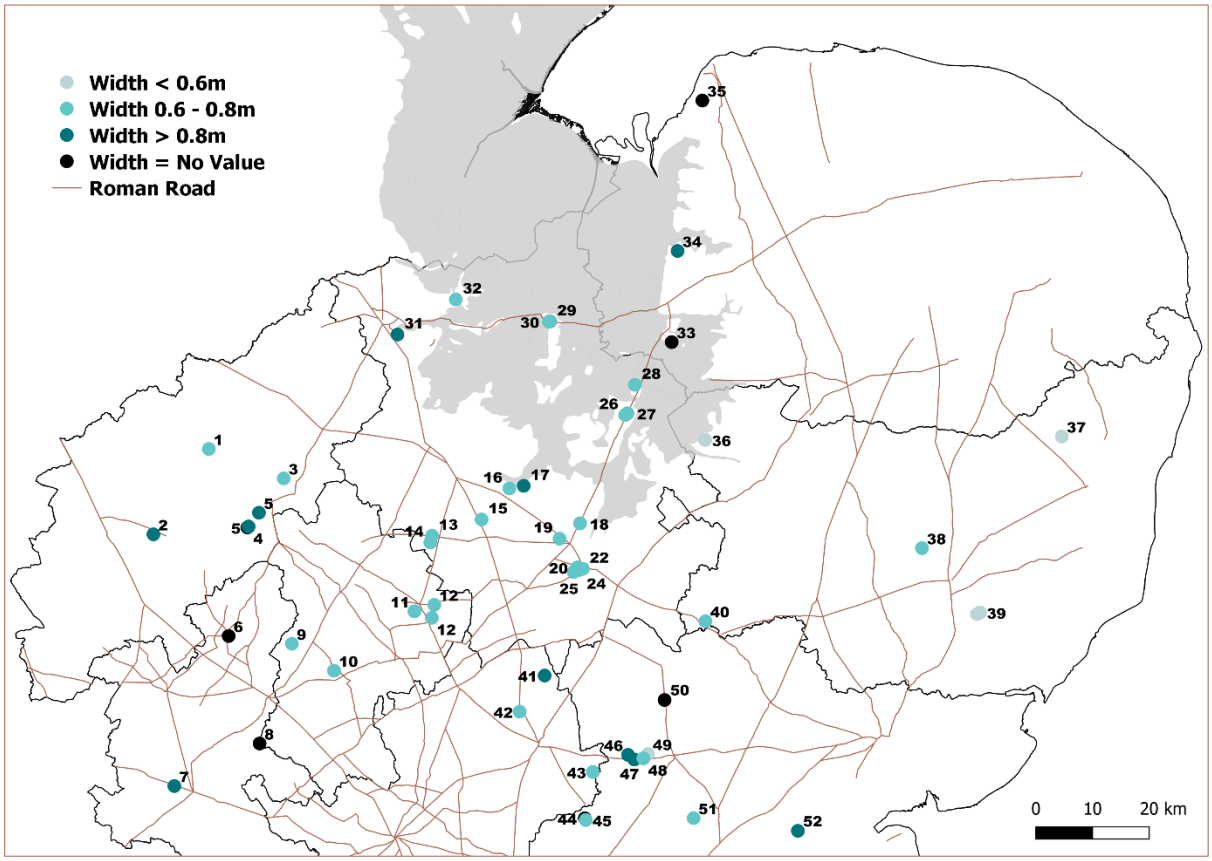
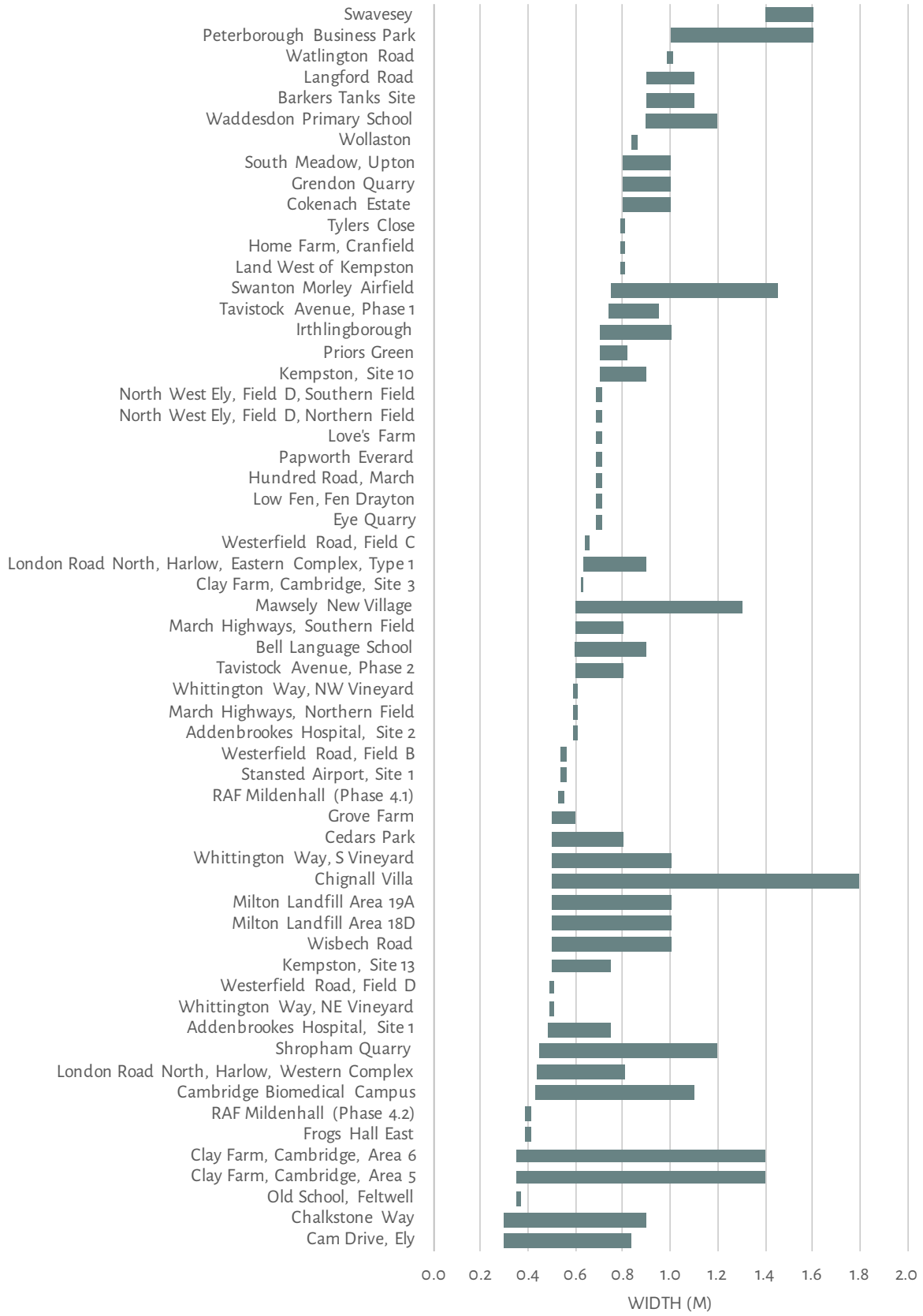


*Figure 3: Graph showing the range of trench widths, arranged from narrowest to widest*



## Trench depth

The depth of the planting trenches also followed a clear pattern, averaging c. 0.25m excavated (Figures 4 and 5). Unfortunately, most sites did not report the depth of the topsoil or estimate the original Roman-era soil depth. However, assuming a ploughsoil depth of 0.4–0.5m, then the trenches would have been about as deep as they were wide.

Three sites had noticeably deeper trenches than the others: *Grendon Quarry*, *Priors Green*, and *Swavesey*. This may indicate they were not planting trenches, although their unusual depth may have been due to by ground conditions or the specific type of crop grown.

*Figure 4: The depth of trenches at individual sites*

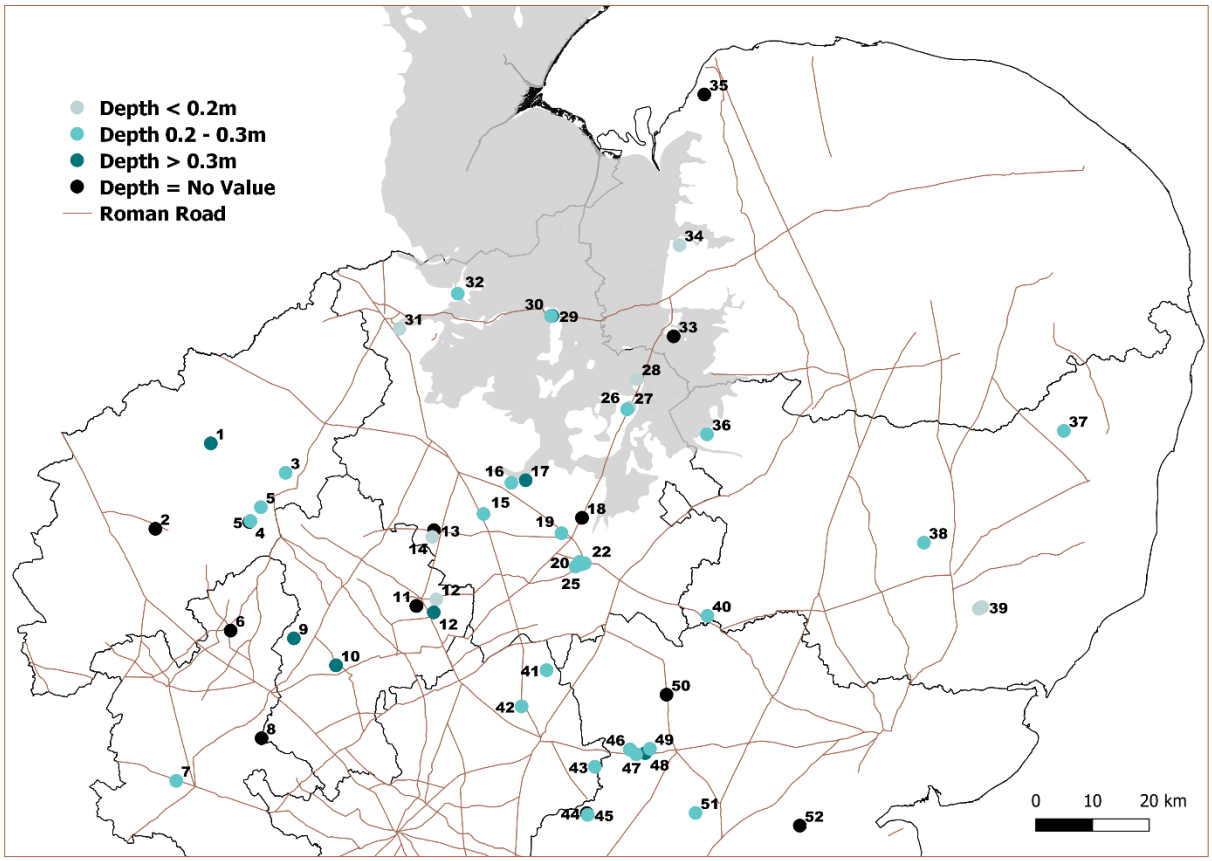
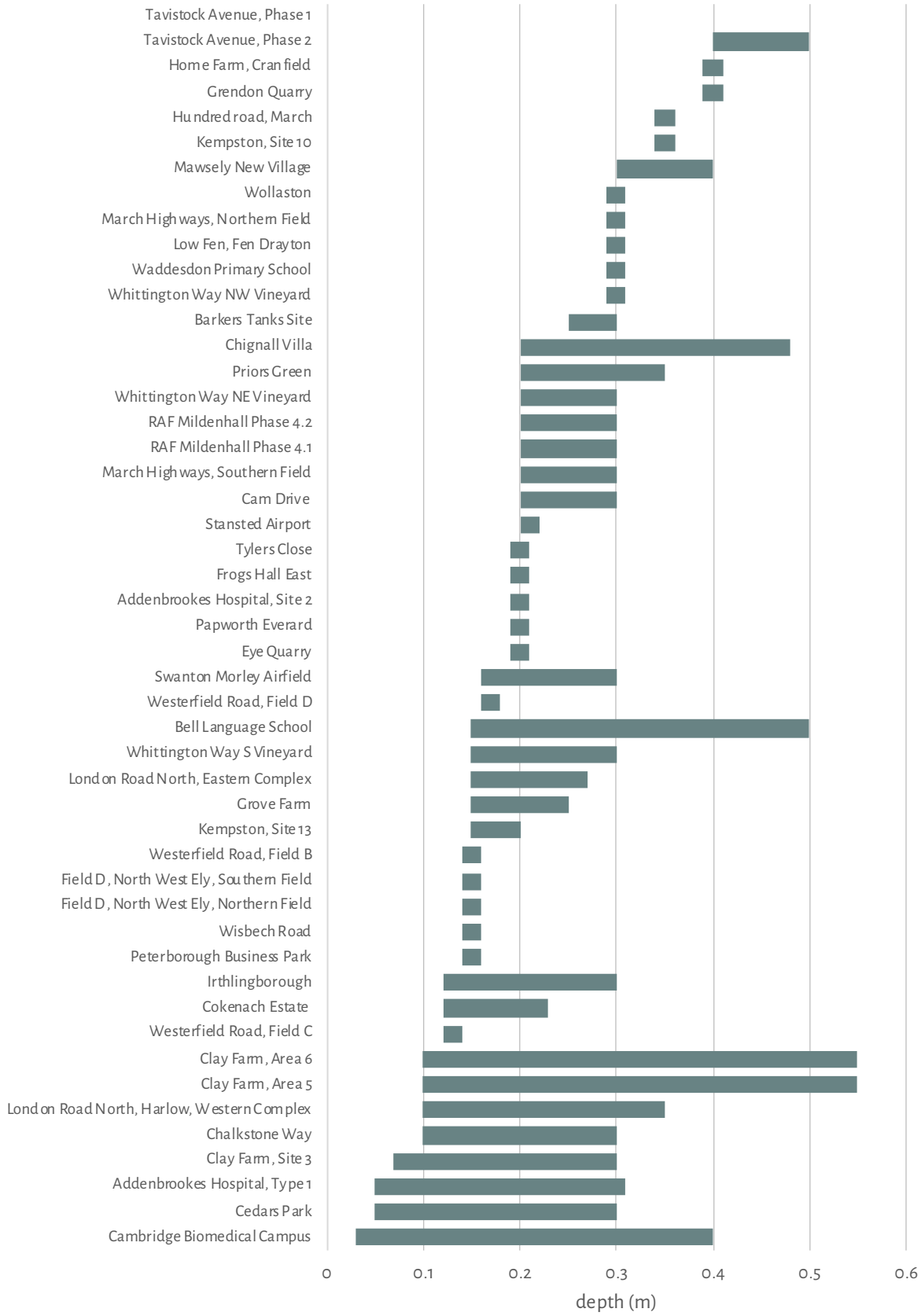


*Figure 5: Graph of trench depth, arranged from shallowest to deepest*



## Trench profile

The profile of the planting trenches was not recorded in every reported instance. The majority were steep-sided with a flat base, although a number had a concave base.

The shape implies the use of a spade to dig the trenches; a pointed suggested previously by Jackson (1995)—although an extensive search by the project team found no evidence of any of the tools used to dig the trenches.

The steep sides and flat base of most trenches implies they could not have been left open to the weather for very long, otherwise the sides would have quickly eroded. This in turn implies that most of the trenches were backfilled promptly after being dug. We will discuss the consequences of this in more detail below.

## Trench spacing

The space between trenches ranged mostly between 3 and 8m, although there were also several outliers (Figures 6 and 7). The site at *Peterborough Business Park* had the smallest spacing of all those considered, at 0.6m, much less than the majority of sites. The widest spacing reported was at *South Meadow Upton*, measuring up to 16m apart. There does not appear to be any geographic clustering in particularly wide or close trench spacing (Figure 6) Despite the range in spacing, the trenches themselves appear to be the same dimensions and profiles as other sites, and contain material of similar dates. For this reasons, they have been classified planting trenches. Their unusual spacing may have simply have reflected the specific requirements of the crop being grown or environmental conditions such as soil or light quality.

*Figure 6: Spacing of trenches across the east of England*

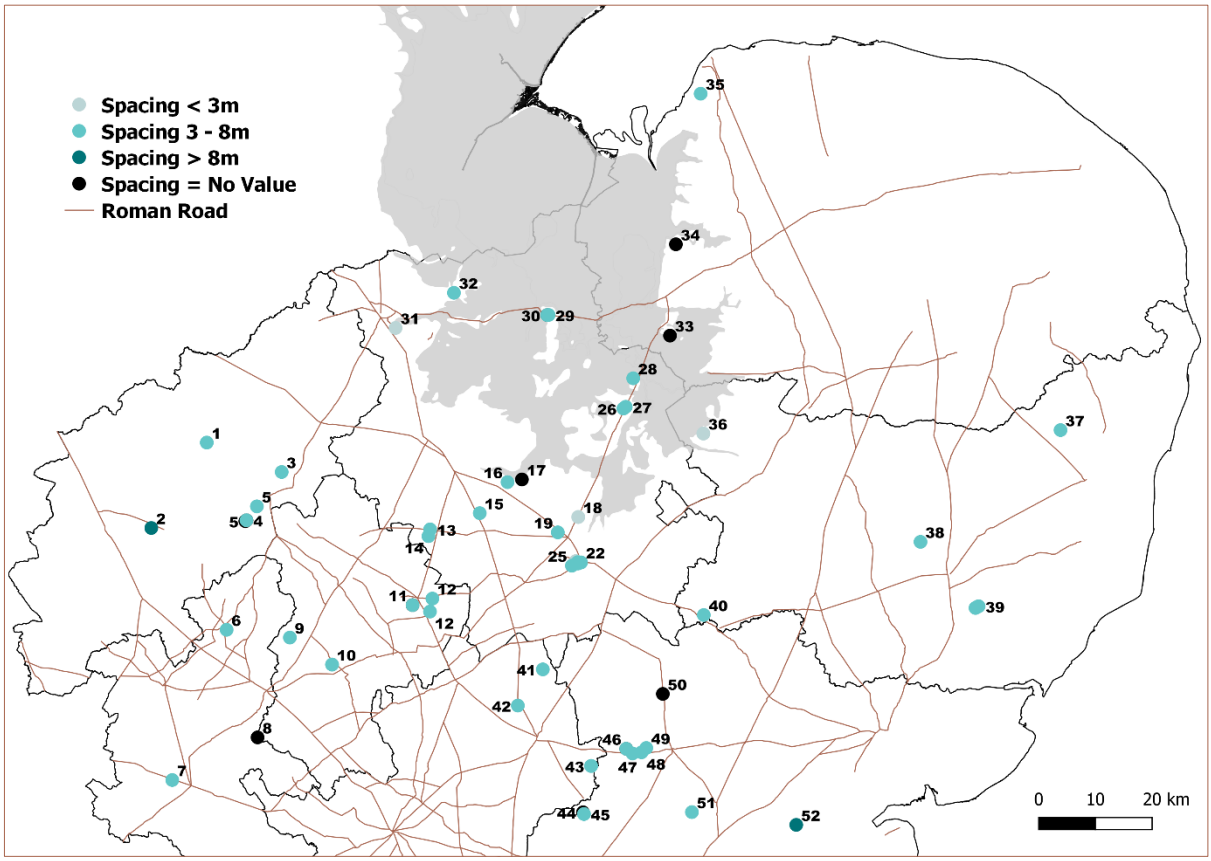
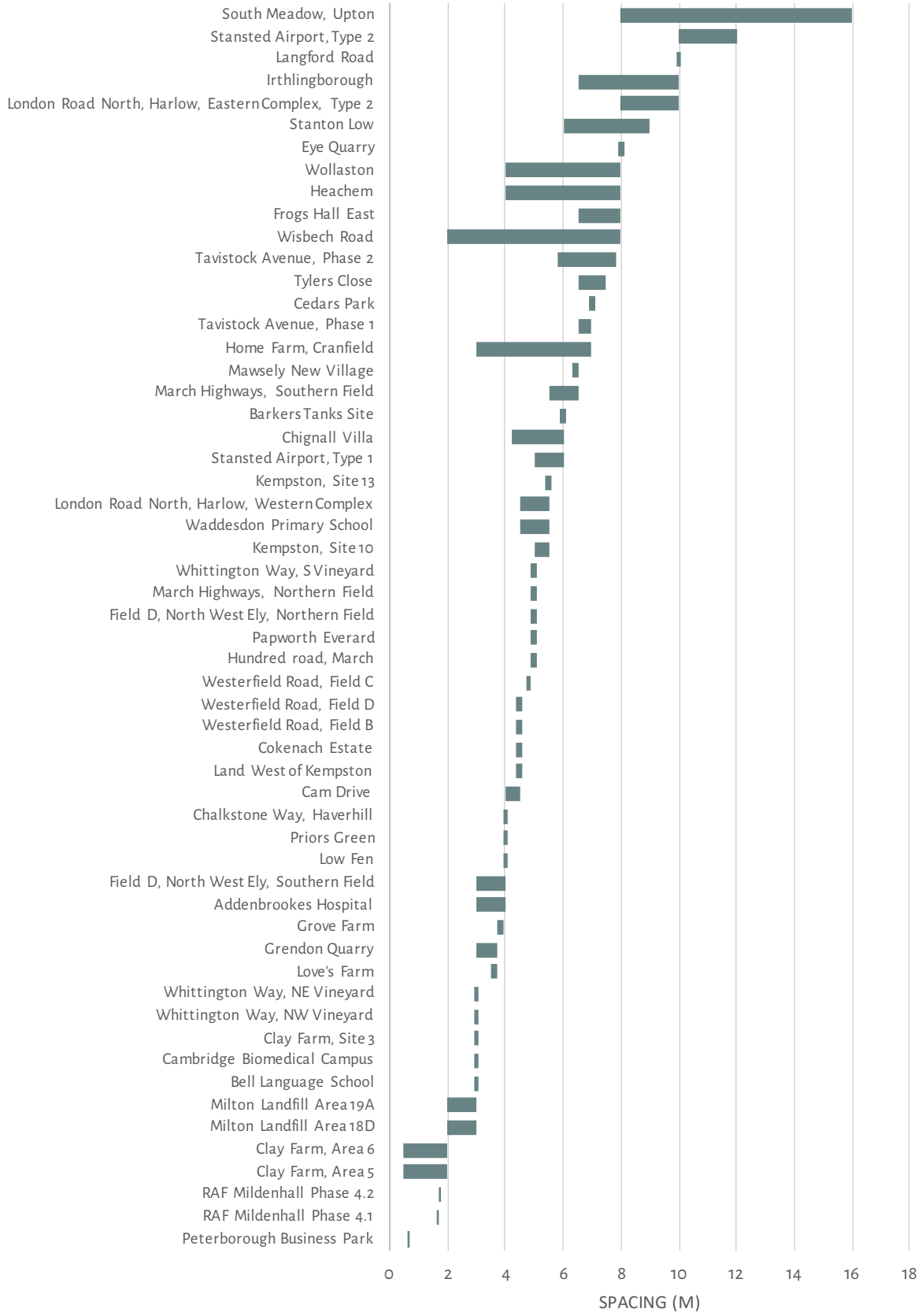


*Figure 7: Graph of the range of trench spaces on individual sites*

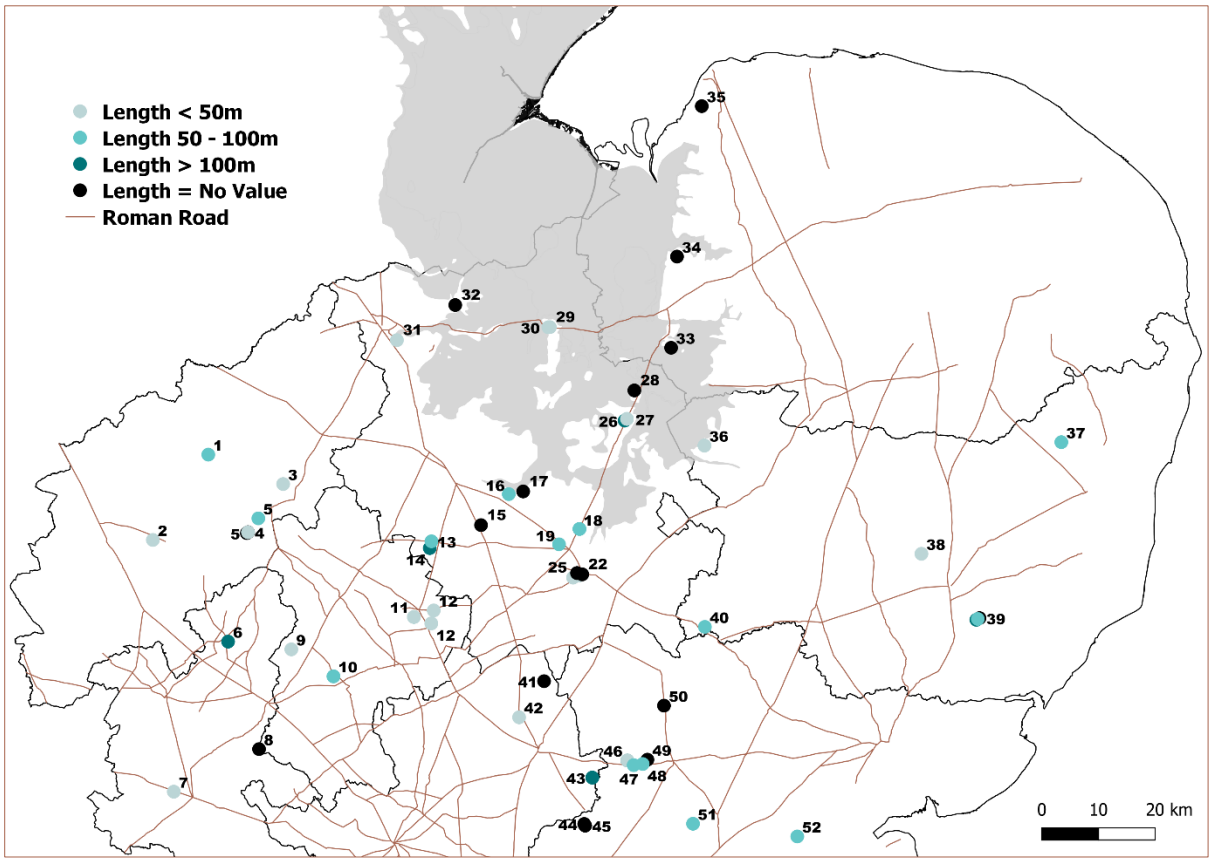


## Length

Of the 52 sites, 16 of the site reports did not record the length of trenches. On the remaining 38 sites, the average length of trenches was 62m, although many of the trenches went beyond the edge of excavation so they would have been longer than is shown in the reports/site plans. There were also a few planter trenches which were broken into different parts, which may have been because they were cut by other ditches or being re-used. Some sites also exhibited trenches that were different lengths such as the *Barkers Tanks Site* which has trenches ranging from 2m to 110m in length. The range trench lengths is shown in Figures 8 and 9.

As the trenches varied in width and spacing, it may be that the same applies to length of strip, indicating different crops were grown depending on the dimensions.

*Figure 8: Graph of the range of excavated trench lengths on individual sites*



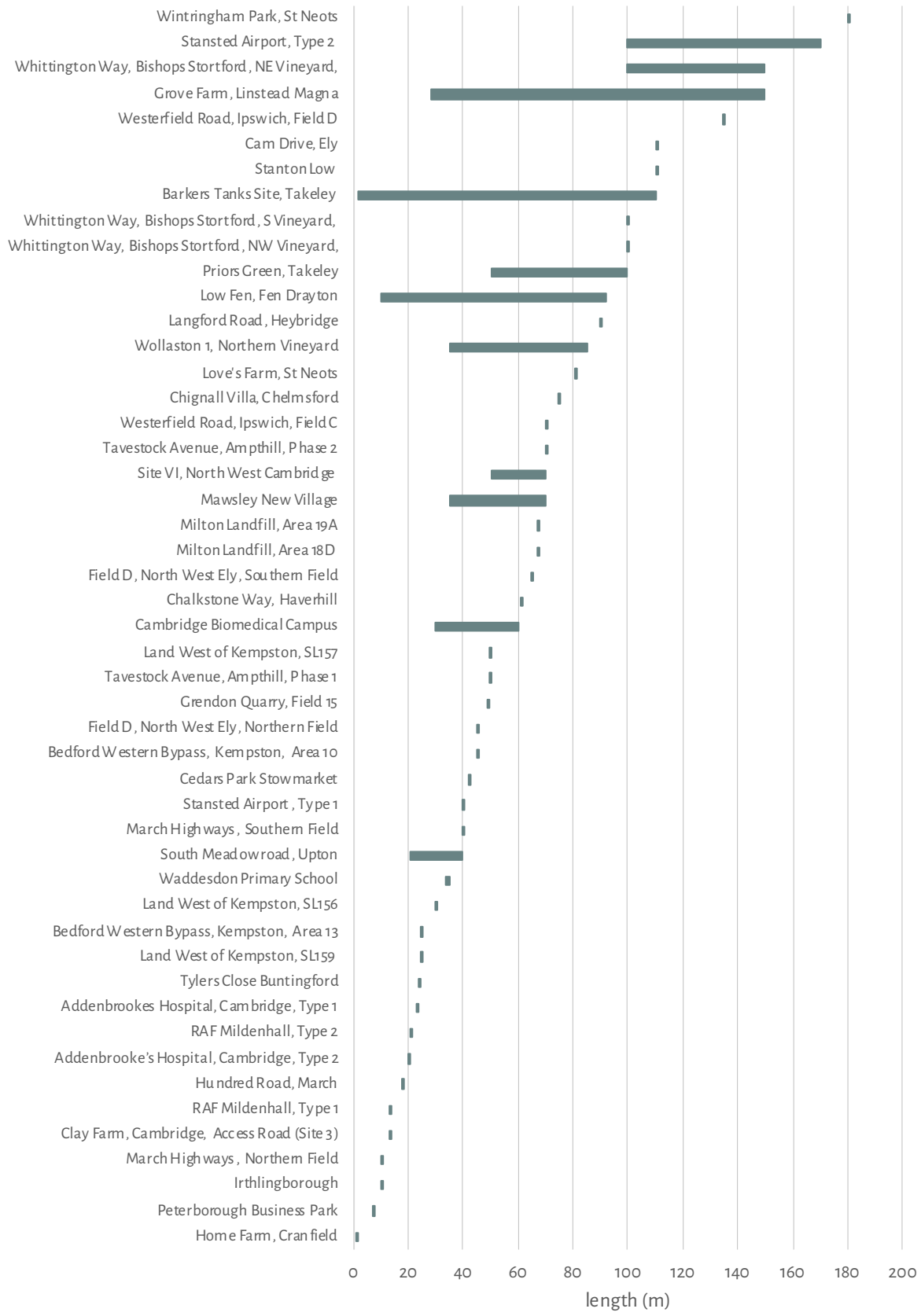



*Figure 9: range of trench lengths on each site.*

## Orientation

The attribute which showed the greatest variability was orientations the trenches had been dug on, with every orientation of the 16-point compass being reported. However, despite these variations, there are trends visible (Figures 10 and 11). One set of results clusters around the NNE-SSW to NE-SW direction, with another cluster grouping around the E-W, NW-SE and WNW-ESE directions. These two opposing groupings further reinforce the idea that a variety of crops are being grown, with the more North to South orientation being preferable for crops requiring steady sunlight exposure, whereas East – West can be best to gain heat during early seasonal planting, as well as being preferable for wind pollenated plants. (Kelly, 2018).

*Figure 10: Orientation of trenches, along with the first order elliptical fit (brown) and second order elliptical fit (green).*

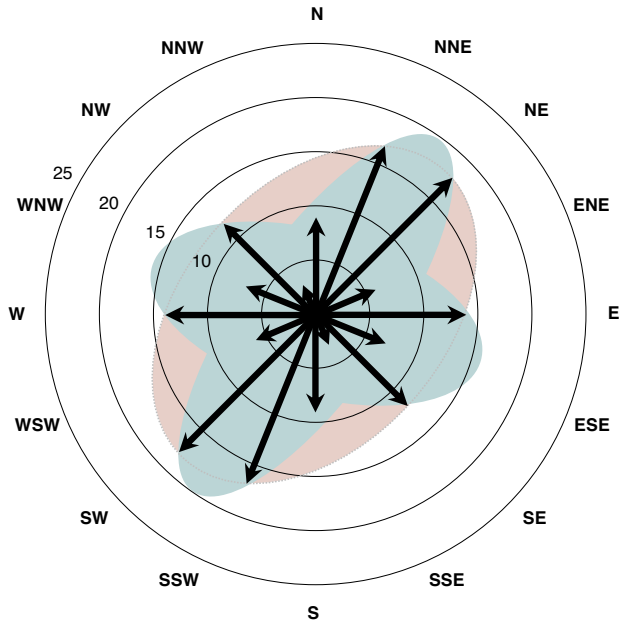
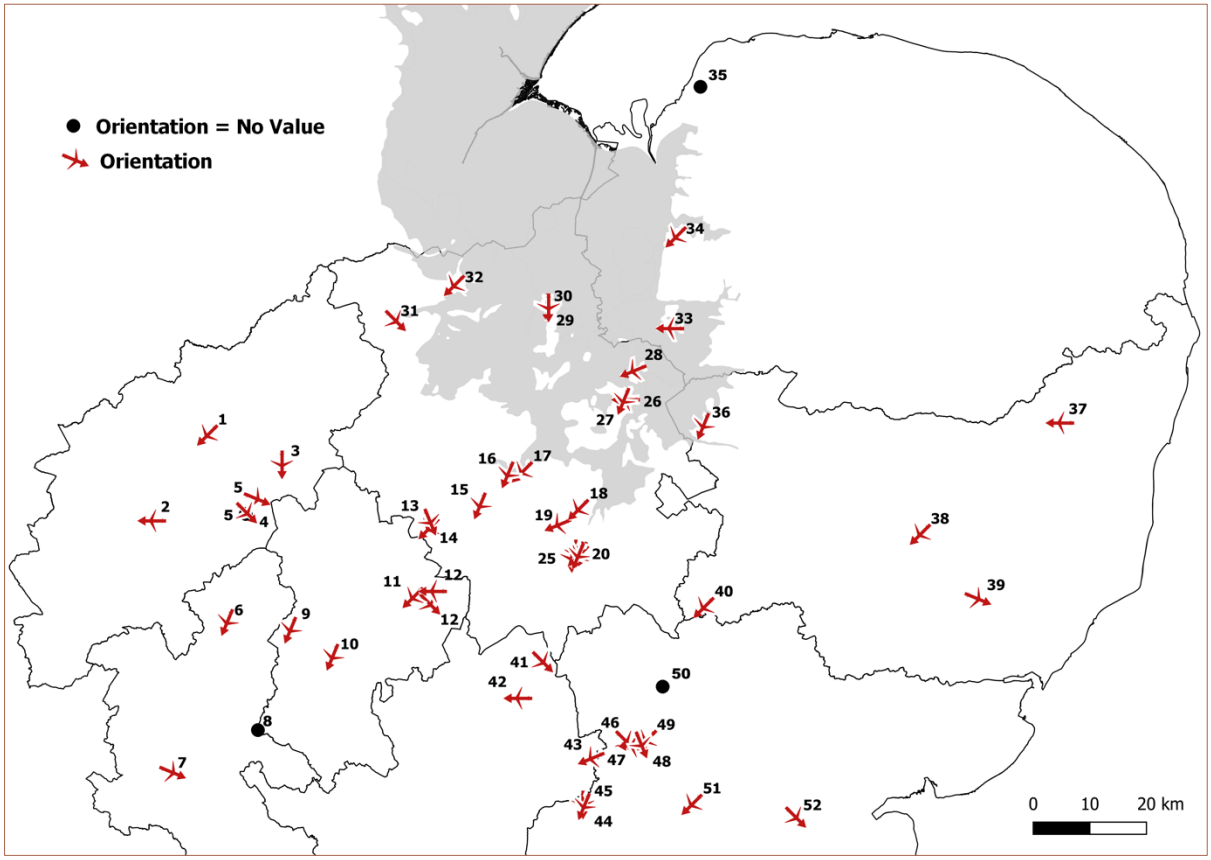


*Figure 11: Orientation of trenches on individual sites*




## Other cut features

Three of the sites (*Wollaston*, *Kempston site 10* and *Mawsley New Village*) produced evidence for post/stake holes. A possible ironstone post packing was also noted at South Meadow Road. The presence of stake holes indicates that wooden posts were being used to the support the crop, this is believed to be evidence of a tall crop being grown. In the Roman era, the most likely candidate appears to be vines (Brown *et al.*, 2001). However, in the case of Mawsley, a lack of dating evidence means an interpretation as a medieval site for hop growing is also possible (Hull and Preston, 2002).

Only Wollaston contained evidence for large root balls, likely formed by vines (*Brown et al.*, 2001), although some evidence for bioturbation was also being noted at Tavistock Avenue, Ampthill (Brown, 2010).

## Comparisons of physical characteristics with Roman sources

Almost all of the detailed Roman advice on digging trenches for cultivate vines. The most detailed guidance is that provided by Columella in *De Re Rustica*, who outlines three basic forms: individual planting bowls, furrows or in trenches (*pastinatio*).

The depth of trenches he suggests depends on the slope of the land (Columella *RR* 3:13):

- 2½ *pedes* (c.75cm) on level ground
- 3 *pedes* (c.90cm) on sloping ground
- 4 *pedes* (c.120cm) on steep ground
- at least 2 *pedes* (c.55 cm) in sunken valleys
- no more than 1½ *pedes* (c.45cm) in marshy ground.

For the mostly flat lands of eastern and central England, the first seems the most appropriate value, and the estimated depth of trenches recorded is a fair to match to this figure (assuming a topsoil of 40–50cm).

Columella does not specify a width for the vine trenches. He does however recommend use of a tool terms a *ciconia* (Columella RR 3.13).Normally T-shaped, Columella recommends the addition of a cross, "in order to prevent disputes". What he means by this is not entirely clear, but it might be that adding two pieces of wood set at right angles would indicate both that the profile was square and the depth equalled the width. On this premise, then the typical width of the trenches reviewed (c. 60–80cm) is a fair match to their estimated depth. Thurmond (2017), who details the expected characteristics for planting trenches used in viticulture through excavations of known sites in Europe, notes that the widths of trenches in vineyards around Rome are a uniform 80–90cm wide.

There are marked divergences between Columella's advice on the spacing of trenches, and what has been found in British excavations. He advises five *pedes* (c.150cm) between the trenches in lean ground, six *pedes* (c.175 cm) in medium soil, and seven pedes (205 cm) (Columella *RR* 3.13)—equivalent to a spacing of 225–280 cm. Almost all of the examples reviewed were much more widely spaced than this (average 4.5–5.5m). This does not automatically mean that UK examples were not used for vineyards. Thurmond's (2017) review of excavated vineyards reports a wide range of spacings. Excavations at Thermi and Pella in Greece uncovered narrowly-spaced vines, but vineyards excavated to the south of Rome itself range from 3 to 10m.

In his discussion of planting by furrows rather than *pastinatio*, Columella does mention farmers ploughing between their vines, indicating that they might be growing other crops between (intercultivation). Varro (*De Re Rustica* 1.23.6) speaks of growing vegetables between young vines, in order to provide a high yield for the farmer. Thurmond (2017), notes intercultivated crops planted in vineyards need trenches to be more widely spaced. White (1970) also highlights intercropping, stressing that monoculture crops—such as cereals or a self-contained vineyard—was rare, while intercultivation of all species, including vines was common practice. Intercultivation option does not appear to have been considered in the interpretation of trenches in Britain, and will be discussed in more detail below.

**Planting trenches or lazy beds?**

Although we are described the features as 'planting trenches' there is a second potential interpretation which heed to be addressed: lazy beds. These are raised planting beds, with drainage ditches between them, used to grow many vegetables, tubers in particular. This technique is described in more detail by Pliny:

> The ground … should be divided into plots or beds with raised and rounded edges, each of which should have a path dug round it, by means of which access may be afforded to the gardener and a channel formed for the water needed for irrigation. (Pliny, *Natural History* 19.20)

There are several features of the planting trenches which suggest the they were generally not part of lazy beds systems. First is that most of the trench profiles have steep or vertical sides, and most have flat bases. If such trenches were left open for even one year, they would show evidence for erosion and silting. Second, several of the excavated sites reveiwed suggest relatively fast backfilling of the trenches, including Grendon Quarry (Jackson, 1995), Home Farm Cranfield (Abrams and Gregson, 2005) and Bell Language School (Bush and Mortimer, 2015). This would make it unlikely that the trenches were used for drainage.

A third argument against this interpretation is the space of the trenches,. When discussing the spacing of garden beds, Columella says that they must be spaced so as to:

> ensure that the weeders' hands easily reach halfway across their width, so when they follow up weeds they won't have to tread on the seeds. Instead, they can walk along paths, and weed half beds turn and turn about.' (Columella, *DRR*, 11.3).

The planting trenches are spaced an average 4.5–5.5m, with around a fifth spaced up to 8 metres apart. Plainly this is far too wide for gardeners to reach halfway across, unless very generous paths were planned (which would reduce the effectiveness of the trenches for drainage).

Another objection is the orientation of trenches on some sites: they are set in ways that would not allow for either drainage or irrigation, such as Fen Drayton (Mortimer 2015) and Cambridge Biomedical Campus (Philips 2015), where sets of trenches are set at ninety degrees to one another on flat ground.

Altogether then, there no evidence that most of the planting trenches were used as part of lazy beds.

## FINDS IN PLANTING TRENCHES

### Pottery

Pottery assemblages from the Planting Trenches are almost invariably small and abraded. The bulk of the pottery dates to the Iron Age and Roman periods, with a few producing residual Bronze Age/Early Iron Age sherds or intrusive medieval and post-medieval material. Unfortunately, the pottery on many sites is only broadly dated as 'Roman' or 'Romano-British', but where close dating of individual pieces is reported, the bulk of the material comes from the Late Iron Age and Early Roman periods, with the majority of types present going out of production by the mid-second century AD. LIA and Early Roman pottery is reported in roughly equally number of sites, which suggests the majority of sites were dug in the first century AD, rather than well into the second (by which time, much of the handmade IA pottery in the topsoil would have disintegrated). There are just a handful reports which suggest a specifically second or even third century date (One trench at *Eye*, and also at *Feltwell* where the excavators attributed the slots to drainage).

Sherds were generally very small, averaging 3 to 7g on sites. They are also typically abraded and refits were very uncommon. Together this suggests the pottery had been in the soil for some time before being deposited. There is direct evidence from some sites of middening. Brown *et al.* (2010, 37) report that some sherds at Tavistock Avenue "retained cessy accretions". Wadeson (in Bush 2010, 18) reports that "The poor condition of the pottery [at Wisbech Road, Littleport] indicates high levels of post-depositional disturbance possibly the result of middening and/or manuring as part of the waste management during the Roman period". And Barker *et al.* (2010, 68) report that, on Land West of Kempston "In some fields, …, the trenches were filled with dark deposits containing moderate quantities of domestic debris including pottery. … It is presumed that the dark, almost midden-like, deposits were deliberately placed in the trenches to improve the quality of the soil, which would otherwise be dominated by clay" (Luke 2016: 293).

### Other Finds

21 of the 52 sites identified contained 'other finds' aside from pottery (Table 2). These include metal objects, CBM, tiles and animal bone.

*Table 2: non-pottery finds from planting trenches.*

| Map No. | Site Name | Finds |
|---|---|---|
| 2 | South Meadow Road, Upton | Animal bone. |
| 9 | Home Farm, Cranfield | Animal bone, iron nail, fired clay. |
| 10 | Tavestock Avenue, Ampthill | Late Iron Age /Romano-British CBM: 'Belgic' bricks (6 sherds) and tegulae (2 sherds). |
| 11 | Land West of Kempston | Animal bone, occasional iron objects (nails and knife), a bronze bracelet and an iron knife. Presumed to come from middens on a nearby settlement and brought to the trenches as compost. |
| 13 | Love's Farm, St Neots | Site at large: metalwork, glass, animal bones, quern stones. |
| 14 | Wintringham Park, St Neots | Animal bones, slag. |
| 19 | Site VI, North West Cambridge | Metalwork (mostly post-medieval, 1 Roman hobnail), animal bones (26 identifiable fragments cattle, sheep/goat, horse common, also pig and red deer antler). |
| 20 | Clay Farm, Cambridge | Flint flakes (likely residual). |
| 21 | Cambridge Biomedical Campus | Fragment of CBM |
| 22 | Bell Language School, Cambridge | Oyster shell (4g). |

| Map No. | Site Name | Finds |
|---|---|---|
| 25 | Clay Farm, Cambridge | Animal bone, burnt stone, flint, tile. |
| 26 | Cam Drive, Ely | Animal bone, fired clay, CBM, residual struck flint. |
| 27 | Field D, North West Ely | Animal bone (2g). |
| 31 | Peterborough Business Park | 240g animal bone. |
| 33 | Feltwell Rd, Southery. | Worked flint. |
| 37 | Grove Farm, Linstead Magna | Single flint, fired clay, large mammal carpal bone. |
| 38 | Cedars Park, Stowmarket | Some metal work, baked clay, and flint, five pieces of animal bone. |
| 40 | Chalkstone Way, Haverhill | Flints |
| 45 | London Road North, Harlow | Copper alloy bell and coin on top of ditches, tile found nearby |
| 47 | Barkers Tanks Site, Takeley | CBM, brick, tile. |
| 49 | Frogs Hall East | Flint (bladelike). |

One of the sites, Land West of Kempston, contains evidence for an iron knife. It is noted that for viticulture, pruning hooks or knives were used to ensure efficient harvesting but the evidence for them is severely lacking in Roman Britain compared to the wider Roman Empire. What is suggested by some authors is that the work force, either through unfamiliarity or due to a lack of *falx vinitaria* blades, were indifferent to utilizing specialised tools and made use of existing Iron-Age or Roman forms (Brown *et al*. 2001: 754). It may be possible that this is what occurred at Land West of Kempston as the trenches here have been interpreted as being used for growing vines or fruit trees (Barker *et al*. 2010). The site is 1.34km from a Roman road, 9.16km from a villa and approximately 20km south of a Roman settlement and a number of villas where there is a strong road network leading to these centres. Though this sounds promising, the report does make it clear that the knife is potentially from a midden nearby rather than being directly associated with the cultivation strips themselves, so it is unclear if the tool was used in correlation with the trench. A more apt conclusion could be that the knife was associated with the populace around the site rather than the function of the trenches.

57% of the sites which contain Other Finds have animal bone. Further investigation would need to occur to determine exactly what kind of animals these were, but initial correlations can be made between these discoveries and the environmental data of the sites where bone is present. As noted above, legumes can be used for animal feed, as can grain. The sites of Loves Farm, Wintringham Park and Cam Drive all show that legumes and cereal types such as spelt were present in their environmental samples so they could have been grown for animal feed. This is particularly interesting if the argument for the trenches being used for the Roman Army is considered. The amount of animal labour that would be used to construct infrastructure would be immense and therefore these sites support that.

## ENVIRONMENTAL EVIDENCE

Environmental samples were taken from 33 of the sites in the dataset with 26 sites directly sampling the planter beds or features dated to the same site phase (see table 1). Eight sites included mollusc analysis and thirteen sites were sampled for pollen, of which eight produced results. It should be noted that eight of the sites were evaluations which produced fewer samples.

Tables 3–7 summarise the presence of the contemporary plant and mollusc remains on each site. Further detail can be found in the project archive.

References to site reports refer to the main author(s). Please refer to the specialist contributions of each report for the original results and interpretation.

*Table 3: Total number of species identified from sites where environmental samples were taken. *indicates evaluations*

| Site name | food plant total | weed total | pollen total | mollusc | total entries |
|---|---|---|---|---|---|
| March Highways | 2 | 13 | 14 | 0 | 29 |
| Cambridge Biomedical Campus | 3 | 12 | 12 | 0 | 27 |
| Ampthill, Tavistock Avenue | 1 | 3 | 23 | 0 | 27 |
| Cambridge, Clay Farm, Access Road (Site 3) | 2 | 3 | - | 18 | 23 |
| RAF Mildenhall | 5 | 18 | - | 0 | 23 |
| Kempston, Bedford Western Bypass | 5 | 11 | 6 | 0 | 22 |
| March, Land off Hundred Road* | 5 | 3 | - | 13 | 21 |
| St Neots, Wintringham Park* | 2 | 18 | - | 1 | 21 |
| Wollaston 1 | - | - | 21 | 0 | 21 |
| Peterborough, Eye Quarry | 5 | 13 | - | 0 | 18 |
| North West Cambridge, Site VI, *(mostly uncharred may be intrusive)* | 0 | 4 | 8 | 6 | 18 |
| Swavesey In-Track Site | 4 | 10 | 0 | 0 | 14 |
| Ipswich, Westerfield Road* | 7 | 4 | - | 0 | 11 |
| Bishops Stortford, Whittington Way* | 4 | 2 | - | 5 | 11 |
| Upton, South Meadow Road | 2 | 5 | 3 | 0 | 10 |
| Cambridge, Bell Language School | 2 | 0 | 7 | 0 | 9 |
| Feltwell Road* | 2 | 6 | - | 0 | 8 |
| Cambridge, Addenbrookes Hospital, Southern Perimeter Road | 3 | 4 | - | 0 | 7 |
| Chelmsford, Chignall Villa | 1 | 1 | 0 | 3 | 5 |
| Haverhill, Land off Chalkstone Way | 4 | 0 | - | 1 | 5 |
| Harlow, London Road North | 3 | 0 | - | 1 | 4 |
| Ely, Cam Drive | 2 | 1 | - | 0 | 3 |
| Bacton to Kings Lynn pipeline* | 2 | 0 | - | 0 | 2 |
| Land West of Irthlingborough* | 2 | 0 | - | 0 | 2 |
| Land West of Kempston | 2 | 0 | 0 | 0 | 2 |
| St Neots, Love's Farm, | 2 | 0 | 0 | 0 | 2 |
| Mawsley New Village | 2 | 0 | - | 0 | 2 |
| Littleport, 98–120 Wisbech Road | 0 | 0 | - | 0 | 0 |

| Site name | food plant total | weed total | pollen total | mollusc | total entries |
|---|---|---|---|---|---|
| Cambridge, Clay Farm, Access Road (Areas 5 and 6)* | 0 | 0 | - | 0 | 0 |
| Cokenach Estate | 0 | 0 | - | 0 | 0 |
| North West Ely, Land at Field D | 0 | 0 | - | 0 | 0 |
| Stansted Airport (Hotel Site) | 0 | 0 | 0 | 0 | 0 |
| Total | 13 | 53 | 38 | 30 | |

**Plant macrofossils in the Planting Trenches**

Environmental samples were taken specifically from planting trenches on eight sites (Table 4).

- At Chalkstone Way, Haverhill, five of the eleven trenches were sampled. The samples produced fewer than ten specimens of wheat (*Triticum* sp.) including spelt (*T. spelta*), indeterminate cereals, charcoal fragments, and occasional black tarry material. It was concluded that the majority of the assemblage was the result of wind-blown debris being incorporated into the feature (Craven 2007, 22-23 not included in the references).
- One sample was taken from the bedding trenches at London Road, Harlow. It contained frequent charcoal fragments, single specimens of charred Barley (*Hordeum* sp.) and wheat grains (Clover 2015, 130).
- At the Bell Language School, Cambridge, eight samples contained carbonised remains, but none were from the planter beds (Bush and Mortimer 2015, 127).
- Four of the thirteen samples taken at Hundred Road, March, were taken from planter beds. All produced occasional remains, mostly cereals: barley and wheat and the glume base of emmer wheat (*T. dicoccum*). There were also singular examples of indeterminate cereal grains and hulled wheat (Hutton and Standring 2008, 33).
- At the Cambridge Biomedical Campus, 59 samples were taken from Roman features, including ten from the planter beds. One of the latter produced occasional and poorly-preserved grains of spelt (Phillips 2015, 99).
- A single planter bed was sampled at Cam Drive, Ely. It contained only sparse charcoal fragments (Phillips and Morgan 2015, 119).
- Three planter beds were sampled Field D North-West Ely. Only one yielded sparse charcoal (Moan and Phillips 2018, 142).
- A single planter bed was sampled at Site VI of the NW Cambridge excavation contained only untransformed seeds (Timberlake 2014, 25).

The scarcity of plant macrofossils in the planter beds coincides with the general lack of pottery and other preserved remains. The limited presence and poor preservation/abrasion of both suggests an origin in field manuring with midden material was applied as a surface mulch. Grain burnt in the field would have resulted in greater quantities being incorporated into the bedding trenches.

**Plant macrofossils from contemporary deposits**

The lack of plant macrofossils found within the planter beds makes it necessary to look at the broader assemblages from contemporary deposits (Table 4), although the degree of contemporality is tentative due to general lack of dating of the planter beds. Where the beds have been dated as LPRIA/ER, contemporary plant assemblages are sparse in density and diversity which may be suggestive of the focus of food production being on the crops from the planter beds. The plant remains recovered provide evidence of varied cultivation practices that is somewhat dependent on the underlying geology: arable farming on tilled or disturbed ground, wetland exploitation, and cultivation on marginal soils.

*Table 4: Potential food plant species by site, X= sample taken from planting trenches Y= samples taken from other features contemporary with the planting trenches.*

| Site name | Generic wheat (*Triticum sp.*) | Spelt wheat (*T. spelta*) | Emmer wheat (*T. dicoccum*) | Generic hulled wheat (*T. diccocum/spelta*) | Free threshing wheat (*T. aestivum/compactum*) | All *Tricium* | Barley (*Hordeum sp.*) | Beans (*Fabaceae* cultivated) | Peas (*Pisum sativum*) | Oats (*Avena sp.*) | Rye (*Secale cereale*) | Cereals indet. | Carrot (*Daucus carota*) | Hazelnut (*Corylus avellana*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cambridge Biomedical Campus | | X | | | | X | Y | | | | | | Y | |
| March, Hundred Road | X | | X | X | | X | X | | | | | X | | |
| Haverhill, Chalkstone Way | X | X | | | | X | | | | | | Y | | X |
| Harlow, London Road North | X | | | | | X | X | | | | | | | Y |
| North West Cambridge, Site VI | | | | | | | | | | | | | | |
| RAF Mildenhall | Y | Y | Y | | | Y | Y | | Y | | | | | |
| Peterborough, Eye Quarry | Y | Y | Y | | | Y | Y | | | | | Y | | |
| St Neots, Wintringham Park | | | | | | | | | Y | Y | | | | |
| Ipswich, Westerfield Road | Y | Y | | | Y | Y | Y | | | Y | | Y | | Y |
| Swavesey In-Track Site | | Y | | | Y | Y | Y | | | | Y | | | |
| Kempston Western Bypass | | | | Y | | Y | Y | Y | | Y | Y | | | |
| Southery, Feltwell Road | Y | | | | | Y | Y | | | | | | | |
| Upton, South Meadow Road | | | | Y | | Y | Y | | | | | | | |
| Bishop Stortford, Whittington Way | Y | Y | | Y | | Y | | | | | | Y | | |
| March Highways | | Y | | | | Y | | | | | | Y | | |
| Cambridge, Addenbrookes | | Y | | Y | | Y | Y | | | | | | | |
| Cambridge, Clay Farm | Y | | | | | Y | Y | | | | | | | |
| Ampthill, Tavistock Avenue | | | | | | | Y | | | | | | | |
| Chelmsford, Chignall Villa | Y | | | | | Y | | | | | | | | |
| Cambridge, Bell Language School | | Y | | | | Y | Y | | | | | | | |
| Land West of Kempston | | | | Y | | Y | | | | | | Y | | |
| Land West of Irthlingborough | | | | | Y | Y | | | | Y | | | | |
| Mawsley New Village | Y | | | | | Y | Y | | | | | | | |
| St Neots, Love's Farm | | | | | | | | Y | | | | Y | | |
| Bacton to Kings Lynn pipeline | Y | | | | | | | | | Y | | | | |
| Ely, Cam Drive | | | | | | | Y | Y | | | | | | |
| **Total from planting trenches** | **3** | **2** | **1** | **1** | **0** | **4** | **2** | **0** | **0** | **0** | **0** | **1** | **0** | **1** |
| Total from wider site | 9 | 8 | 2 | 5 | 3 | 16 | 14 | 3 | 2 | 5 | 2 | 7 | 1 | 2 |
| Total from site | 12 | 10 | 3 | 6 | 3 | 20 | 16 | 3 | 2 | 5 | 2 | 8 | 1 | 3 |

Cereals are the most common charred plant remains present with hulled wheat predominant and barley (most commonly six-row barley) having the second highest ubiquity. This is consistent with the crops being cultivated in Roman Britain, particularly in the east of England (Lodwick 2017, 18). Other possible cultivars include cabbage/turnip family (*Brassica* sp.), flax/linseed (*Linum usitatissimum*) and fodder crops of vetch/tares (*Vicia/Lathyrus* sp.). However, each of these taxa include wild varieties that may have been growing as weeds such as the waterlogged carrot (*Daucus carota*) seeds, indistinguishable as the wild or cultivated variety, recovered from Cambridge Biomedical Campus (Phillips 2015).

Plant macrofossils representing weeds have been recovered in greater density and diversity and mainly provide evidence of the flora either growing around the site or harvested with a cultivated crop. The most common taxa appear to be plants of disturbed soils such as docks (*Rumex* spp.), Orache/ goosefoots/ (*Atriplex/Chenopodium* spp.), stinging nettle (*Urtica dioica*) and knotgrass (*Polygonum aviculare*), with some taxa particularly likely to be found growing amongst crops such as corncockle (*Agrostemma githago*), cleavers (*Galium aparine*), corn gromwell (*Lithospermum arvense*) and bromes (*Bromus* spp.) along with stinking mayweed/chamomile (*Anthemis cotula*) which is linked to cultivation taking place on heavier clay soils in the Roman period (Lodwick 2017, 27). Seeds of wild fruit bushes such as brambles (*Rubus* sp.), elder (*Sambucus nigra)* and sloe (*Prunus spinosa*) are often present in waterlogged deposits and would probably have been exploited as food but these plants are also colonisers of disturbed ground and hedgerows and are not considered to have been deliberately cultivated. Pasture/grassland taxa include grasses (Poaceae), ribwort plantain (*Plantago lanceolata*), cinquefoils (*Potentilla* sp.) and onion couch grass (*Arrhenatherum elatius* subsp. *bulbosus*). There is evidence of wetland plants such as sedges (*Carex* spp.) and spike rush (*Eleocharis* sp.), particularly from the wetter fenland sites, for example Swavesey in-track (Dickens and Collins 2011), RAF Mildenhall (Tester et al. 2012), and Hundred Road (Hutton and Standring 2008). Aquatic plants such as duckweed (*Lemna* sp.), water-crowfoot (*Ranunculus* subgenus *BATRACHIUM*) and horned pondweed (*Zanichellia pallustris*) recovered from waterlogged deposits such as wells such as at Cambridge Biomedical Campus (Phillips 2015) are common colonisers of water-filled features.

**Weed/wild taxa**

A total of 53 weed/wild taxa are found (see table 3), but diversity on individual sites is quite low (see table 1); 25 of the 32 sites sampled for macrofossils had five or less different species and the majority of the weed seeds were recovered from samples which also contained cereal remains, most likely as crop contaminants. The most common taxa appear to be plants of disturbed soils such as docks (*Rumex* spp.), Orache/ goosefoots/ (*Atriplex/Chenopodium* spp.), stinging nettle (*Urtica dioica*) and knotgrass (*Polygonum aviculare*), with some taxa particularly likely to be found growing amongst crops such as corncockle (*Agrostemma githago*), cleavers (*Galium aparine*), corn gromwell (*Lithospermum arvense*) and bromes (*Bromus* spp.) along with stinking mayweed/chamomile (*Anthemis cotula*) which was noted on 4 sites and is linked to cultivation taking place on heavier clay soils in the Roman period (Lodwick 2017, 27).

Pasture/grassland taxa include grasses (Poaceae), ribwort plantain (*Plantago lanceolata*), cinquefoils (*Potentilla* sp.) and onion couch grass (*Arrhenatherum elatius* subsp. *bulbosus*). There is evidence of wetland plants such as sedges (*Carex* spp.) and spike rush (*Eleocharis* sp.), particularly from the wetter fenland sites, for example Swavesey in-track (Dickens and Collins 2011), RAF Mildenhall (Tester et al. 2012), and Hundred Road (Hutton and Standring 2008). Aquatic plants include duckweed (*Lemna* sp.) and horned pondweed (*Zanichellia pallustris*) recovered from waterlogged deposits such as wells such as at Cambridge Biomedical Campus (Phillips 2015). The most diverse site assemblage has 18 different weed taxa, RAF Mildenhall (Tester et al 2012).

In summary, the weeds identified on sites with planting trenches suggest varied cultivation practices: arable farming on tilled or disturbed ground, wetland exploitation, and cultivation on marginal soils.

*Table 5: Presence of weed/wild taxa.*

| Weeds/Wild taxa | No of sites |
|---|---|
| *Galium aparine* (goosegrass) | 9 |
| *Rumex* sp. (dock) | 9 |
| *Chenopodium sp.* (goosefoot) | 8 |
| *Bromus* sp. (Bromes) | 6 |
| Poaceae (grasses) | 6 |
| *Artiplex* sp. (orache) | 5 |
| *Polygonum aviculare* (knotgrass) | 5 |
| *Trifolium/Medicago* sp. (clover/medick) | 5 |
| *Brassicas* spp. (cabbages) | 4 |
| *Raphanus raphanistrum* (wild radish) | 4 |
| *Vicia/Lathyrus* (vetches/vetchling) | 4 |
| *Agrostemma githago* (corn cockle) | 3 |
| *Anthemis cotula* (stinking mayweed) | 3 |
| *Cladium mariscus* (saw-sedge) | 3 |
| *Eleocharis palustris* (spike-rush) | 3 |
| *Ranunculus* sp. (buttercup) | 3 |
| *Stellaria media* (chickweed) | 3 |
| *Tripleurospermum inodorum* (scentless mayweed) | 3 |
| *Arrhenatherum elatius* (onion couch grass) | 2 |
| *Carex* sp. (sedges) | 2 |
| *Centaurea cyanus* (cornflower) | 2 |
| *Conium maculatum* (hemlock) | 2 |
| Fabaceae (legumes) | 2 |
| *Fallopia convolvulus* (black bindweed) | 2 |
| *Hyoscyamus niger* (henbane) | 2 |
| *Lemna sp.* (duckweed) | 2 |
| *Pisum sp.* (cultivated pea) | 2 |
| *Ranunculus subg. BATRACHIUM* (water crowfoot) | 2 |
| *Sambucus nigra* (elderberry) | 2 |
| *Scirpus sp.* (bull-rushes) | 2 |
| *Urtica dioica* (stinging nettle) | 2 |
| Apiaceae (Carrot family) | 1 |
| *Brassicas nigra* (black mustard) | 1 |
| *Centaurea nigra* (common knapweed) | 1 |
| *Cirsium* sp. (thistle) | 1 |
| *Eupatorium cannabinum* (hemp agrimony) | 1 |
| *Euphorbia* sp. (spurge) | 1 |
| Festuca sp. (fescue) | 1 |
| *Lamium* sp. (dead nettle) | 1 |
| *Linum usitatissimum* (flax) | 1 |

| Weeds/Wild taxa | No of sites |
|---|---|
| *Lithospermum arvense* (field gromwell) | 1 |
| *Lolium* sp. (rye-grass) | 1 |
| *Odontites vernus* (red bartsia) | 1 |
| *Persicaria hydropiper* (water-pepper) | 1 |
| *Persicaria lapathifolia* (pale persicaria) | 1 |
| *Plantago lanceolata* (ribwort plantain) | 1 |
| *Potentilla* sp. (cinquefoil) | 1 |
| *Sonchus* sp. (sow-thistle) | 1 |
| *Zannichellia palustris* (horned pondweed) | 1 |
| *Rubus* spp. (brambles) | 1 |

**Molluscs**

The presence of molluscs can be used to infer micro-environments or vegetation cover of sites. This is commonly done by assuming the proportions reflect that of the living assemblage and that can be translated to the prevalence of different micro-environments (Allen 2017). The chalky soils of the east of England makes the survival of shell more likely and they provide a supplement to poor pollen assemblages in those same soils (Allen 2017).

Eight of the sites which were bulk sampled for plant remains also included an analysis of mollusc assemblages (Table 6). The lists exclude sites where the only molluscs reported were food shells such as mussels (*Mytilus edulis*) and oysters (*Ostrea edulis*), which would have been transported from the coast.

*Table 6: Species on each site where molluscs were reported.*

| Species | Clay Farm, Cambridge | Land off Hundred Road, March | North West Cambridge excavations, Site VI | Whittington Way, Bishops Stortford | Chignall Villa, Chelmsford | Land off Chalkstone Way, Haverhill | London Road north, Harlow | Wintringham Park, St Neots | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| *Cepaea nemoralis* | | Y | | | | Y | | Y | **3** |
| *Cepaea sp.* | | | | Y | | | Y | | **2** |
| *Cochlicopa sp.* | Y | Y | | | Y | | | | **3** |
| *Ceciliodes acicula* | Y | Y | | | | | | | **2** |
| *Carychium tridentatum* | Y | | | | | | | | **1** |
| *Clausilla sp.* | Y | | | | | | | | **1** |
| *Carychimum tridentatum/minimum* | | | Y | | | | | | **1** |
| *Vertigo pygmaea* | | Y | Y | | | | | | **2** |
| *Vertigo antivertigo* | Y | | Y | | | | | | **2** |
| *Vertigo pusilla* | Y | | | | | | | | **1** |

| Species | Clay Farm, Cambridge | Land off Hundred Road, March | North West Cambridge excavations, Site VI | Whittington Way, Bishops Stortford | Chignall Villa, Chelmsford | Land off Chalkstone Way, Haverhill | London Road north, Harlow | Wintringham Park, St Neots | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| *Vertigo pulchella/prostrata* | | | Y | | | | | | **1** |
| *Discus rotundatus* | | | | Y | | | | | **1** |
| *Vallonia costata* | | | | Y | Y | | | | **2** |
| *Vallonia excentrica* | Y | Y | | Y | | | | | **3** |
| *Lauria/Pupilla* | Y | | | | | | | | **1** |
| *Lauria cylindracea* | | Y | | | | | | | **1** |
| *Candidula sp.* | | | | | Y | | | | **1** |
| *Bithynia sp.* | | Y | | | | | | | **1** |
| *Planorbis planorbis* | Y | Y | | | | | | | **2** |
| *Planorbarius corneus* | Y | | | | | | | | **1** |
| *Hippeutis complanatus* | Y | Y | | | | | | | **2** |
| *Helix sp.* | Y | | | | | | | | **1** |
| *Lymnaea sp./truncatula* | Y | Y | Y | | | | | | **3** |
| *Aplexa hypnorum* | | Y | | | | | | | **1** |
| *Anisus leucostoma* | Y | Y | | | | | | | **2** |
| *Anisus vortex* | Y | | | | | | | | **1** |
| *Trichia sp.* | Y | | Y | | | | | | **2** |
| *Trichia hispidia/striolata* | | Y | | Y | | | | | **2** |
| *Succinea sp.* | Y | | | | | | | | **1** |
| *Oxychilus/ Aegopinella* | Y | | | | | | | | **1** |
| **Total number of species found** | **18** | **13** | **6** | **5** | **3** | **1** | **1** | **1** | |

Four sites provided detailed mollusc reports:

- Clay Farm (Timberlake 2007). Here a quarry pit and ditches of Late Iron Age/Early Roman date were sampled. A number of species that favour a damp, shady-though-mostly-open environment were recovered. These suggest an environment of moist ground with good coverage of grasses, low meadow or grassland plants, and pools of fresh water (Timberlake 2007, 92–93).
- North West Cambridge excavation, Site VI (Timberlake 2014). One sample was taken from an early Roman ditch roughly 100m from the planting trenches. A wide variety of habitats were represented including seasonal ponds, well-vegetated wet/damp environments such as marshes, meadow or woods, as well as open land dry-damp. Further samples taken directly from the planting trenches found some mollusc shell fragments of *Vallonia pulchella* which is indicative of an open dry-to-damp environment (Timberlake 2014, 26–27).
- Land off Hundred Road, March (Hutton and Standring 2008). A small assemblage of molluscs was recovered from a planting trench. It included fragments of terrestrial species with broad preferences, including *Lymnaea truncatula*, which suggests the

area was seasonally wet. A Romano-British linear feature some 100m from the planting trenches contained numerous semi-aquatic species which flourish in small bodies of water that may dry out seasonally. The general picture obtained from the mollusc remains was of episodes of flooding and standing water in planting trenches, while nearby linear features contained slow flowing water (Hutton and Standring 2008, 33–34).

- Chignall Villa, Chelmsford (Clarke 1998). A column sample was taken from the section of a Late Iron Age to Roman ditch. The fill dated to Roman period. It contained three different species which showed clearance of vegetation from earlier phases and possibly some deliberate backfilling of the ditch via ploughing and levelling of nearby fields (Clarke 1998, 126–127).

## Pollen

Pollen analysis was undertaken on thirteen sites, but only eight produced any pollen (Table 7). Pollen was described as 'degraded' or 'poorly preserved' at several sites. In general, pollen can be preserved better in acidic soils than alkaline conditions (Pearsall 2016, 201). At Swavesey In Track, the relatively high pH of the chalky/marly soils was cited as the reason for the pollen's degraded state (Dickens and Collins 2011, 109); and at Chignall Villa the highly acidic soils were responsible (Clarke 1998, 130). Several samples failed to produce more than the 300 pollen grains required for statistically relevant analysis (Thatcher 2009, 84), limiting the reliability of the results. Only two sites produced high grain counts: Tavistock Avenue, Wollaston, and Cambridge Biomedical Campus.

Pollen samples were taken from planting trenches on five sites:

- Tavistock Avenue (Brown 2010). Samples were taken from the upper and lower fills of four planting trenches. Results were fairly consistent across the samples showing a main component of Lactuceae (dandelions-type) and Poaceae (grasses). Other less common taxa included a range of common trees, shrubs and herbs, including low concentrations of indeterminate cereal pollen. Most of the samples were counted to around 100 pollen grains: one was up to 1000 grains to increase reliability. This larger sample detected a wider range of taxa in very low numbers but followed a similar pattern to the others. The assemblage was interpreted as indicating that limited cultivation was taking place, and some of the herbs were present indicative of pastoral activity (Brown 2010, 32–35).
- Wollaston (Brown *et al*. 2001). The three samples were dominated by Poaceae, Cyperaceae (sedges), Lactuceae, *Plantago lanceolata* (ribwort plantain) and Pteridium (bracken). The most notable taxon in the results was the low but consistent presence of *Vitis* (vines) which greatly contributed to the conclusion that the area surrounding the planting trenches contained vineyards
- Kempston (Archer *et al*. 2008). Six column samples were taken from the planting trenches, and four were analysed. Pollen concentrations were low and preservation was poor. Results were a low diversity mixture of weeds, aquatic plants and ferns. The most common types (*Pteridium* and Lactuceae) were noted to be more resistant to environmental degradation, and hence may not reflect actual environmental conditions (Archer *et al*. 2008, 119).
- South Meadow Road, Upton (Speed et al 2016). The material was degraded, with very low number of grains recovered. Pollen identified came from trees, such as *Betula* and *Alnus*, along with wild grasses.
- Bell Language School, Cambridge (Bush and Mortimer 2015). Two samples were taken from a single planting trench. Preservation was poor and the presence of fungal spores (*Glomus*) suggested erosion or some form of ground disturbance (Bush and Mortimer 2015, 132). The assemblages were sparse and too low for a valid interpretation. They contained Poaceae, *Taraxaxum* (dandelion type), *Alnus*, *Corylus*, and Polypodium (ferns) (Bush and Mortimer 2015, 132).

*Table 7: Presence of species recovered from pollen samples, along with ubiquity in the planting trenches and wider site X=sample taken from planting trench, Y=sample taken from other features contemporary with the planting trenches..*

| Site Name | Tavistock Avenue, Ampthill | Wollaston | March Highways | Cambridge Biomedical Campus | North West Cambridge, Site VI | Cambridge, Bell Language School | Kempston, Bedford Western Bypass | Upton, South Meadow Road | **Total from planting trenches** | **Total from wider site** | **Total from site** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Alnus* (alder) | X | X | Y | Y | Y | X | | X | **4** | **3** | **7** |
| *Corylus* (hazel) | X | X | Y | Y | | X | | | **3** | **2** | **5** |
| *Quercus* (oak) | X | X | Y | Y | | | | | **2** | **2** | **4** |
| *Pinus* (pine) | X | X | Y | | Y | | | | **2** | **2** | **4** |
| *Betula* (birch) | X | X | Y | | | | | X | **3** | **1** | **4** |
| *Tilia* (lime) | X | | Y | | | | | | **1** | **1** | **2** |
| *Acer* (sycamore) | X | | | | | | | | **1** | **0** | **1** |
| *Prunus* (sloe/cherry) | | X | | | | | | | **1** | **0** | **1** |
| *Juniperus* (juniper) | | | Y | | | | | | **0** | **1** | **1** |
| Poaceae (grasses) | X | X | Y | Y | Y | X | X | X | **5** | **3** | **8** |
| Asteraceae (daisies) | X | X | Y | Y | Y | | | | **2** | **3** | **5** |
| Lactuceae (lettuce family) | X | X | | | Y | | X | | **3** | **1** | **4** |
| *Plantago lanceolata* (ribwort plantain) | X | X | Y | Y | | | | | **2** | **2** | **4** |
| Brassicaceae (cabbage family) | X | | Y | Y | Y | | | | **1** | **3** | **4** |
| Polypodium (true ferns) | X | | Y | | Y | X | | | **2** | **2** | **4** |
| Cereal indet. | X | X | Y | | | | | | **2** | **1** | **3** |
| Chenopodiaceae (goosefoots) | X | X | | | Y | | | | **2** | **1** | **3** |
| Cyperaceae (sedge family) | X | X | | Y | | | | | **2** | **1** | **3** |
| Caryophyllaceae (pinks) | X | X | | | | X | | | **3** | **0** | **3** |
| Taraxacum (dandelion-type) | | | | Y | | X | | | **1** | **1** | **2** |
| *Gallium* (bedstraw) | X | X | | | | | | | **2** | **0** | **2** |
| Lycopodium (club mosses) | X | | | | | X | | | **2** | **0** | **2** |
| *Pteridium* (coarse ferns/brackens) | X | | | | | | X | | **2** | **0** | **2** |

| Site Name | Tavistock Avenue, Ampthill | Wollaston | March Highways | Cambridge Biomedical Campus | North West Cambridge, Site VI | Cambridge, Bell Language School | Kempston, Bedford Western Bypass | Upton, South Meadow Road | **Total from planting trenches** | **Total from wider site** | **Total from site** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pteropsida monolete* (Vascular plant) | X | | | | | | X | | **2** | **0** | **2** |
| *Hordeum sp.* (Barley) | | X | | | | | | | **1** | **0** | **1** |
| *Cirsium* (thistle) | X | | | | | | | | **1** | **0** | **1** |
| Amaranthaceae (goosefoot family) | | | | Y | | | | | **0** | **1** | **1** |
| *Calluna* (heather) | X | | | | | | | | **1** | **0** | **1** |
| *Centaurea (knapweeds)* | | X | | | | | | | **1** | **0** | **1** |
| *Anthemis arvensis* (camomile) | | X | | | | | | | **1** | **0** | **1** |
| Filipendula (meadowsweet) | | X | | | | | | | **1** | **0** | **1** |
| *Ranunculus* (buttercup) | | | Y | | | | | | **0** | **1** | **1** |
| *Adonis annua (Pheasant's eye)* | | X | | | | | | | **1** | **0** | **1** |
| Apiaceae (carrot family) | | | | Y | | | | | **0** | **1** | **1** |
| Artemisia (mugwort) | | | | Y | | | | | **0** | **1** | **1** |
| Nymphaea (water lillies) | | | | | | | X | | **1** | **0** | **1** |
| Polygonum (knotgrasses) | | | | | | | X | | **1** | **0** | **1** |
| *Vitis* (Vines) | | X | | | | | | | **1** | **0** | **1** |

As with plant macrofossils, the pollen samples taken from the planting trenches are too few and too poorly-preserved to build any firm conclusions. In site-wide assemblages, the more common taxa could only be identified to the level of genus. Poaceae pollen was the most ubiquitous, and undifferentiated members of the family Asteraceae were the second-most ubiquitous taxa. Pollen from crop plants were found on three sites:

- indeterminate cereals on three sites
- *Hordeum sp.* on one site
- *Vitis* on one site

The four sites that yielded pollen of Brassicaceae may represent crops of cabbage or turnip but equally may represent local wild taxa.

The most frequently occurring taxa identifiable to species was *Plantago lanceolata* *Galium sp.* and *Pteropsida monolete* were both present on two sites. The remaining 17 of the 38 taxa were recovered on only one site each.

Pollen was identified from nine different taxa of arboreal trees. Five occur regularly: *Alnus*, *Corylus*, *Pinus*, *Quercus* and *Betula*—all common taxa in Britain.

## Discussion

Preservation of plant remains in the east of England depends primarily on either charring or waterlogging. This requires either that plants undergo processing which exposes then to fire, or else they are grown close to wet conditions where their remains can become incorporated into an oxygen-free environment which prevent microbial attack. For many of the crops which might have been grown in the planting trenches, neither of these conditions is present, which limits potential interpretations.

### *Vines*

Roman-era planting trenches are often connected with viticulture (e.g. Speed *et al.* 2016; Brown 2010, 33; Fletcher 2009, 12; Williams 2008). The process of wine-making, however, does not routinely expose grapes or vines to fire, which might preserve them by charring. Evidence for grape-growing therefore has to rely primarily on pollen.

*Vitis* pollen was found on just one site: Wollaston (Brown *et al.* 2001). Sampling at South Meadow Road (Speed *et al.* 2016) and Tavistock Avenue (Brown 2010) explicitly sought *Vitis* pollen, but none was recovered. One reason that has been suggested for the lack of pollen at other sites is the way *Vitis* disperses—via insect and wind/gravity, resulting in atmospheric densities exponentially decreasing a few metres from the vine (Brown *et al.* 2001). This issue is then compounded by the poor preservation encountered on many sites, as noted above. And finally, if vines were being grown in the planting trenches, any pollen would have to penetrate maybe half metre of soil in order to reach the base of the trenches in order to survive later ploughing and agriculture.

The site at Wollaston also produced evidence for postholes in the trenches, which were interpreted as trellises for vines.

The planting of vines is potentially supported by the spacing of trenches: it might have been done to maximise the light individual vines received, so they were not being blocked by neighbouring vines (Brown 2010, 38). Against this needs to be set the rather wide range of orientations on which the trenches were laid out.

Another potential line of evidence for vine production is the presence of molluscs which indicate a shaded environment. This is slender evidence, as a shaded environment may also indicate hedgerows or tall grasses.

Against the interpretation of planting trenches as primarily concerned with vine-growing is the historical spread of viticulture across western Europe. While viticulture was well established in southern Gaul by the first century AD, it did not become established on the Moselle around Trier until the third century AD, and along the Seine until the fourth and the Loire in the mid-fifth centuries. (Unwin 1991, 114, fig 20. Brown *et al.* 2001, 745, quoting Brun 1993, Brun & Tchering 1999, gives a date of the late second century for the arrival of viticulture in the Loire, Rhine, Mosel, Normandy and Bourgogne areas—which is earlier than Unwin's dates, but nonetheless later than the bulk of planting trenches reviewed)

While it is possible that individual vineyards might have been established in Britain in the first or early second centuries AD, it seems implausible that they should have become widespread at this time, well in advance of their spread through better-suited climates to the south. Moreover, there is a distinct lack of archaeological evidence for vineyards in Late Roman Britain, when viticulture was finally established in nearby parts of the Empire—a time when their appearance would seem much more likely. Together, this suggests that, leaving aside a few individual cases, such as at Wolloston, vineyards did not become widespread over central and eastern Britain.

*Cereals*

The dominant domesticated crops identified were the cereals. Their high ubiquity is typical of Romano-British sites as they were staples of arable farming in the period (Lodwick 2017, 11).

Unfortunately, the presence of charred cereal remains does not necessarily imply cereal cultivation in the planting trenches. None of the reports of samples taken from the planting trenches mentioned in situ burning or chaff elements. The presence of charred cereal remains in the trenches likely reflects secondary deposition of a late stage of crop processing. These remains may have been incorporated into the trenches by dumping, or via middening, or be wind-blown debris (the latter being the as interpretation at Chalkstone Way [Craven 2007]).

The presence of cereal pollen in the planting trenches would provide stronger evidence for cereal production in the planting trenches. However, cereal pollen was not often present. Generic cereal pollen was only found in at March Highways and Wollaston, while *Hordeum sp.* was recovered from Wollaston. (As discussed above, finds of *Vitis* pollen at Wollaston point to the planting trenches being used to grow vines, not cereals.)

***Horticulture***

The development of horticulture for the cultivation of vegetables, herbs and fruits is seen as a significant innovation in late Iron Age/Early Roman period with the introduction of numerous new food plants that were subsequently cultivated (van der Veen, Livarda and Hill 2007, Lodwick 2013, van der Veen 2016).

Columella devotes the whole of Books 10 and 11 of *De Re Rustica* to the cultivation of the produce garden, listing in detail over sixty plants. They include fifteen varieties of cabbage (brassica), five kinds of lettuce (*lactuca*), artichoke (*cinara*), rocket (*eruca*), parsnips (*pastinaca*), skirrit (*siseris*), garlic (*alium*), onions (*cepina*), leek (*porrum*), radish (*radix, raphanus*), turnip (*rapa*), beets (*beta*), carrot (*carota*), asparagus (*asparagus*), cucumbers (*cucumis*), and gourds (*cucurbita*). Columella also lists many herbs: cress (*nasturcium*), coriander (*coriandrum*), cumin (*cuminum*), mint (*menta*), mallow (*moloche*), basil (*ocimum*), sorrel (*lapathum*), thyme (*thymus*), marjoram/oregano (*cunila*), chervil (*chaerphyllium*), dill (*anethum*), fennel (*ferula*), poppy (*papaver*), mustard (*sinape*), rue (*ruta*), capers (*capparis*), parsley (*apium*), elecampane (*inula*), and saltbush/orache (*atriplicis*). Another useful source of foodstuffs available in Britain is listed on a Vindolanda tablet (Tab. Vindol. II 190) include garlic (*alium*), Fodder/oats (*avena*), malting cereal (*bracis*), beans (*fabae*), wheat (*frumentum*), barley (*hordeum*), lentil (*lens*), lovage (*ligusticum*), apple (*malum*), olives (*olivae*), pepper (*piper*), plum (*prunolum*), radishes (*radices*) and spices (*condimenta*) (Bowman 1994, 68–69). Whilst some of the items in these lists continued to be imported, it is likely that many were obtained from within the country.

Evidence of these foodstuffs survives only rarely in the archaeobotanical record as vegetative plants are usually harvested and consumed in their leaf/stem/flower form, unless they have been left to set seed. Such evidence is mostly recovered from waterlogged deposits is features such as wells and deep pits and ditches which are rarely well-preserved on rural sites (Van der Veen 2016, 816). Herbs and vegetables would otherwise leave very few remains, as they would not have been exposed to fire during crop processing (Bush and Mortimer 2015, 129). Root vegetables are usually harvested prior to setting seeds, also their pollen might potentially survive (Phillips 2015, 100).

Very few of the sites yield evidence for horticultural crops. One exception was Site VI of the North West Cambridge excavation (Timberlake 2014), Brassicaceae pollen and macrofossils were found in the field boundary ditch. The excavators noted the lack of *Vitis* pollen or trellis postholes like those found at Wollaston. Combined with comments

of Roman authors, they concluded tentatively that cabbages or other members of the Brassica family, such as turnips, were cultivated in or around the planting trenches.

Other sites also produced evidence for the presence of Brassicaceae:

- March Highways (Thatcher 2009): pollen and macrofossils
- Swavesey (Dickens and Collins 2011): macrofossils
- Wintringham park (Phillips and Hinman 2009): macrofossils
- Tavistock (Brown 2010): pollen
- Cambridge Biomedical Campus (Phillips 2015): pollen.

Presence, by itself, is not sufficient to demonstrate cultivation of cabbages, turnips or other Brassicaceae , as this family also includes wild genera (Stace 2010, 412–420). The case for cultivation is better at Tavistock Avenue, Ampthill, Brassicaceae pollen was found in multiple Beds. On the other sites reviewed however, the evidence is too slim for positive confirmation that members of the cabbage family were being cultivated.

*Intercultivation*

One problem with an interpretation of planting trenches as horticultural beds is why there was so much space between the individual trenches. It is possible that there were separate crops grown between the trenches (inter-cultivation).

As noted above, inter-cultivation was practised by Roman farmers. Even if all the crops were being sold commercially, with none reserved for domestic consumption, planting just a single crop would have left farmers at risk of catastrophic loss if the crop failed. Prudence would suggest cultivation of several different crops.

Naturally, if evidence for crops grown in the trenches is difficult to establish, then establishing the nature of crops grown on the grown surface between the trenches is nigh impossible, as all evidence for this would have been long since ploughed away.

*Other crops*

We are leaving aside an interpretation of the planting trenches as being for orchards, as no root bowls have been found in the trenches. Nor do we think it is likely they were used to raise flowers for commercial sale—an income source mentioned by Columella—as the planting beds are too distant from towns where flowers might have been sold (discussed in more detail below)

*Soil treatment*

Beyond direct evidence for crops in the planting trenches, environmental samples taken on several sites point to alterations in the soil.

- Cambridge Biomedical Campus. Cereal grains recovered directly from planting trenches were occasionally found in a degraded prior to deposition. This was taken to indicate the possible use of midden or domestic refuse as fertiliser (Phillips 2015).
- Wintringham Park, St Neots. Ditches dating to the Late Pre-Roman Iron Age and Romano-British periods yielded common ostracods and duckweeds (*Lemna sp.*). These are species which thrive in eutrophic water which may indicate the use of fertiliser (Phillips and Hinman 2009, 97) or the use of well-water for watering the crops.

On the other hand there is specific reference to the *absence* of any enrichment at Bell Language School, Cambridge, where the planting trenches were thought by to have been immediately refilled with non-fertilised soil (Bush and Mortimer 2015, 129). Other reports say nothing either way.

Growing conditions appeared quite variable across the sites reviewed.

- RAF Mildenhall: the Planting Trenches were phased to a period of rising water table in the later Roman period. Analysis of the soil morphology determined a lack of

flowing water in the beds, which were concluded to be unrelated to drainage (Tester 2012, 50).

- Clay Farm, Cambridge: damp and open environments were suggested by the mollusc assemblage (Timberlake 2007, 92–93)
- North West Cambridge (Site VI): the planting trenches themselves had low numbers of shell fragments, which suggested an open dry/damp habitat (Timberlake 2014, 26–27), although this site produced only a few specimens of a single species.
- Cambridge Biomedical Campus: wet ground conditions around the planting trenches suggests whatever was grown had to be tolerant of wet conditions and/or require a lot of water (Phillips 2015, 100).
- Hundred Road, March: repeated flooding and/or standing water was suggested by the molluscs found within the around the planting trenches (Hutton and Standring 2008). Whilst few molluscs remains were recovered at this site, they hint that the crop grown were possibly tolerant of wet conditions.

## Conclusions

Generally, the plant remains recovered from planting trenches were limited, which limits the interpretations possible. The limited data available are inconsistent in many regards:

- no crop can be consistently found in association with the planting trenches, other than cereals, and their presence does not necessarily reflect cultivation.
- there is limited evidence of soil enrichment and drainage, but also the explicit absence of soil enrichment
- the few analyses of molluscs suggest a variety habitats in and around planting trenches—some open; some shaded; some damp and seasonally wet.

As noted, there are some crops which might potentially have been grown in the planting trenches—vines, vegetables, herbs—which would have left at best only minimum evidence for their presence, as they would not be charred or their pollen dispersed before it could be incorporated into the base of planting trenches.

No strong positive conclusions can be reached about the plants grown in the planting trenches with the current dataset. Perhaps patterns will become clearer if more data becomes available—especially molluscs which give insight into water levels and vegetation cover.

## LOCATION OF PLANTING TRENCHES

### Site location in relation to water

The distance to the nearest identifiable water source was measured by comparing the location of sites with the Ordnance Survey's Open Rivers dataset (Figure 12). The straight-line distances for individual sites are listed in Table 8, and illustrated in Figure 15. Two-thirds of the 52 sites lay within one kilometre of a river or water source. Assuming a walking speed of 5 km/h, this distance is roughly 10–15 minutes walking time, meaning that water would have been easily accessible. Only 6% of the sites were more than two kilometres from a water source (*RAF Mildenhall, Cam Drive Ely* and *Field D, North West Ely*), with the greatest distance being 2.4km. This distance would take roughly 30 minutes to walk.

These figures suggest that proximity to water was an important factor when the sites were selected, and is consistent with our interpretation that planting beds were used for growing plant crops.

*Figure 12: Sites and rivers/watercourses (source: OS Open River dataset)*

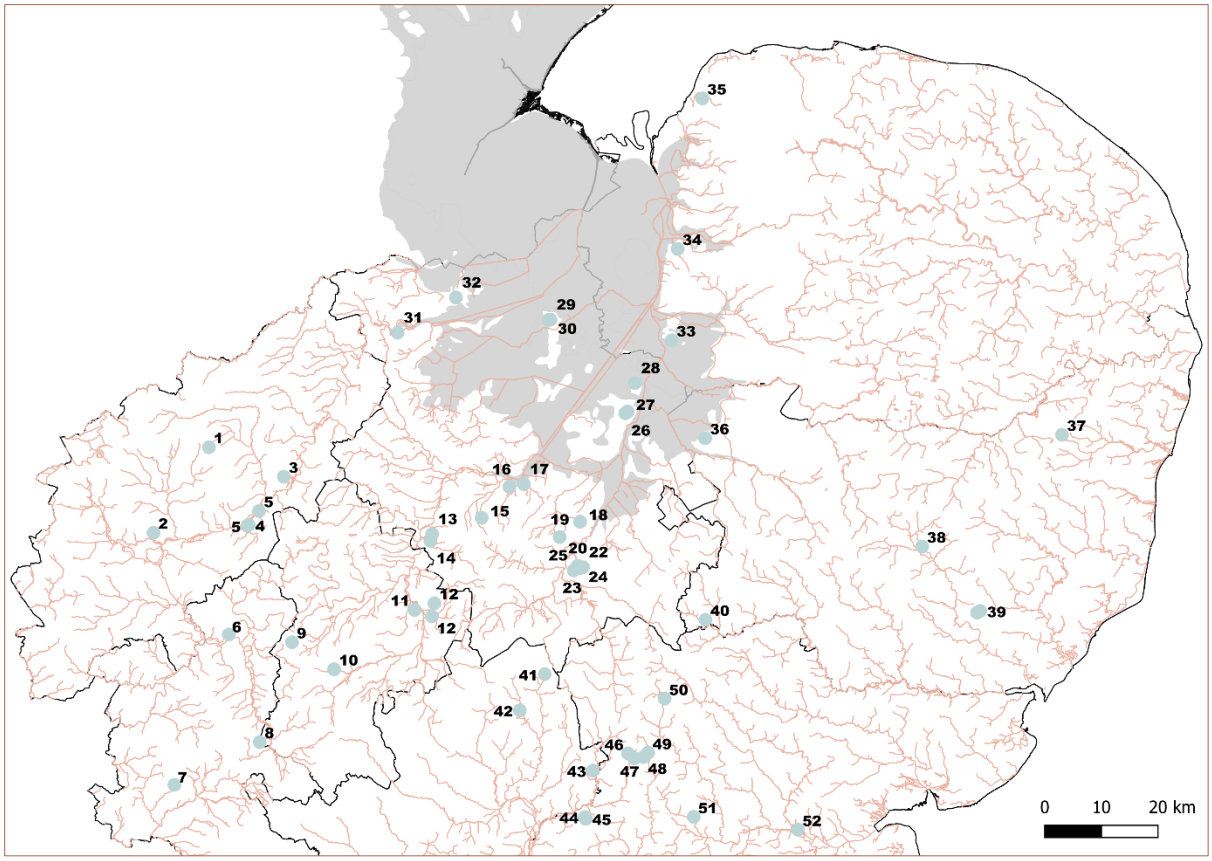



*Table 8: Straight-line distance from sites to the nearest river or watercourse (km)*

| Map No. | Site Name | Distance (km) |
|---|---|---|
| 1 | Mawsley New Village | 0.74 |
| 2 | South Meadow Road, Upton | 1.15 |
| 3 | Irthlingborough | 0.94 |
| 4 | Grendon Quarry | 0.2 |
| 5 | Wollaston 2, Southern Vineyard | 0.06 |

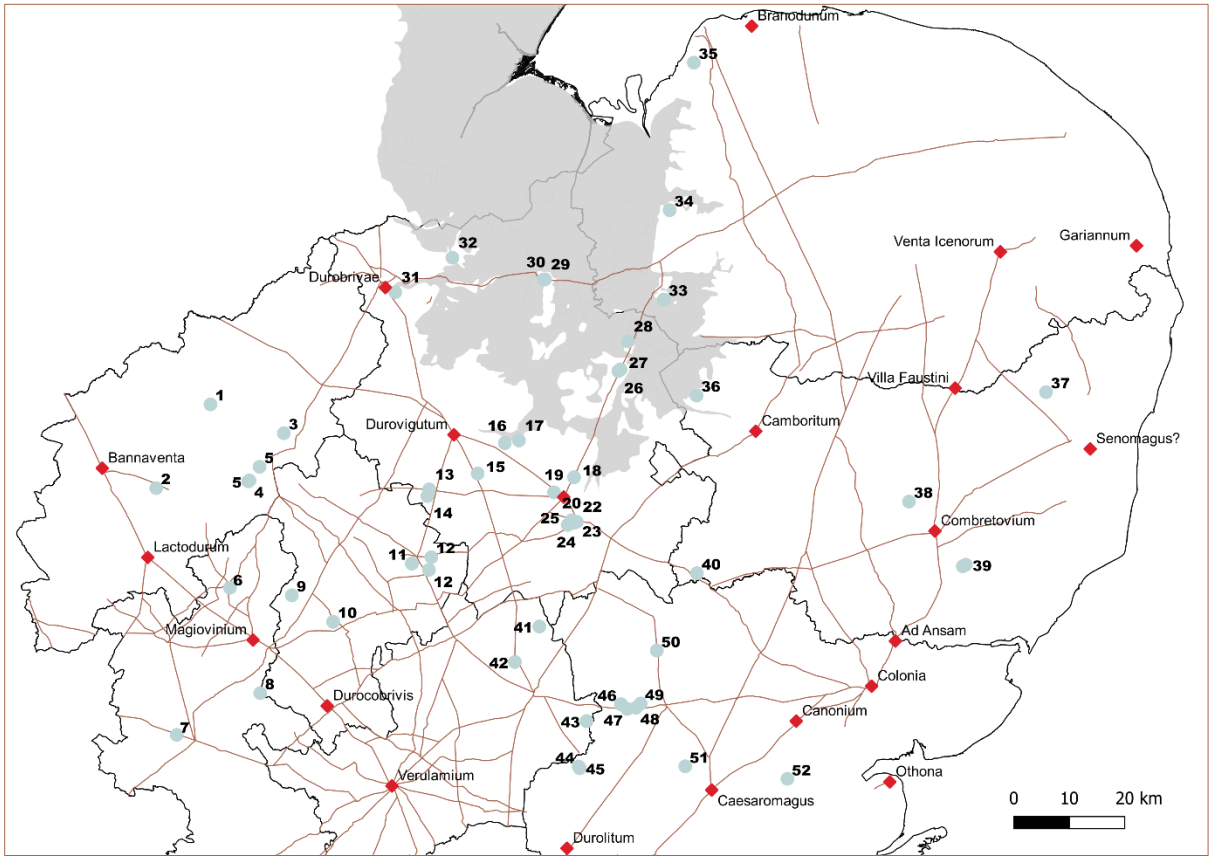
| Map No. | Site Name | Distance (km) |
|---|---|---|
| 5 | Wollaston 1, Northern Vineyard | 0.05 |
| 6 | Stanton Low | 0.05 |
| 7 | Waddesdon Primary School | 0.34 |
| 8 | Stoke Hammond and Linslade Bypass | 1.1 |
| 9 | Home Farm, Cranfield | 1.57 |
| 10 | Tavestock Avenue, Ampthill | 0.2 |
| 11 | Land West of Kempston | 0.86 |
| 12 | Bedford Western Bypass, Kempston | 0.29 |
| 12 | Bedford Western Bypass, Kempston | 0.63 |
| 13 | Love's Farm, St Neots | 0.15 |
| 14 | Wintringham Park, St Neots | 0.1 |
| 15 | Papworth Everard | 0.46 |
| 16 | Low Fen, Fen Drayton | 0.22 |
| 17 | Swavesey | 0.14 |
| 18 | Milton Landfill | 1.2 |
| 19 | Site VI, North West Cambridge | 0.2 |
| 20 | Clay Farm, Cambridge | 0.4 |
| 21 | Cambridge Biomedical Campus | 0.67 |
| 22 | Bell Language School, Cambridge | 1.03 |
| 23 | Addenbrookes Hospital, Cambridge | 0.55 |
| 24 | Addenbrookes Hospital, Cambridge | 0.55 |
| 25 | Clay Farm, Cambridge | 0.41 |
| 26 | Cam Drive, Ely | 2.4 |
| 27 | Field D, North West Ely | 2.09 |
| 28 | Wisbech Road, Littleport | 1.71 |
| 29 | Hundred Road, March | 1.58 |
| 30 | March Highways | 1.52 |
| 30 | March Highways | 1.52 |
| 31 | Peterborough Business Park | 0.43 |
| 32 | Eye Quarry, Peterborough | 1.71 |
| 33 | Feltwell Rd, Southery. | 1.8 |
| 34 | Watlington Road, Tottenhill | 0.31 |
| 35 | Heachem | 0.34 |
| 36 | RAF Mildenhall | 2.29 |
| 37 | Grove Farm, Linstead Magna | 1.16 |
| 38 | Cedars Park, Stowmarket | 0.62 |
| 39 | Westerfield Road, Ipswich | 1.68 |
| 39 | Westerfield Road, Ipswich | 1.69 |
| 39 | Westerfield Road, Ipswich | 1.74 |
| 40 | Chalkstone Way, Haverhill | 0.81 |
| 41 | Cokenach Estate | 0.97 |

| Map No. | Site Name | Distance (km) |
|---|---|---|
| 42 | Tylers Close Buntingford | 0.77 |
| 43 | Whittington Way, Bishops Stortford | 0.15 |
| 44 | Mark Hall School, Harlow | 0.7 |
| 45 | London Road North, Harlow | 0.43 |
| 46 | Stansted Airport | 0.27 |
| 47 | Barkers Tanks Site, Takeley | 0.84 |
| 48 | Priors Green, Takeley | 0.73 |
| 49 | Frogs Hall East | 0.26 |
| 50 | Sampford Road, Thaxted | 0.5 |
| 51 | Chignall Villa, Chelmsford | 0.35 |
| 52 | Langford Road, Heybridge | 0.13 |

## Site locations in relation to Roman roads

Figure 13 shows the location of known Roman roads, along with sites. Even a cursory glance shows a close relationship. The straight-line distance from sites to roads was calculated in the same way as for rivers. The distances for individual site are listed in Table 9 and illustrated in Figure 14. Roman towns are also shown in Figure 13, and it is apparent that the bulk of planting trenches are not especially close to towns—some are 40 or 50 kilometres in a straight line.

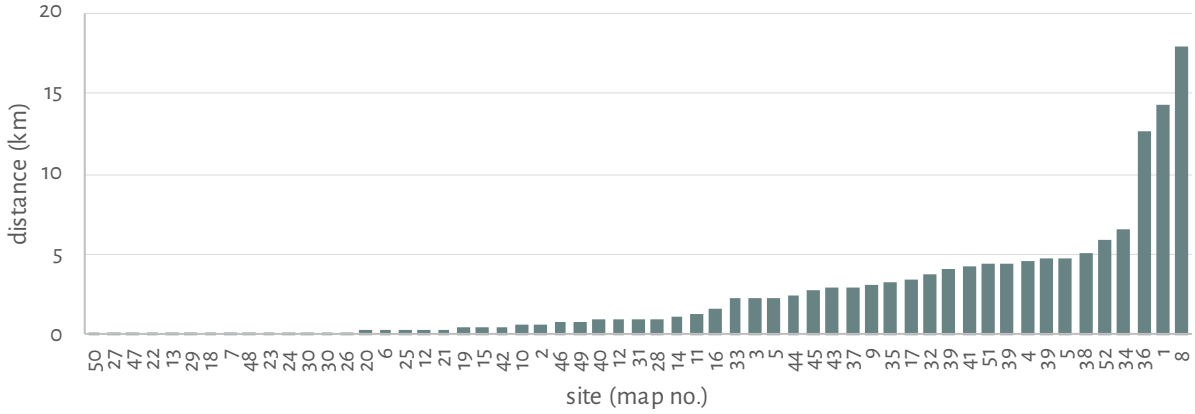
*Figure 13: Sites and Roman roads and Roman towns (red diamonds)*




Keith Briggs has estimated that about two thirds of modern-day England was within five kilometres of a Roman road, and about 20 per cent was within one kilometre. By

contrast, only 6 of the 52 sites (11.5%) were more than five kilometres from a Roman Road, while 27 (52%) were less than one kilometre from a Roman Road. This shows the sites had been positioned close to roads, and implies that distribution of products or road traffic was an important factor in deciding their location.

*Figure 14: Straight-line distance from sites to Roman roads*




Further evidence for this relationship is shown through the sites of *Hundred Road March, Waddesdon Primary School, Bell Language School Cambridge, Loves Farm St Neots, Milton Landfill, Field D North West Ely* and the *Barkers Tanks Site Takeley* which were all less than 0.2 kilometres from a road.

A recent study of Roman viticulture in the Laetanian region in Spain concluded that the accessibility of a location and its connectivity to the local and regional distribution centres and trade routes (determined by topography) was decisive for the establishment of wine-making facilities (Stubert *et al.* 2020). Although the present study area is particularly flat compared to this region of Spain where altitude is a factor, the principles of connectivity and accessibility still seem to be key in the selection of sites.

An interesting side note is the implication for the development of the road network. As discussed earlier, the sites majority of sites were dug in the first century AD. If they were deliberately placed close to a road, this implies that a lot of the network in the east of England was in place and well used by the start of the second century, or within about fifty years after the Conquest. Since the project team found no good evidence to suggest that planting trenches were dug before the Conquest, this rises the intriguing possibility that the routeways if not the roads might have already been in existence when the Roman arrived. There is a potential parallel here in the use of salterns. There was an explosive growth in salt production the last century before the Roman invasion. The Romans continued to expand these production sites wherever the climatic conditions were suitable and *there were good existing trade networks* (Historic England 2011: 5). The planting trenches might provide further evidence for these networks.

*Table 9: Straight-line distance from sites to the nearest known Roman road.*

| Map no. | Site name | Distance to road (km) |
|---|---|---|
| 1 | Mawsley New Village | 14.3 |
| 2 | South Meadow Road, Upton | 0.68 |
| 3 | Irthlingborough | 2.33 |
| 4 | Grendon Quarry | 4.58 |
| 5 | Wollaston 1, Northern Vineyard | 2.34 |

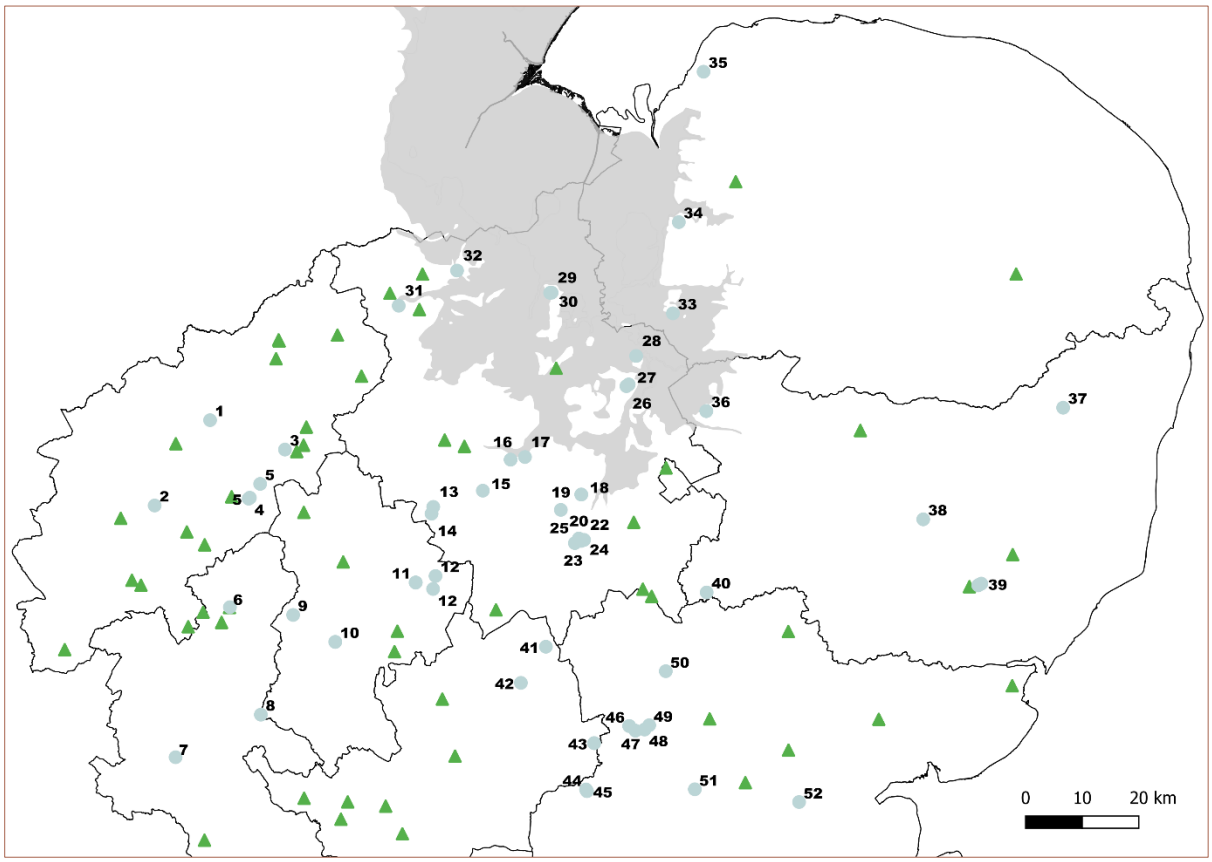
| Map no. | Site name | Distance to road (km) |
|---|---|---|
| 5 | Wollaston 2, Southern Vineyard | 4.8 |
| 6 | Stanton Low | 0.3 |
| 7 | Waddesdon Primary School | 0.15 |
| 8 | Stoke Hammond and Linslade Bypass | 17.97 |
| 9 | Home Farm, Cranfield | 3.04 |
| 10 | Tavestock Avenue, Ampthill | 0.57 |
| 11 | Land West of Kempston | 1.34 |
| 12 | Bedford Western Bypass, Kempston | 0.32 |
| 12 | Bedford Western Bypass, Kempston | 0.91 |
| 13 | Love's Farm, St Neots | 0.1 |
| 14 | Wintringham Park, St Neots | 1.14 |
| 15 | Papworth Everard | 0.5 |
| 16 | Low Fen, Fen Drayton | 1.61 |
| 17 | Swavesey | 3.41 |
| 18 | Milton Landfill | 0.12 |
| 19 | Site VI, North West Cambridge | 0.43 |
| 20 | Clay Farm, Cambridge | 0.25 |
| 21 | Cambridge Biomedical Campus | 0.35 |
| 22 | Bell Language School, Cambridge | 0.09 |
| 23 | Addenbrookes Hospital, Cambridge | 0.17 |
| 24 | Addenbrookes Hospital, Cambridge | 0.17 |
| 25 | Clay Farm, Cambridge | 0.31 |
| 26 | Cam Drive, Ely | 0.22 |
| 27 | Field D, North West Ely | 0.02 |
| 28 | Wisbech Road, Littleport | 0.95 |
| 29 | Hundred Road, March | 0.1 |
| 30 | March Highways | 0.18 |
| 30 | March Highways | 0.18 |
| 31 | Peterborough Business Park | 0.93 |
| 32 | Eye Quarry, Peterborough | 3.73 |
| 33 | Feltwell Rd, Southery. | 2.24 |
| 34 | Watlington Road, Tottenhill | 6.63 |
| 35 | Heachem | 3.35 |
| 36 | RAF Mildenhall | 12.65 |
| 37 | Grove Farm, Linstead Magna | 3.02 |
| 38 | Cedars Park, Stowmarket | 5.13 |
| 39 | Westerfield Road, Ipswich | 4.17 |
| 39 | Westerfield Road, Ipswich | 4.44 |
| 39 | Westerfield Road, Ipswich | 4.76 |
| 40 | Chalkstone Way, Haverhill | 0.9 |
| 41 | Cokenach Estate | 4.29 |

| Map no. | Site name | Distance to road (km) |
|---|---|---|
| 42 | Tylers Close Buntingford | 0.55 |
| 43 | Whittington Way, Bishops Stortford | 2.98 |
| 44 | Mark Hall School, Harlow | 2.53 |
| 45 | London Road North, Harlow | 2.82 |
| 46 | Stansted Airport | 0.77 |
| 47 | Barkers Tanks Site, Takeley | 0.08 |
| 48 | Priors Green, Takeley | 0.16 |
| 49 | Frogs Hall East | 0.84 |
| 50 | Sampford Road, Thaxted | 0.002 |
| 51 | Chignall Villa, Chelmsford | 4.41 |
| 52 | Langford Road, Heybridge | 5.84 |

### Site locations in relation to Roman villas

Figure 15 shows the location of known Roman villas dating to the first or second centuries—those broadly contemporary with the planting trenches. Even a cursory glance shows there is no close relationship between the two. The distance between the two was calculated in a straight line, rather than via roads., which would have been longer. The distances for individual site are listed in Table 10 and illustrated in Figure ?16

*Figure 15: Sites and locations of first and second century Roman villas (green triangles) (Source: RRPS)*



The straight-line distance can be used to see if there are any possible influence of villas on the selection of sites for planting trenches. If the planting trenches were being used to cultivate vegetables, the perishable nature of much of the horticultural produce would necessitate the areas of production being located close to villas or towns ease of access for both maintenance and harvest (van der Veen, Livarda and Hill 2007, 205,). They are perishable and not easily stored for long periods of time or transported over large distances (Van der Veen 2014, 9). So it would make sense to locate production close to centres of consumptions, such as towns and villas. These crops also need significant labour to raise them: more than cereals or livestock. If villas were establishing these planting beds, then labourers and overseers would need to travel out to them and back each daily to water, weed, hoe, and harvest.

The average distance was over 11 kilometres in a straight line. Assuming a walking speed of 5 km/h, this distance would have involved labourers walking an average of 4.5 hours per day to and from the planting trenches: hardly an efficient placement. This also ignores the few sites that lie twice this walking distance from known villas. There are just eight sites which are within five kilometres of a villa.

*Figure 16: Straight line distances from sites to the nearest villa.*

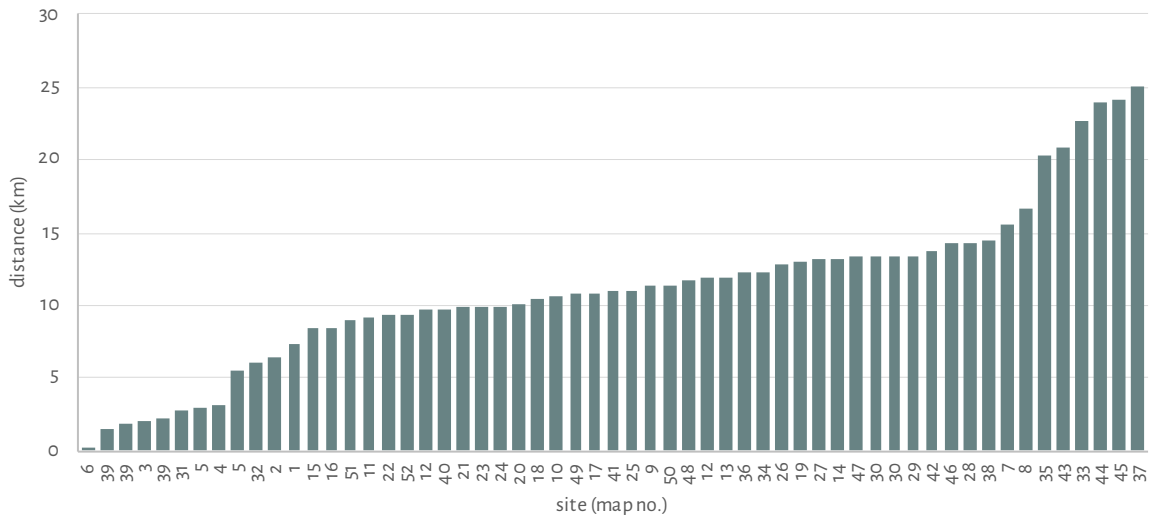



Figure 17 plots the distance of each site to the nearest road and villa. About three quarters (43 site) are significantly closer to a road than a villa, while just eight per cent (5 sites) are significantly closer to villas. The remainder are roughly equidistant. This suggests that placement close to roads was far more significant in the selection of site's locations than their relationship to villas.

*Figure 17: Comparison of distances of planting trenches to the nearest roads and villas. Sites closer to roads than villas are show in green; those with comparable distances are in grey; those closer to villas than roads are shown in brown.*

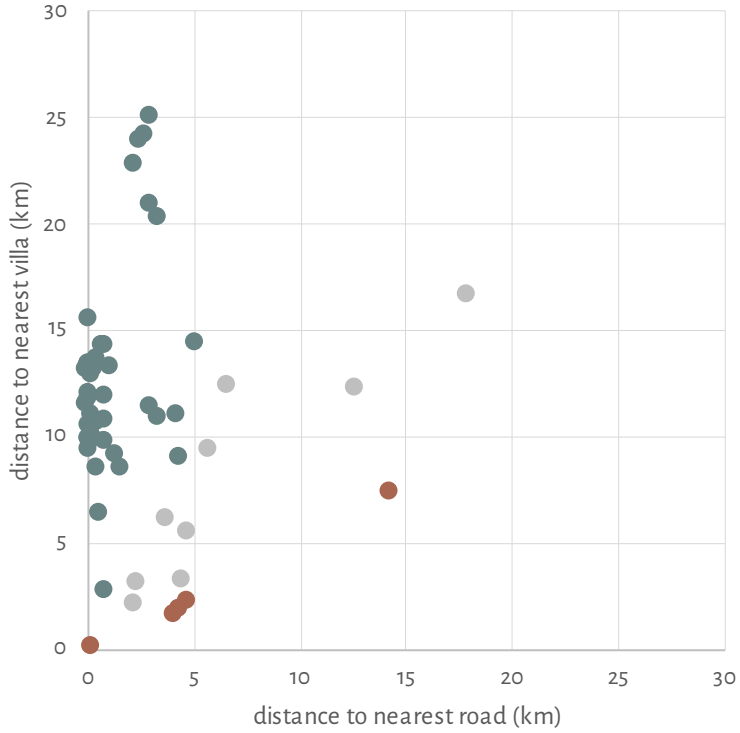



*Table 10: Straight-line distance to the nearest villa recorded in the RRPS dataset*

| Map No. | Site Name | Distance to Villa (km) |
|---|---|---|
| 1 | Mawsley New Village | 7.33 |
| 2 | South Meadow Road, Upton | 6.4 |
| 3 | Irthlingborough | 2.11 |
| 4 | Grendon Quarry | 3.2 |
| 5 | Wollaston 2, Southern Vineyard | 3.03 |
| 5 | Wollaston 1, Northern Vineyard | 5.52 |
| 6 | Stanton Low | 0.09 |
| 7 | Waddesdon Primary School | 15.48 |
| 8 | Stoke Hammond and Linslade Bypass | 16.6 |
| 9 | Home Farm, Cranfield | 11.32 |
| 10 | Tavestock Avenue, Ampthill | 10.6 |
| 11 | Land West of Kempston | 9.16 |
| 12 | Bedford Western Bypass, Kempston | 9.74 |
| 12 | Bedford Western Bypass, Kempston | 11.82 |
| 13 | Love's Farm, St Neots | 11.99 |
| 14 | Wintringham Park, St Neots | 13.22 |
| 15 | Papworth Everard | 8.49 |
| 16 | Low Fen, Fen Drayton | 8.49 |

| Map No. | Site Name | Distance to Villa (km) |
|---|---|---|
| 17 | Swavesey | 10.86 |
| 18 | Milton Landfill | 10.48 |
| 19 | Site VI, North West Cambridge | 13.06 |
| 20 | Clay Farm, Cambridge | 10.13 |
| 21 | Cambridge Biomedical Campus | 9.87 |
| 22 | Bell Language School, Cambridge | 9.32 |
| 23 | Addenbrookes Hospital, Cambridge | 9.87 |
| 24 | Addenbrookes Hospital, Cambridge | 9.87 |
| 25 | Clay Farm, Cambridge | 11.04 |
| 26 | Cam Drive, Ely | 12.81 |
| 27 | Field D, North West Ely | 13.13 |
| 28 | Wisbech Road, Littleport | 14.28 |
| 29 | Hundred Road, March | 13.33 |
| 30 | March Highways | 13.32 |
| 30 | March Highways | 13.32 |
| 31 | Peterborough Business Park | 2.71 |
| 32 | Eye Quarry, Peterborough | 6.13 |
| 33 | Feltwell Rd, Southery. | 22.76 |
| 34 | Watlington Road, Tottenhill | 12.33 |
| 35 | Heachem | 20.21 |
| 36 | RAF Mildenhall | 12.26 |
| 37 | Grove Farm, Linstead Magna | 25.02 |
| 38 | Cedars Park, Stowmarket | 14.39 |
| 39 | Westerfield Road, Ipswich | 1.56 |
| 39 | Westerfield Road, Ipswich | 1.84 |
| 39 | Westerfield Road, Ipswich | 2.16 |
| 40 | Chalkstone Way, Haverhill | 9.74 |
| 41 | Cokenach Estate | 10.97 |
| 42 | Tylers Close Buntingford | 13.64 |
| 43 | Whittington Way, Bishops Stortford | 20.85 |
| 44 | Mark Hall School, Harlow | 23.87 |
| 45 | London Road North, Harlow | 24.11 |
| 46 | Stansted Airport | 14.27 |
| 47 | Barkers Tanks Site, Takeley | 13.27 |
| 48 | Priors Green, Takeley | 11.67 |
| 49 | Frogs Hall East | 10.74 |
| 50 | Sampford Road, Thaxted | 11.43 |
| 51 | Chignall Villa, Chelmsford | 9 |
| 52 | Langford Road, Heybridge | 9.38 |

## PRODUCTION AND YIELDS

### Labour investment

Columella advises that digging planting beds *pastinatio* for vines was time consuming, and therefore expensive, compared with furrows or single holes. The same consideration would presumably have been true for planting trenches. He gave a figure of 80 man-days per *iugerum* (c.2500 m$^2$) (Columella 5.4.2 in White 1970: 494 n. 32) On these figures, the trenches exposed at Addenbrookes Hospital, Cambridge (c.1.0 ha) and Milton landfill (c.1.2 ha.) would have required 320 and 385 work-days to excavate. This is far beyond the labour available to single farmer, especially when other crops and animals required attention. Indeed, they imply large-scale planning and resources: even a team of twenty would have taken 2–3 weeks to complete the task—and the full extent of the plots is larger than that exposed in excavation.

### Yields

If these sites were being used to cultivate vegetables, then the number of people they might have supported is large. Table 11 illustrates their potential yields and the number of people they might have fed. The table shows the lengths of trenches exposed or visible on four of the more complete sites reviewed. Assuming that cabbages—one of the vegetables highly praised by Cato and Columella—were being grown, and that they were spaced at 50cm, then the excavated areas would have produced 1,600–5,230 cabbages in a season. If a person ate five cabbages in a growing season, then this crop would have supported 320–1,220 people; if they ate ten cabbages, then these plots would have supported 16–610 people. These figures only take into account the areas exposed in excavation the real plots would have been larger, and hence could have supported more people.

*Table 11: Hypothetical cabbage production and consumption at four large sites with planting beds*

| | Metres exposed | Cabbages per season at 50cm apart | People at 5 cabbages per season | People at 10 cabbages per season |
|---|---|---|---|---|
| Addenbrookes Hospital, Cambridge | 1765m | 3,530 | 706 | 353 |
| Milton Landfill, Cambridge | 2615m | 5,230 | 1046 | 523 |
| Greedon Quarry | 800m | 1,600 | 320 | 160 |
| Tavistock Avenue, Ampthill | 3050m | 5,100 | 1220 | 610 |

These figures do not take into account any inter-cultivated crops. Assuming an average spacing between trenches of 4.5–5.5m, then a second crop could have been grown between the trenches on most site. This would have doubled the yields and the numbers of people fed in Table 11.

### The scale of the planting trenches

It is useful to contrast the scale of the British planting trenches with examples of horticulture from elsewhere in the Roman world. For example, a number of formal kitchen gardens are located at the rear of the houses at Pompeii. One of these is the House of Pansa, where the garden is laid out in eleven rectangular beds measuring c.25m × c.3m separated by paths approximately 2.5 meters wide, the paths supposedly designed to allow both access and irrigation (Jashemski *et al.* 2017, 122). This would have provided 275m of trenches—not dissimilar to the 325m of trenching at the Chignall Roman Villa in Essex (Clarke et al. 1998, 20, fig. 14). While the layout of these 'house gardens' is not dissimilar to the British planting trenches, the scale is completely different: the beds at the House of Pansa total less than a tenth the length of trenches excavated on the largest examples listed in Table 11. Moreover, like the Chignall villa,

the Italian examples are all attached to households, unlike almost all of the examples reviewed. Plainly, the larger planting trench sites are serving a population many times larger than a villa site. So, while the trenches might have been used for horticulture, the economics which drove their creation was plainly quite different.

## Who created the planting trenches

The labour required to excavate the planting trenches in the first place, along with the volume of crops they might have produced is far above the sorts of kitchen gardens envisaged by the Columella, Pliny or Cato. Columella advises that surplus produce can be sold for revenue, especially if near a town. But oddly, most of the sites identified in this review were not near towns. And over three quarters were more than 10km from the nearest identified villa. To site these plots at some distance from potential markets or consumption seems counter-intuitive. Their placement, however, is plainly not haphazard however, judging by the proximity of so many examples close to Roman roads.

One possibility which might explain the size, labour force and location of planting beds is that they were created and maintained by the Roman army, positioning them near roads where they could provision troops moving between towns and forts. The Roman Army would need an enormous amount of food to maintain the legions that were in charge of infrastructure.

The military would have had the resources and planning to establish these sites, particularly the large sites which would have taken hundreds of person days to dig.

Finally, an association with the Roman military would fit with the dating of most of the trenches in southern England: the first and early second centuries AD. After c. AD 75, most for the legionary forts lay to the north of the study area (Millet 1990: 47, fig. 12): the study area itself appears to have been demilitarised by the second century. If larger volumes of troops were no longer being moved around the civilian-administered south of Britannia, then the need for the army to maintain supply depots between camps would have disappeared.

## DISCUSSION AND CONCLUSIONS

### Formation Processes

The evidence collected in this project suggests the following sequence in the creation and use of these planting trenches.

1. Sites for the bedding trenches were selected near Roman roads.
2. Within the site, the trenches were laid out in parallel, generally spaced 4–8 metres apart. (Wider spacing suggests there might have been second crops cultivated between the trenches as well as in them, although all direct evidence for them has now been lost.)
3. The trenches were dug with a deliberately rectangular profile, almost certainly with a spade. The bulk of those identified measured 60–80cm wide.
4. The original depth of the trenches is not clear because of later ploughing, loss of topsoil, and lack of data in excavation reports. But, as the average depth of surviving trenches dug into natural geology is around 25cm deep, and taking into account 30–50cm of topsoil, they would have been about as deep as they are wide.
5. The trenches were then backfilled almost immediately: a few of those excavated showed signs of flowing water, but most remained distinctly steep-sided and flat-based, implying they were not left open to the weather for any length of time.
6. The trenches appear to have been filled with topsoil from the field in most cases, but a few may also have incorporated material from middens. The presence of pottery sherds and charred plant remains in some of the of planting trenches supports the presence of midden material, but the low counts of both and abraded nature of pottery suggests that midden material was generally not deposited directly into the planting trenches. Rather, it was spread on fields where it became incorporated into the topsoil, and was only subsequently deposited in the planting trenches when they were constructed.

The last point has clear consequences for interpretations of the crops grown in the planting trenches. Environmental sampling from planting trenches has recovered charred plant remains and pollen from a variety of crops. But there is no clear way to distinguish traces from crops grown in planting trenches from those grown in the field immediately before the trenches were dug, or from midden material brought in from outside. Similarly, the presence of snail species favouring wet conditions in the fill of the planting trenches cannot be used to infer that the trenches were lefts open—only that the trenches had been dug in wetter areas.

Charred plant remains are dominated by wheat varieties found on two thirds of samples sites, followed by barley on half and oats on a quarter. Cultivated beans (Fabaceae)and peas (Pisum sativum) were 14% and 11% respectively.

As charred plant remains are almost certainly derived from crop-processing which would not have happened in the fields, pollen provides the best potential evidence for the crops planted in the planting trenches. Apart from Wollaston, where pollen from grape vines was recovered, the plants identified by charred remains and pollen were:

- Trees—elm (*Alnus*), hazel (*Corylus*), pine (*Pinus*), oak (*Quercus*), birch (*Betula*), beech (*Fagus*), lime (*Tilia*), maples (*Acer*), plums and sloes (*Prunus*), juniper (*Juniperus*), and willows (*Salix*)
- grasses (Poaceae) and cereals
- vegetables, most commonly including cabbage and turnip family (Brassicaceae) and lettuce family (Lactuceae), which include both wild and domesticated species.

The scale of planting implies substantial populations being fed. Larger sites might have fed hundreds of people each growing season, even before intercultivated crops are taken into account. The volumes that would have been produced are far larger than the scale seen on even large house gardens, such as those at Pompeii or Chignall Roman villa.

The bulk of pottery recovered directly from the trenches dates to the Late Iron Age and Early Roman periods (1st and early 2nd centuries AD). The general lack of late second or third century pottery across the bulk of sites indicates these planting trenches went out of widespread use by the mid- second century AD (although a few individual sites may post-date this).

Although some of the planting trenches were located near towns and villas, the bulk were not, even though they could have provisioned hundreds of people. The planting trenches were however sited close to roads, suggesting they might have been raised commercially for road users rather than domestic consumption. One possibility is that they might have been planted to support the Roman army during the first century of the Roman occupation, and positioned close to roads in order to provision troops on manoeuvre.

The location of planting trenches close to Roman roads, coupled with the early date of most planting trenches, implies that many parts of the Roman road system in the east of England were in place by the end of the first century AD.

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