The pre-Roman Walbrook landscape and Roman London

Tony Taylor

Introduction

The purpose of this paper is to report on the further research undertaken by the author, which completes his original Walbrook study[1] by revealing the many tributaries, identifying the principle stream(s) and establishing the buried natural landscape prior to the Roman settlement. The study clarifies the landscape's impact on the nascent Roman city and its plan. This has entailed comprehensive research of available data from over 1,800 boreholes and many archaeological sites recording the levels of the superficial deposits of Devensian Langley Silt, Quaternary Terrace Gravels and the underlying Eocene London Clay.

Plotting the data based on the OS grid has enabled the assembly of a map of the landscape surface and its watercourses upon which the future Roman roads, ditches and development of *Londinium* took place. The map extends over an area of some 8 sq km, sufficient to encompass the catchment of the Walbrook and its potential source, together with the streams within the *Londinium* area.

The second part of the paper studies the Roman water engineering required, involving several large ditches in areas west of Ludgate Hill and east of Cornhill and external to the City. The paper describes and clarifies in particular the probable purpose and effect of these Roman ditches together with the impact of the construction of the city wall.

The borehole and well data sources used are mainly from records on the BGS website,[2] apart from the author's own records, obtained by having been responsible for some 15 or more developments in the City, including Broadgate, and its environs.[3] In addition, information has been obtained from published archaeological sites and more recent boreholes, including from Crossrail.

The mapping and creation of the Walbrook buried landscape surface, derived from the recorded level information, is based on the author's engineering experience in interpreting borehole level data. In this study, the mapping involved creating the contours of the surface of both Terrace Gravels and the London Clay at 1m intervals.

Although this research concentrates mainly on the area of *Londinium*, by extending the research northward beyond Islington, the principal tributaries can be more accurately mapped in terms of landscape and stream-bed levels. On the other hand, the plotting of the level contours associated with the short tributaries

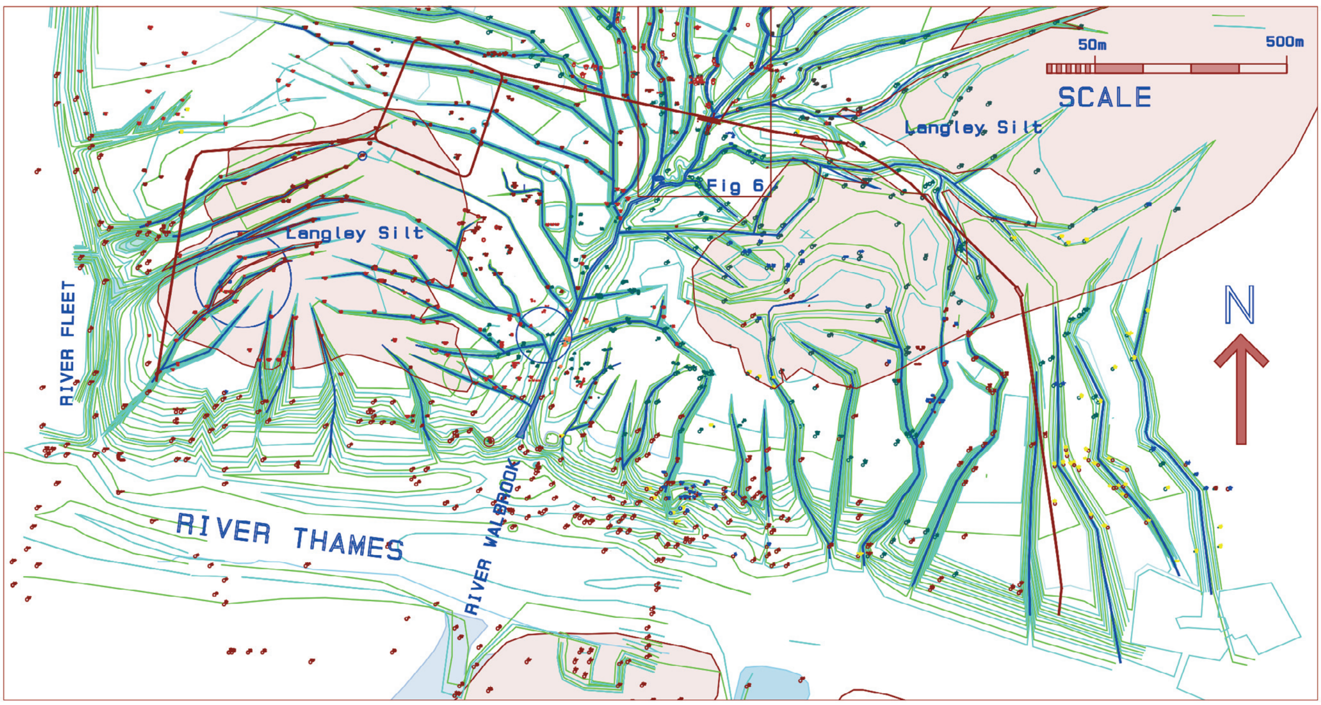

Fig 1: the pre-Roman landscape of the future area of *Londinium* (delineated by the later city wall) showing the Walbrook and other streams, based on borehole data (small dots), and where blue circles denote areas of doubt. The area around Drapers' Gardens and Eldon Street, north of the city wall, features in Fig 6.

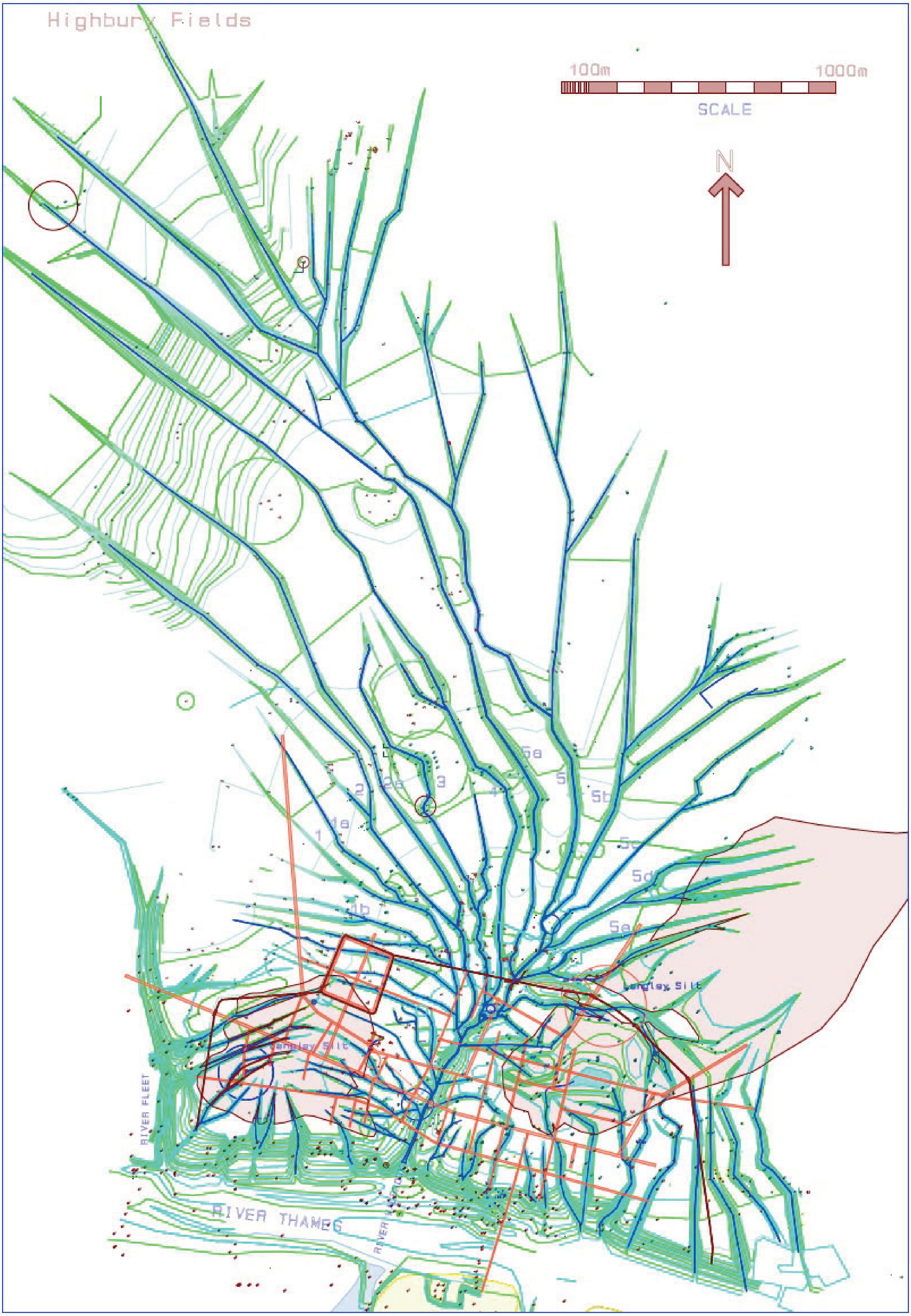

Fig 2: the extent of the catchment area of the Walbrook, and the wall and roads of *Londinium*

draining off Cornhill and Ludgate Hill is more problematic. This is due to having fewer relevant boreholes to accurately determine the bed levels of the streams. In these areas, the author has also studied stream locations identified on archaeological sites, such as 1 Poultry and the Roman amphitheatre at Guildhall for example, and the current *Londinium* map.[4]

Mapping the contours

The mapping of the various stream beds eroding the London Clay is based on locating the lowest relative clay levels found in borehole or well data within any particular area. The data have then been plotted on the OS location as stated in the record or adjudged from any map provided. These lowest clay levels were assumed to be within the banks of stream valleys formed in the clay surface. The distribution of these lower levels was then used to establish the continuity of likely streams.

The stream valleys were allotted side gradient contours ranging from a steep 1:1.5 for fast flowing to a shallower 1:2.5 or more for the slowing streams across the Hackney plain (see Fig 2). The natural clay surface levels were then plotted and co-ordinated with archaeology where known, building up a landscape surface of the local Thames Basin.[5] Thus working northwards from the Thames a provisional system of tributaries can be proposed.

Progressing northwards, the discovery of borehole records with a clay level lower than surrounding levels, indicated that it lay within one of the tributaries. In this way, the estimated contours can be readjusted and also reviewed in adjacent tributaries. Using this process, it has been possible to attribute locations and gradients to the various stream beds. Progressively these can be reconfirmed by results from records found further north.

The direction of secondary streams is based on surrounding factors, and it is possible that in some of the shorter streams, the interpretation might be incorrect. Areas of doubt are noted by circles, particularly where the borehole data are minimal and unreliable.

Given the number of older records, the author opted not to translate to current OS Newlyn datum where the Liverpool datum was given. It should be understood that any current datum levels in an area associated with the deeper depths of the underlying London Clay can be somewhat lower than earlier times.[6] However, it was noted nearly 80 years ago that the water extraction had been much reduced[7] and this continues, causing a partial rebound in clay levels in affected areas.

In the worst cases, it was necessary for the current local ground-level data to be used to assess depth levels. As noted above, for the short tributaries, mapping near the source of the longer streams was also tenuous and particularly in the northern areas, due to there being fewer boreholes and data. This leads to possible imprecise locations of where stream beds are located. In these areas the stream-bed locations shown are essentially intelligent extrapolations.

Further mapping of the Terrace Gravels was undertaken in case the original stream location in the London Clay was displaced by the (re)deposition of the gravels. Logically the main streams in the deposited gravels would generally follow the stream valleys in the clay, although the gravel deposition is not necessarily centralised to the bed in the clay and, in some cases, were found to be locally eroded. This process of building a gravel-surface map led to some interpretation difficulties in areas where the data are widely spread, such as in residential areas with few boreholes.

However, on a more positive note, when studying the map of the Langley Silt surface in the area of *Londinium* (see Fig 2) covering parts of Ludgate Hill and all of Cornhill,[8] this study found that almost all of those stream locations showed a surface stream erosion of the Langley Silt close to the stream, many metres below in the London Clay. Various Walbrook stream locations in the London Clay are undisturbed and represent those prior to the Roman period. To a lesser degree, the gravel contours are also indicative of the Roman period landscape, but they will have experienced local changes due to occupation of the land.

The Walbrook catchment

This research has identified many tributaries which have formed a dendritic drainage pattern, sending watery tendrils through the extent of the catchment area (Fig 2). Five or more major northern tributaries have been identified feeding into the Walbrook stream. It has been possible to assess which of these several longer tributaries may be defined as the primary Walbrook. These major tributaries were fed by many minor streams which in turn branched out into two or more streamlets each.

It is clear now from this research that one of these primary feeder streams was located in the archaeological section excavated on the Broadgate site in 1984, just east of the primary Walbrook stream.[9] South of the line of the future wall, further minor tributaries fed into the Walbrook stream off the shoulders of Cornhill and Ludgate Hill.

A measurement carried out on the catchment of each of the five primary tributaries from the north, gives some indication as to their area and flow capacity. The principal stream of these from the north would represent the Walbrook as used by the Romans, based on the size of the water flow at that time. These size factors are directly related to the catchment area of each of the five tributaries.

The more detailed mapping of this research extended the catchment area of the Walbrook from that previously proposed. For streams 1–5, the catchment is now estimated at 6.33 million sq m (633 hectares), some 20% larger than previously estimated by the author.[10] The small contribution from streams discharging from Ludgate and Cornhill has been ignored. Tributary 4 on the eastern side of the catchment has its own catchment area estimated at 1.85 million sq m.

Adjacent on the eastern edge, tributary 5 has a catchment area estimated at 2.98 million sq m. This implies that, in the western system, tributaries 1–3 have a combined area of only 1.5 million sq m. Hence tributary 5, which this research has shown to rise in Highbury Fields, carries almost half the discharge of the Walbrook catchment north of the future city wall and is, therefore, the principal stream.

The research data have enabled a longitudinal profile (Fig 3) to be drawn along the bed of the principal Walbrook stream from its high point in Highbury Fields flowing down to Walbrook

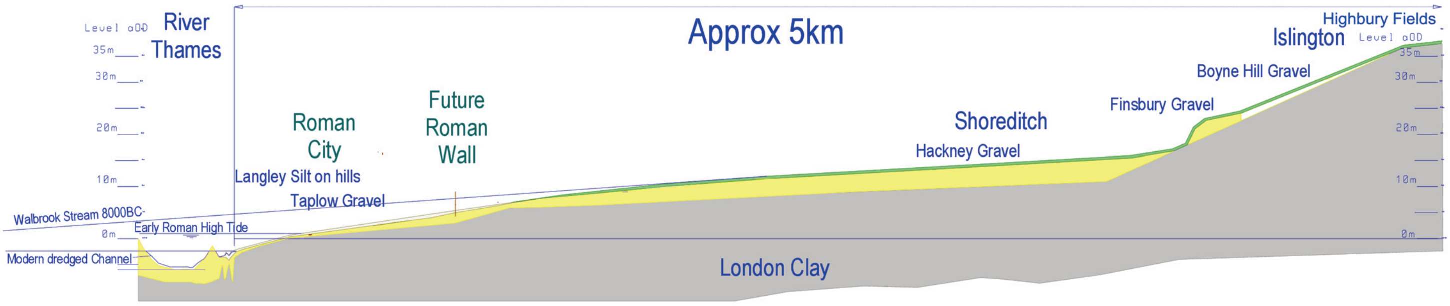

Fig 3: reconstructed longitudinal gradient profile of the pre-Roman Walbrook from its source in Highbury Fields in AD 45

Wharf. This is a distance of almost 5 km overall, with an elevation change found to be 42m and an average fall of 1:120.

The course of the Walbrook

The principal stream (tributary 5) of the Walbrook rose from a source on the south side of Highbury Fields where the London Clay lies directly below the surface. A parallel stream to the west rose from part of Barnsbury around Arundel Square (see Fig 2). None of the streams are visible today, due to centuries of made-up ground levels and surface-water drainage systems. However, within the Terrace Gravel bed, a continuous residual flow remains, percolating downstream along the various tributary streams of the Walbrook into the Thames.

These two source streams conjoined just north of Prebend Street and were then joined by three smaller tributaries. The Walbrook then ran southwards crossing the line of the Grand Union Canal at the western end of Eagle Wharf Road, south of Bevan Street. Further south it ran parallel to Provost Street. The stream then headed south-east towards Great Eastern Street but, on crossing Old Street, turned to be joined by a tributary from the north.

The stream then continued south in Shoreditch, parallel with Paul Street, and crossed Worship Street along the line east of Clifton Street and then on, crossing Sun Street at the eastern end. The flatter gradient here may have caused meanders to occur rather than the straighter streams illustrated. From here it flowed gently south under the Broadgate site to the west side of Broadgate Circle where was joined by an eastern tributary from the north. This tributary was found in the excavation at Broadgate in 1984.[11] It passed close to the 16th-century theatres, The Curtain and The Theatre, as well as the Priory of Holywell.[12]

The Walbrook then ran south from Broadgate at the east end of Eldon Street and flowed down the line of Blomfield Street, collecting further tributaries from the north-east that ran through the Broadgate and Liverpool Street Station sites. At the south end of Blomfield Street, it would have met the future line of the Roman wall. From here it flowed south to the east of Carpenters Hall and then bent towards the south-south-west.

The author's earlier research on the Drapers' Gardens site[13] placed the channel under the south end of Throgmorton Avenue. It then circled around the Drapers' Gardens site to the west under Copthall Avenue (somewhat displaced by local Roman land filling) before it turned to the south-west under Copthall Chambers. A further tributary from the north joined it on the western side. It then flowed under Tokenhouse Yard, just south of Kings Arms Yard, and was joined by a further tributary from the north on the west side.

The stream continued south to cross under Lothbury with a further tributary joining on the eastern side before it turned to the south-west under where the Bank of England now stands. After this, it crossed Princes Street before it turned south-south-west to flow under where Mansion House Square is located and where three tributaries joined it as it passed the eastern end of where 1 Poultry now stands. From there, it turned slightly south to cross under Bucklersbury and ran parallel to the western side of Walbrook (the medieval street) and passed the western end of the Temple of Mithras (partially restored within the Bloomberg Building).[14] It was then joined by a further tributary from Ludgate Hill.

The final length of the stream crossed under Cannon Street west of Dowgate Hill, where the Romans later constructed a bridge across the stream. The Walbrook then collected a further tributary from the west. In the 1st century, the stream finally ran under the

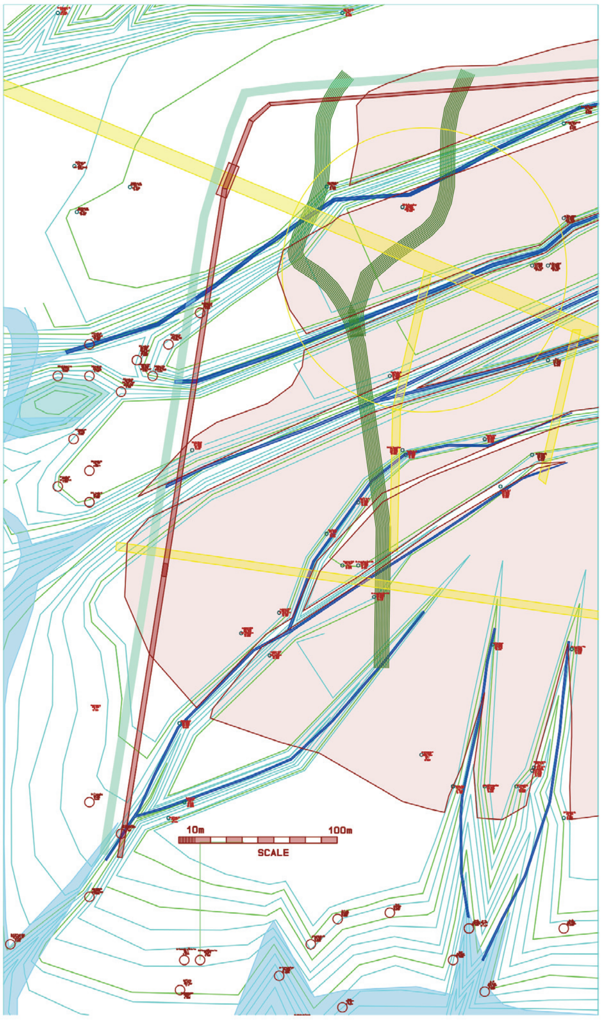

Fig 4: the area of the Western Stream

west side of the Tallow Chandlers and Skinners Halls respectively to enter the Thames at low tide around College Street (where an outfall still exists).

The various streams on the south side of Ludgate and Cornhill entered the Thames directly and are not therefore within the catchment. These were subject to the tides in the early period of the 1st century. Tide levels, estimated from Southwark levels, probably did not exceed 1.5m above OD, and Thames river natural inlets have been indicated based on these levels. Based on the provisional high tide level of up to 1.5m OD, the river would have encroached up the Walbrook as far as the northern end of modern Bucklersbury at high tide. Shallow vessels could, therefore, have carried goods on the tide into the centre of the city.

Early Roman London

The decision by the Romans to build a settlement initially in the area dominated by Cornhill relates, in the author's view, to the river crossing from Southwark and the early establishment of docks needed to bring in people, building and other materials from downriver and the continent. Cornhill is the last significant high ground on the north bank having views down to the estuary and is an obvious potential military location. Here a possible early fort/defensive ditches have been located on the east bank of the Walbrook, found during excavations at Walbrook Building.[15] Later, the Romans extended the settlement across the Walbrook and settled on Ludgate Hill.

Creating the settlement involved site clearance of mainly scrub, and would have focussed on laying down primary access roads interlinking long-distance roads within the settlement. The Roman roads, as they later developed, are shown in red on Fig 2. Stream crossings of the Walbrook itself required bridges, as demonstrated by an early trackway uncovered on the south side of Drapers' Gardens.[16] The trackway was found on both sides of the Walbrook and was constructed at a level above the river, indicating a bridging of the Walbrook. Other bridging points were also found along the length of the Walbrook.[17]

As development continued, surface water run-off was taken into deep roadside drains and directed into the Walbrook or one of the larger local tributaries. Minor tributaries would have then become redundant and subject to being filled in as development continued. The Romans carried out water management on the various streams. For example, the 'Broadgate trench' identified a large Roman embankment of brickearth running northwards. The problem of the Walbrook and tributaries flash floods causing damage within the city was only eliminated when the city wall was constructed across the Walbrook and its tributaries.

This study primarily determines the landscape prior to the Roman settlement. The pre-Roman landscape of *Londinium* is illustrated in Fig 1. By overlaying the Roman road network, it has shown how this integrated with the natural landscape (see Figs 4, 5 and 6). There are residual links of that network today. There are, however, several other effects on the Roman city landscape – not least being the construction of the Roman wall and several large-scale ditches as discussed below.

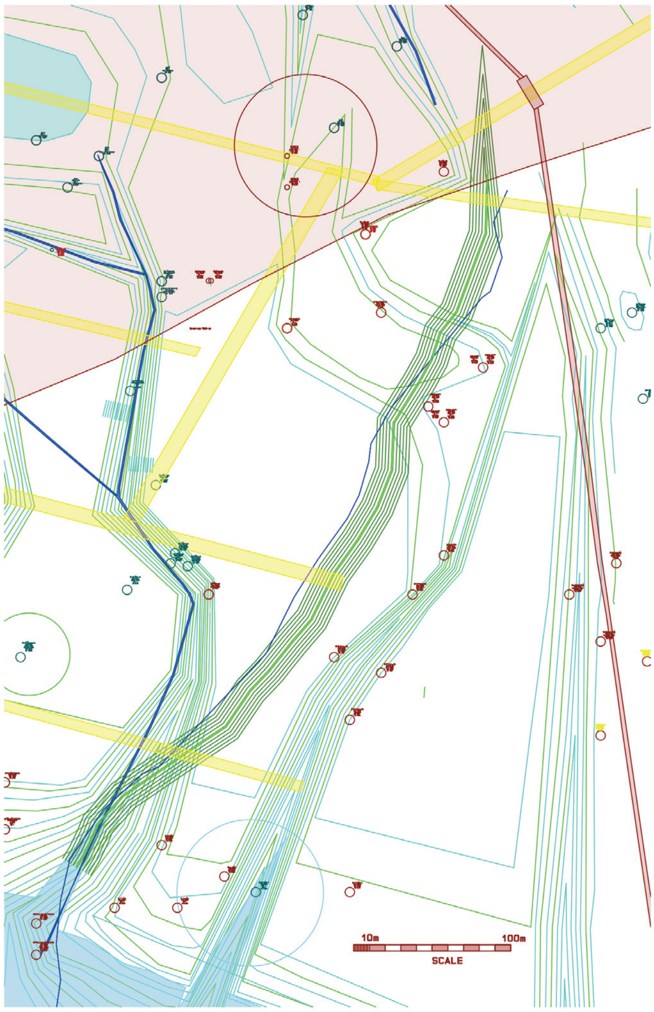

Fig 5: the area of the Lorteburn, the eastern stream

Excavation results

The important site at Drapers' Gardens[18] uncovered an extensive area of Roman development beside the Walbrook on its eastern side (see Fig 6) over a long period. The water was diverted from the Walbrook into revetted timber channels for various industrial uses including potentially milling. The final report is awaited,[19] but the detailed dating of the site layers and the adjacent sites have revealed, as part of an intricate history, occupation with datable land-filling activities alongside and over the Walbrook.

The MOLA excavations in Finsbury Circus,[20] revealed a west–east ditch some 6m across (parallel with modern Eldon Street) which discharged eastwards. It dated to the early part of the 2nd century. The mapping shows the ditch discharged the water into a Walbrook tributary stream at the west end of modern Liverpool Street. From this study, it is clear that the ditch intercepted the surface water streams of two tributaries (see Fig 6). It can be assumed the ditch was dug to prevent the tributaries washing away the graves just south of the ditch – evidence for which can be found in various excavation reports.

In addition, on the Drapers' Gardens site further south, the signs of an earlier tributary were exposed coming through from Finsbury Circus. The signs indicated a dried-up stream in the surface of the gravel entering from the north-west corner. Cores on the same site indicated a deeper north–south channel in the London Clay. The diversion ditch above may also have been made to increase the flow in the main Walbrook as it passed through the Drapers' Gardens site,

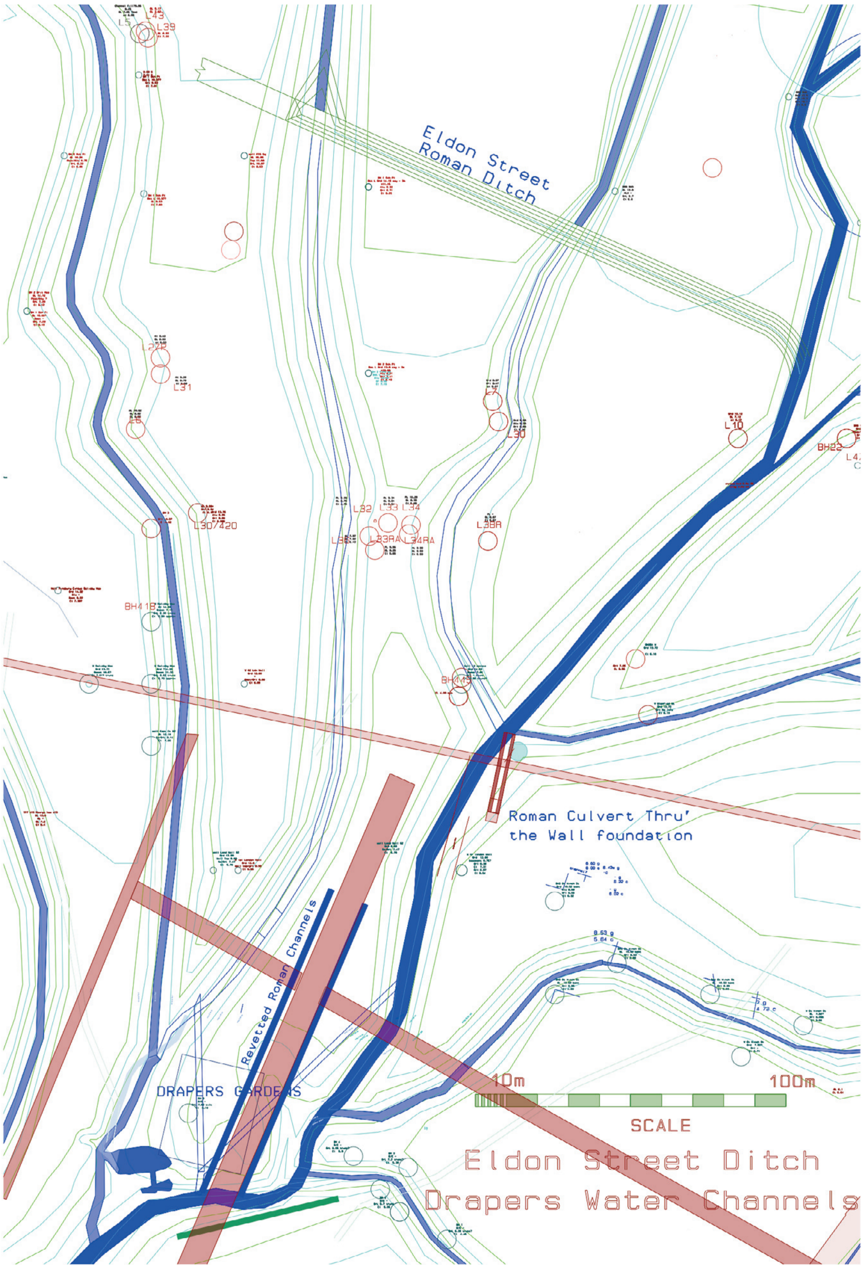

Fig 6: the north-eastern area of the Roman town showing the early 2nd-century Eldon Street Roman ditch north of the city wall, the culvert set through the wall and the Walbook streams flowing down to the revetted channels at Drapers' Gardens

where potential for a watermill remains a possibility.

At the south end of Blomfield Street, this same Walbrook tributary was diverted into a long culvert by the Romans to pass through the wall foundation. The culvert was discovered during the installation of new City drains in 1837.[21] My earlier article[22] explained that the culvert would have been too small to discharge the full accumulated flow from the tributaries north of the wall line, particularly during periods of high rainfall.

The level of the masonry invert of the culvert most probably represented the bed of the Walbrook at the time the wall was built. This level can be extrapolated from the 'Temple Period' filling layers building up a short distance downstream at Drapers' Gardens.[23] This period, dated to between AD 250 and 300, would also apply to the construction of this length of the wall.

The culvert would have created serious constriction to flows and flood waters which, if no longer being properly maintained, would have been the major factor in flooding north of the wall that continued into the medieval period. On the other hand, it almost certainly protected *Londinium* thereafter from major flooding, which is confirmed by the archaeology at Drapers' Gardens. The surface water surplus from the area north of the constructed wall and the resulting flooded landscape could only find its way to the Thames eastwards or westwards along the external city ditch. Given the culvert restriction on flows after the wall was constructed, it is questionable for how long that water-powered milling operations, dependent on the Walbrook, would have been able to continue within the city.

The Western Stream and the Lorteburn

This study of the landscape has also examined the two major Roman ditches found within *Londinium*, the Western Stream and the Lorteburn, described by Bentley[24] and shown in Figs 4 and 5 respectively. It is apparent that the Western Stream intercepts three or more natural streams flowing into the Fleet. The Western Stream at its southern end appears to discharge into a short natural tributary of the Thames.

One obvious observation is that these diversions were related in some way to the construction of the perimeter Roman wall or an earlier boundary. Once constructed, the wall or boundary structure would have acted as a blockage to the surface water streams flowing to the west off Ludgate Hill. However, the record also indicates the Western Stream's northern arms commenced beyond the wall. This may be because any initial construction pre-dated the wall's construction and was filled in when the wall was constructed.

The eastern slope of Cornhill is more complex in that there is no Fleet river equivalent into which streams could flow. There appear to be streams in the north-east corner flowing north-west around the hill into the Walbrook and a small stream flowing south within the wall. However, the streams which flowed into the Walbrook would have been cut off by the wall construction. The result would have been a lake forming against the wall, if it were not for a new drainage ditch flowing south into the Thames, which the Lorteburn logically provided.

The other stream flowing south into the Thames alongside may have proved a problem for the organisation and defence of the wall. Hence, by providing an alternative drain away from the wall; this would have allowed the natural stream to be filled in to create a level surface up to the wall.

These ditches intercepting major streams were an enterprise of serious earth movement. Taking dimensions from Bentley's sketches for the Western Stream gives an overall total of at least 30,000 cu m of gravel, silt and soil. Once the surface water streams had been diverted and the remainder filled in, the area between the Western Stream and the wall was ready for development. By dating these ditches, it may be possible to date more securely the wall's construction in that area.

Water production

It is highly unlikely, in the author's view therefore, that the Walbrook directly provided potable water to the city as it developed. The stream inevitably would have been used to remove human and industrial waste and collect run-off from the many roadside ditches.

Many Roman wells have been found which were typically timber-lined through the terrace gravel and, in most cases, cut into the London Clay below, as at the Bank of London and South America site at Queen Street/Queen Victoria Street.[25] The site was discovered to contain 11 wells, six of which were timber-lined. One deep well contained a wooden ladder and a pair of leather briefs (see cover), both now displayed at the Museum of London.

In the case of the mechanical water lifting devices,[26] the wells were constructed through the deep gravel strata and were timber-lined, allowing water to enter only at the base, thereby increasing the length of filtration. Many smaller domestic wells were constructed a safe distance from the stream into the gravel where clean water was available.

Conclusion

The process of mapping the contours of the clay is not without problems but this study has provided a general picture of the landscape and some real detail on not only the Walbrook itself, but also the minor streams within *Londinium*. The research has revealed to a degree the relationship of the natural landscape and its waterways with the developing city.

The importance of checking clay levels on sites would add greatly to our current knowledge and understanding of that early landscape, and the author would earnestly recommend that geoarchaeologists are able do that where possible on future excavations in London.

Acknowledgements

The views and discussion in this paper are the culmination of my work as a civil engineer in the City and I have discussed the evidence with various archaeologists over time and with reference to the different excavations in which I have been involved over a number of years. This paper has relied on years of my own mapping and drafting and my grateful thanks go to Foggo Associates for the use of their drawing facilities and help.

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1. T Taylor, 'A study of the River Walbrook through Roman London' *London Archaeol* **13** (4) (2012), 95–9.
2. BGS Viewer: http://tinyurl.com/u48vu5z [accessed 6 April 2020] British Geological Soc. Contains British Geological Survey materials ©NERC 2019.
3. The author's 'City' Projects 1983–2010: Finsbury Avenue; 1–4 Broadgate; Paternoster; 60 Queen Victoria Street; 168 Fenchurch Street (S E Forum); 131 Finsbury Pavement; 111 Old Broad Street; 280 Bishopsgate (Spitalfields external works and access); Gresham Street (Roman Bucket Chains); Temple of Mithras; City Waterside; Riverbank House; Drapers' Gardens; Cannon Place and Station (Roman 'Governors Palace'); 'The Theatre' Hackney.
4. J Hill & P Rowsome *Roman London and the Walbrook stream crossing* (2011) MOLA Monogr 37; N Bateman, C Cowan and R Wroe-Brown *London's Roman amphitheatre: Guildhall Yard, City of London* (2008) MOLAS Monogr 35; Londinium: *a new map and guide to Roman London* MOLA (2011).
5. K R Royse *et al* 'Geology of London, UK' *Proceedings of the Geologists' Association* **123**, Issue 1 (Jan 2012), 22–45.
6. This is due to underdrainage of the London Clay, caused by significant water extraction from the underlying chalk and gravel beds, commencing from the early Victorian period, leading to shrinkage (drying out) of the clay column. However, local level relationships will not be affected due to the very gradual level change over a distance.
7. G Wilson & H Grace'The Settlement of London due to underdrainage of the London Clay' *Journal Inst Civil Engineers* **19** Issue 2 (Dec 1942), 100–27.
8. *Op cit* fn 2.
9. *Ibid*.
10. *Op cit* fn 1.
11. See http://tinyurl.com/ut98x6c [accessed 6 April 2020], 51–2.
12. Excavations at the sites of The Curtain Theatre and The Theatre, built in the grounds of the former Priory of Holywell, in Shoreditch. In the case of the Curtain, they revealed a trace of a dried-up stream through the site in the gravel, which could have supplied water to the theatre, where it would have been needed for brewing.
13. N Hawkins 'New evidence of Roman settlement along the Walbrook: excavations at Drapers' Gardens' *London Archaeol* **12** (6) (2009), 153–60.
14. J Shepherd *The Temple of Mithras, London: Excavations by W F Grimes and A Williams at the Walbrook* English Heritage Arch Rep 12 (1998), 216–17.
15. Early Roman ditches were found during excavations for Walbrook Building (WAO06) in Walbrook/Cannon Street that may have formed part of an early military enclosure as suggested by H Sheldon & R Merrifield 'Roman London Bridge: A View from both Banks' *London Archaeol* **2** (8) (1974), 183–91.
16. *Op cit* fn 13.
17. *Op cit* fn 4.
18. *Op cit* fn 13.
19. N Hawkins, J Gerrard, K Hayward, K Rielly, B Sudds & V Ridgeway *Excavations at Drapers' Gardens, City of London* PCA monogr (forthcoming).
20. C Harwood, N Powers & S Watson *The upper Walbrook valley cemetery of Roman London – Excavations at Finsbury Circus, City of London, 1987–2007* (2015) MOLA Monogr 69.
21. Reproduced from C Roach Smith *Illustrations of Roman London* (1859) in RCHME: Vol 3 *Roman London* (1928), 87–9, Pl 27.
22. *Op cit* fn 1, 97–8 and Fig 5.
23. *Op cit* fn 13.
24. D Bentley 'Western Stream reconsidered: an enigma in the landscape' *London Archaeol* **5** (12) (1987), 328–34; D Bentley 'A recently identified valley in the City' *London Archaeol* **5** (1) (1984), 13–16.
25. T Wilmott 'Excavations at Queen Street, City of London, 1953 and 1960, and Roman timber-lined wells in London' in *Trans London Middlesex Archaeol Soc* **33** (1982), 1–78.
26. I Blair, R Spain, D Swift, T Taylor & D Goodburn 'Wells and bucket-chains: unforeseen elements of water supply in early Roman London' *Britannia* **37** (2006), 1–52.