



THE GREAT EASTERN RAILWAY

London Boroughs of Newham, Tower Hamlets and Waltham Forest

Standing structure survey

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THE GREAT EASTERN RAILWAY

London Boroughs of Newham, Tower Hamlets and Waltham Forest

Standing structure survey

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Project Manager
Author
Graphics

Kieron Tyler
Emma Dwyer
Judit Peresztegi

Museum of London Archaeology Service

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Mortimer Wheeler House, 46 Eagle Wharf Road, London N1 7ED

tel 020 7410 2200 fax 020 7410 2201

email molas@molas.org.uk

web www.molas.org.uk

PCA

Unit 54, Brockley Cross Business Centre, 96 Endwell Road, Brockley, London SE4 2PD

tel 020 7732 3925 fax 020 7732 7896

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SUMMARY (non technical)

The Museum of London Archaeology Service and Pre-Construct Archaeology (MoLAS-PCA) were commissioned by the Olympic Delivery Authority to analyse and record, by means of a photographic survey of its structure and setting, the former Great Eastern Railway Mainline, between Fairfield Road in Bow and Stratford Station, and the Great Eastern Railway line to Cambridge, from Stratford Station to the A12 East Cross Route. In addition, the Great Eastern Railway bridge across the River Lea, the railway viaduct between Pudding Mill Lane and the City Mill River, and the railway bridge across Carpenter's Road were investigated by means of measured survey and photography. The railway structures were to be removed or altered in order to redevelop the site, and the archaeological investigation and a subsequent report were required as a condition of planning consent for the redevelopment. The investigation took place periodically from June to September 2007.

The Eastern Counties Railway from London to Romford was constructed between 1836 and 1839, to designs by the ECR's chief engineer, John Braithwaite. In contrast to London's East End, where a brick viaduct was constructed at considerable expense to carry the railway above crowded streets, the railway was carried across the Lea valley on an embankment, raising it above the flood-prone marshes. A number of bridges were incorporated into the embankment, and a short viaduct was constructed to carry the railway between Pudding Mill Lane and Marshgate Lane.

The Eastern Counties Railway amalgamated with a number of smaller railway companies in 1862, forming the Great Eastern Railway. The railway embankments, viaduct and bridges over the River Lea, City Mill River, Waterworks River, Warton Road and Carpenter's Road were successively widened in order to meet the increase in railway traffic that occurred throughout the late 19th and early 20th centuries. The expansion of the railway network across the Lea Valley attracted businesses which had formerly been based in the centre of London to the area, settling previously undeveloped parts of the Lea and allowing businesses to expand their premises.

The Railways Act of 1921 created the 'Big Four' railway companies, and the Great Eastern Railway became part of the London and North Eastern Railway Company in 1923. Following a period of neglect of the railways during the First World War, investments were made to improve the infrastructure, and the Great Eastern Railway was widened in 1923 and 1936. During the post-Second World War period use of the railways declined, however, and no new investment was made until the 1980s, when the Docklands Light Railway was constructed.

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1 Introduction

1.1 Site background

In the Olympic Park area (“the site”), the former Great Eastern Railway Mainline from London to Romford and mainline from Stratford to Cambridge was recorded. The former is aligned east-west and continues eastwards beyond the site and Stratford Station. The latter is integral to the former, is aligned north-south, projects north from Stratford Station and thence to Cambridge (Fig 1).

The areas surveyed were in part on the western side of the River Lea, in the London Borough of Tower Hamlets, and in part on the southern side of the A12, in the London Borough of Waltham Forest; the remainder being located entirely within the London Borough of Newham.

Within the Olympic Park, the Great Eastern Railway Mainline is aligned north-east from OS National Grid Reference 537520 183320 in the south-west, to 538800 184700 in the north-east (Fig 2). At the south-eastern end of the site, the railway is carried on an embankment and crosses Wick Lane, the A12 Blackwall Tunnel Northern Approach and the River Lea. A viaduct then carries the railway over Pudding Mill Lane, Marshgate Lane, the Northern Outfall Sewer and the City Mill River, after which the railway returns to being carried on an embankment. Bridges carry the railway over the Waterworks River, Wharton Road and Carpenter’s Road before the railway reaches the higher ground on which the centre of Stratford is located, and the Great Eastern Railway Mainline approaches Stratford Station at ground level.

The Stratford to Cambridge mainline of the Great Eastern Railway branches northwards from Stratford Station at 538520 184440 and curves north-west, leaving the Olympic Park at 537690 186030 (Fig 3). The railway crosses the approach to Stratford International Railway Station and is crossed by bridges carrying Temple Mill Lane and the A12 East Cross Route before leaving the study area.

The areas of the Great Eastern Railway that were recorded were located in Planning Delivery Zones 1, 2, 3, 4, 6, 8, 9, 11 and 14 of the Olympic and Paralympic Games and Legacy Facilities planning applications. See Fig 1 for site location and the limits of Planning Delivery Zones 1, 2, 3, 6, 8, 9, 11 and 14 (in red).

A number of desk top *Archaeological and Built Heritage impact assessments* were previously prepared by MoLAS-PCA, which cover the whole area of the site, namely Planning Delivery Zones 1, 2, 3, 4, 6, 8, 9, 11 and 14 (MoLAS-PCA, 2007a, 2007b, 2007c, 2007d, 2007e, 2007f, 2007g, 2007h, 2007i).

These documents should be referred to for information on the natural geology, archaeological and historical background of the site, and the initial assessment of its archaeological potential.

The historic infrastructure of parts of the Great Eastern Railway has been the subject of previous archaeological investigations carried out by the Museum of London Archaeology Service. The site of the former Bishopsgate Goodsyards, the original terminus of the Great Eastern Railway before the construction of Liverpool Street Station, was subject to standing building recording and excavation between 2005 and 2007 in advance of the extension of the East London Line of the London Underground, and its incorporation into the London Overground network. Part of the railway viaduct on the site, constructed between 1839 and

1842 to a plan by the Eastern Counties Railway's architect, John Braithwaite, and which carried trains into the terminus, was listed as a building of special architectural or historic interest, Grade II, in 2002. The listing entry is in Appendix 1.

A further, unlisted, stretch of the Braithwaite viaduct, between Brick Lane and Fleet Street Hill in Shoreditch was subject to standing building recording and archaeological evaluation during 2007, prior to its demolition in advance of the extension of the East London Line of the London Underground.

The recording of the railway bridges over Warton Road and the Waterworks River (OL-00305) was reported in an earlier document (MoLAS-PCA 2005), the results of which are summarised in this report.

The Great Eastern Railway (GER), its predecessor the Eastern Counties Railway (ECR), and its successor organisations the London and North Eastern Railway (LNER) and British Railways have been the subject of a number of publications. Some of these publications mention the stretch of railway covered by this report. These include:

- Allen, C J, 1975 *The Great Eastern Railway* Ian Allan Ltd, London
- Gordon, D I, 1990 *A Regional History of the Railways of Great Britain: Vol. 5: The Eastern Counties*, 3rd ed. David & Charles
- Moffat, H, 1987 *East Anglia's First Railway* Terence Dalton, Lavenham

The recorded structures are as follows (NB – they are listed here in ascending numerical order of their site codes: elsewhere in this report they are discussed in order of geographical confluence, with relevant site code references):

1.1.1 OL-02407: photographic survey of the Great Eastern Railway's London to Romford mainline and Stratford to Cambridge mainline.

The London to Romford mainline runs north-east from OS National Grid Reference 537520 183320 in the south-west, to 538800 184700 in the north-east. The Stratford to Cambridge mainline branches northwards from Stratford Station at OS National Grid Reference 538520 184440 and curves north-west, leaving the Olympic Park at 537690 186030. Within the project this was referred to as BH34.

1.1.2 OL-05307: Great Eastern Railway bridges from the Lea River to the City Mill River

The bridge that carries the railway over the River Lea in the southern corner of PDZ3, and the viaduct that carries the railway over Pudding Mill Lane, Marshgate Lane, the Northern Outfall Sewer and the City Mill River in the southern and eastern corners of PDZ2 and PDZ3 respectively and along the north-west edge of PDZ8. Within the project this was referred to as BH78.

1.1.3 OL-05807: Great Eastern Railway Bridges over the Waterworks River, Warton Road and Carpenter's Road

The bridge that carries the railway over the Waterworks River in the southern, eastern and northern corners of PDZ1, 2 and 8 respectively (referred to within the project as BH85); the bridge that carries the railway over Warton Road in the southern corner of PDZ1 ((referred to within the project as BH84); and the bridge that carries the railway over Carpenter's Road on the south-eastern edge of PDZ1 (referred to within the project as BH83).

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Note: within the limitations imposed by dealing with historical material and maps, the information in this document is, to the best knowledge of the author and MoLAS-PCA, correct at the time of writing. Further archaeological investigation or more information about the nature of the present building may require changes to all or parts of the document.

1.2 Planning and legislative framework

The legislative and planning framework in which the archaeological exercise took place was summarised in the desktop *Archaeological and Built Heritage impact assessments*, previously prepared by MoLAS-PCA, which cover the whole area of the site (MoLAS-PCA, 2007a, 2007b, 2007c, 2007d, 2007e, 2007f, 2007g, 2007h, 2007i) and *the Method Statements* (MoLAS-PCA 2007j, 2007k, 2007l), which formed the project design for the survey.

These documents should be referred to for information on the natural geology, archaeological and historical background of the site, and the initial assessment of its archaeological potential.

The structure is not a Scheduled Monument, nor is any part of it listed as a building of special architectural or historic interest. No part of the railway is located in an Archaeological Priority Zone. Towards the western end of the study area, the Great Eastern Railway runs through the Fairfield Road Conservation Area.

1.3 Planning background

1.3.1 Planning Delivery Zones 1, 2, 3, 4, 6, 8, 9 and 10

In accordance with local and national policies, archaeological evaluation and built heritage survey of the areas of PDZ1, 2, 3, 4, 6, 8, 9 and 10 to be impacted upon in advance of its redevelopment was required as part of the planning process. Evaluation is intended to define the archaeological potential and significance of any deposits present on the site, so that the local authority can formulate responses appropriate to any identified archaeological resource.

The recording of the subject site(s) in PDZ 1, 2, 3, 4, 6, 8, 9 and 10 will be undertaken in support of a condition required by English Heritage and attached to the consent granted by the Olympic Delivery Authority Planning Decisions Team with respect to Olympic, Paralympic and Legacy Transformation Planning Application Reference 07/90010/OUMODA and Site Preparation Planning Application Reference 07/90011/FUMODA. Condition SP.0.39 of planning permission 07/90011/FUMODA states:

Demolition of any historic building specified for recording in the submitted Built Heritage Written Schemes of Investigation shall not take place until the recording set out in the relevant Written Scheme of Investigation has been undertaken and written confirmation received from English Heritage that the recording is satisfactory and that the building can be demolished. A report detailing the recording shall be submitted to the Local Planning Authority within six months of the written confirmation received from English Heritage.

Reason: To ensure that buildings with an identified historic interest are recorded.

1.3.2 Planning Delivery Zone 11

In accordance with local and national policies, archaeological evaluation and built heritage survey of the areas of PDZ11 to be impacted upon in advance of its redevelopment was required as part of the planning process. Evaluation is intended to define the archaeological potential and significance of any deposits present on the site, so that the local authority can formulate responses appropriate to any identified archaeological resource.

The recording of the subject site(s) in PDZ11 will be undertaken in support of a condition required by English Heritage and attached to the consent granted by the Olympic Delivery Authority Planning Decisions Team with respect to Olympic, Paralympic and Legacy Transformation Planning Application Reference 07/90010/OUMODA and Site Preparation Planning Application Reference 07/90011/FUMODA. Condition OD11.2 of planning permission 07/90010/OUMODA states:

Demolition of any historic building specified for recording in the submitted Built Heritage Written Schemes of Investigation shall not take place until the recording set out in the relevant Written Scheme of Investigation has been undertaken and written confirmation received from English Heritage that the recording is satisfactory and that the building can be demolished. A report detailing the recording shall be submitted to the Local Planning Authority within six months of the written confirmation received from English Heritage.

Reason: To ensure that buildings with an identified historic interest are recorded.

1.3.3 Planning Delivery Zone 14

In accordance with local and national policies, archaeological evaluation and built heritage survey of the areas of PDZ14 to be impacted upon in advance of its redevelopment was required as part of the planning process. Evaluation is intended to define the archaeological potential and significance of any deposits present on the site, so that the local authority can formulate responses appropriate to any identified archaeological resource.

The recording of the subject site(s) in PDZ14 will be undertaken in support of a condition required by English Heritage and attached to the consent granted by the Olympic Delivery Authority Planning Decisions Team with respect to Olympic, Paralympic and Legacy Transformation Planning Application Reference 07/90010/OUMODA and Site Preparation Planning Application Reference 07/90011/FUMODA. Condition OD14.2 of planning permission 07/90010/OUMODA states:

Demolition of any historic building specified for recording in the submitted Built Heritage Written Schemes of Investigation shall not take place until the recording set out in the relevant Written Scheme of Investigation has been undertaken and written confirmation received from English Heritage that the recording is satisfactory and that the building can be demolished. A report detailing the recording shall be submitted to the Local Planning Authority within six months of the written confirmation received from English Heritage.

Reason: To ensure that buildings with an identified historic interest are recorded.

1.4 Origin and scope of this report

The archaeological work of analysis and recording, and the production of this report, were commissioned from the Museum of London Archaeology Service and Pre-Construct Archaeology (MoLAS-PCA) by the Olympic Delivery Authority. The work was carried out in accordance with the *Method Statements* (MoLAS-PCA, 2007j, 2007k, 2007l).

The report has been prepared within the terms of the relevant standards specified by the Institute of Field Archaeologists (IFA 2001) and corresponds approximately to the form of record and reporting for a 'Photographic Survey' for the Great Eastern Railway (OL-02407), 'Level 1' for the railway bridges over the Waterworks River, Warton Road and Carpenter's Road (grouped collectively under OL-05807, although the bridges over the Waterworks River and Warton Road were previously recorded under the site code OL-00305) and 'Level 2' for the bridge over the River Lea and the viaduct between Pudding Mill Lane and the City Mill River (OL-05307), in the specifications, *Understanding Historic Buildings: A guide to good recording practice*, recommended by English Heritage (2006).

This report presents the results of an analytical survey carried out on the site in June, October and November 2007, combined with the available results of documentary research.

1.5 Research aims and method of work

The research aims of this archaeological work to record the Great Eastern Railway (Fig 2 & Fig 3) were defined in the *Method Statements* (MoLAS-PCA, 2007j, 2007k, 2007l) in conformity with applicable planning policies and English Heritage guidelines (Archaeological Guidance Paper No. 3, revised June 1998).

1.5.1 OL-02407: Photographic Survey of the Great Eastern Railway

The overall aim of the photographic survey of the Great Eastern Railway (OL-02407) was to secure 'preservation by record' of the structures to be removed or altered by the development. The scope of the work as defined in the *Method Statement* was as follows:

'The railway will be viewed, described and photographed. Drawings in the form of sketches may be undertaken if required. The railway's type/purpose and the materials used in its construction will be summarised' (MoLAS-PCA 2007j, 3.3).

The investigation satisfied the research aims, and it was determined that it would not be necessary to investigate the structure further during demolition.

1.5.2 OL-05307: Great Eastern Railway bridges from the Lea River to the City Mill River

The overall aim of the programme of work at the Great Eastern Railway bridge across the River Lea and the viaduct that carries the railway over Pudding Mill Lane, Marshgate Lane, the Northern Outfall Sewer and the City Mill River (OL-05307) was to secure 'preservation by record' of those aspects of the structures that were of architectural, archaeological and historical interest. The scope of work as defined in the *Method Statement* was as follows:

'The exterior of the structures will be viewed, described and photographed. Elevations of the exterior will be undertaken. A brief written description will be undertaken, and a report presenting conclusions regarding the development and use of the structures will be produced' (MoLAS-PCA 2007k, 3.3).

The investigation satisfied the research aims, and it was determined that it would not be necessary to investigate the structure further during demolition.

1.5.3 OL-05807: Great Eastern Railway Bridges over the Waterworks River, Warton Road and Carpenter's Road

The overall aim of the programme of work at the Great Eastern Railway bridges across Carpenter's Road, Warton Road and the Waterworks River (OL-05807) was to secure 'preservation by record' of those aspects of the structures that were of architectural, archaeological and historical interest. The scope of work as defined in the *Method Statement* was as follows:

'The exteriors will be viewed, described and photographed. Drawings in the form of sketches may be undertaken if required. The structures' type/purpose, the materials used in their construction and their possible date of construction will be summarised' (MoLAS-PCA 2007l, 3.3).

The investigation satisfied the research aims, and it was determined that it would not be necessary to investigate the structure further during demolition.

1.6 Organisation of this report and conventions used

Section 2 outlines the topographical and background of the area, on a PDZ by PDZ basis.

Sections 3 covers the development and function of the railways.

Section 4 outlines the development and function of the recorded structures, incorporating conclusions (section 4.5), followed by a discussion of potential (Section 5).

A series of appendices follow:

- Appendix 1 contains the NMR OASIS archaeological report forms
- Appendix 2 contains the listed building entry for the grade II listed Braithwaite viaduct at the former Bishopsgate Goods Yard in Spitalfields
- Appendix 3 lists of photographs
- Appendix 4 lists of working drawings

To aid navigation around the document, all illustrations are included sequentially in separate appendices. Appendix 5 is the figures and Appendix 6 is the plates.

All dimensions are given in metres or millimetres and in feet and inches where appropriate. Heights are given where appropriate in metres above Ordnance Datum (mean sea level), abbreviated 'm OD'.

BGS	British Geological Survey
DCMS	Department of Culture, Media and Sport
DoE	Department of the Environment
ECR	Eastern Counties Railway
EH	English Heritage
GLAAS	Greater London Archaeological Advisory Service
GER	Great Eastern Railway
LNER	London and North Eastern Railway
MoLAS	Museum of London Archaeology Service
OD	Ordnance Datum (mean sea level at Newlyn, Cornwall)
OS	Ordnance Survey
PDZ	Planning Delivery Zone
RCHME	Royal Commission on Historical Monuments, England
RSJ	Rolled steel joist
VCH	Victoria County History

Table 1 Abbreviations used in this report

2 Topographical and early historical background

Detailed descriptions of the geology, archaeology and history of the site was outlined in the earlier Archaeological and Built Heritage assessments (MoLAS-PCA, 2007a, 2007b, 2007c, 2007d, 2007e, 2007f, 2007g, 2007h, 2007i). A brief, contextualising, summary is provided below.

2.1 Geology and natural topography

The Great Eastern Railway is located within and around PDZs 1, 2, 3, 6, 7, 8, 9, 11 & 14 on the Olympic site.

Within this section the topography of each zone is summarised (below).

2.1.1 Planning Delivery Zone One

PDZ1 is located within the wide floodplain of the Lea Valley, c 3.5km to the north of the confluence with the River Thames. The Lea flows through this stretch of the valley via a series of canalised and culverted channels, commonly referred to as the Stratford Back Rivers. The local drift geology consists of a complex sequence of interstratified Holocene alluvial peats and clays sitting on a basal surface of terrace gravels overlying London Clay (British Geological Survey 1996, sheet 257). The Holocene alluvial peats and clays constitute an archaeological horizon, and accordingly are identified as having archaeological potential.

2.1.2 Planning Delivery Zone Two

PDZ2 is located roughly in the middle of the valley floor, c 3.5km to the north of the Lea's confluence with the River Thames. The site is bounded on three sides by river channels. The River Lea, which is tidal for some distance upstream, forms the zone's northern boundary, with its western and eastern sides following the canalised City Mill and Waterworks Rivers respectively. Modern ground level across the site lies at around 6m OD. The edge of the valley floor lies c 500m to the west and c 900m to the east of the site, where the ground rises up the valley sides onto the river terrace.

The British Geological Survey Sheet 256, North London shows that the site lies on alluvium, which represents a range of different wetland and dry land environments existing on the valley floor ('floodplain') of the Lea from the Mesolithic period onwards.

2.1.3 Planning Delivery Zone Three

PDZ3 is located on the western side of the floodplain (valley bottom) of the Lea Valley, between the River Lea and the City Mill River, which form the western and eastern boundaries of the site respectively.

Modern ground level across the site lies at around 4m to 6m OD. The edge of the valley floor lies c 200m to the west and c 1.1km to the east of the site, where the ground rises up the valley sides to the river terrace.

The British Geological Survey (Sheet 256) shows that PDZ3 lies on alluvium, which represents a range of different wetland and dry land environments existing on the valley floor ('floodplain') of the Lea from the Mesolithic period onwards. The alluvium overlies gravels and associated deposits of Pleistocene (Palaeolithic) date. The higher ground of the

gravel terrace, which forms the western side of the valley, lies immediately west of the site, on the opposite side of the River Lea.

2.1.4 Planning Delivery Zone Four

PDZ4 is located on the western side of the floodplain (valley bottom) of the Lea Valley, between the Hackney Cut and the River Lea, which form the western and eastern boundaries of the site respectively.

The landscape of the site in the past will have been very different to its characteristics today. In particular, the dumping of thick ‘made ground’ deposits in many areas has obscured its ancient topography. MoLAS-PCA produced a detailed study for the Olympics project entitled ‘*Ground disturbance and ground raising and the implications for archaeological strategies*’ (July 2005). The study shows that PDZ4 contains an infilled an East London Waterworks Company reservoir and associated channels occupying approximately one-half of the site. The MoLAS-PCA site visit noted that the ground level of the Bow Industrial Park is c. 1m higher than the level of the canal path on the western side of the site, indicating at least c. 1m of modern land-raising material.

The British Geological Survey (Sheet 256) shows that the site lies on alluvium, which represents a range of different wetland and dry land environments existing on the valley floor (‘floodplain’) of the Lea from the Mesolithic period onwards. The alluvium overlies gravels and associated deposits of Palaeolithic date. The higher ground of the river terraces (the Kempton Park and Taplow Gravels) lies c 200m west of the site, on the opposite site of the Hackney Cut.

2.1.5 Planning Delivery Zone Six

PDZ6 is located on the eastern side of the floodplain (valley floor) of the River Lea, to the east of the Waterworks River. The modern topography and drainage of the area around the ditch has been much modified by human agency and bears little resemblance to the landscape of the site in historic and prehistoric times.

The site overlies alluvium, which represents a range of different wetland and dryland environments existing within the floodplain of the Lea from the Mesolithic period onwards. These deposits overlie the Lea Valley Gravels, the most recent of a series of Pleistocene river terrace deposits. The underlying London Clay forms a bottom line for deposits of archaeological interest, as its formation predates human evolution.

2.1.6 Planning Delivery Zone Eight

PDZ8 is located roughly in the middle of the valley floor of the River Lea, c 3km to the north of its confluence with the River Thames. The zone covers the south-eastern part of a grid-like network of river channels known as the Back Rivers, which are bounded to the south-west by the River Lea, and to the north-east by the canalised Waterworks River. The Bow Back River also flows through the site, the south bank of which forms the southern boundary. The City Mill River crosses the central area of the zone. The modern topography and natural drainage of the zone has been extensively modified over time. It currently bears little resemblance to the natural landscape present in both historic and prehistoric times. Modern ground rising has masked the natural land surface by several metres of ‘made ground’. Similarly, very little remains in the modern landscape of the natural course of the Lea, which today flows through a series of canalised and culverted channels, such as those bounding and crossing the site itself.

2.1.7 Planning Delivery Zone Nine

Planning Delivery Zone Nine is located on the centre and the eastern side of the floodplain (valley bottom) of the Lea Valley, to the east of the Waterworks River, which forms the western boundary of the zone. The Channelsea River flows across the western application site. The extent to which the rivers are man made or were originally natural is not yet known. The Channelsea River is reputed to have been constructed by King Alfred.

Modern ground levels vary greatly, as a result of modern and historic groundraising associated with construction of the present railway depots and freight terminal. Generally the modern landsurface lies at around 5m–6m OD

The geology of the zone is alluvium (British Geological Survey Sheet 256), which represents a range of different wetland and dryland environments existing on the valley floor ('floodplain') of the Lea from the Mesolithic period onwards. Immediately beyond the eastern application site and the overall Planning Delivery Zone, areas of Kempton Park Gravel and exposed bedrock are mapped, which denote the eastern valley side. Although little archaeological work has previously been undertaken in the local area, excavation in the valley of the Thames and its tributaries suggests that archaeological remains of the prehistoric and earlier historic period are likely to lie within the alluvium.

2.1.8 Planning Delivery Zone Eleven

PDZ11 is located on the eastern edge of the valley of the River Lea, c 3km to the north of its confluence with the River Thames. The Channelsea River passes near the south-west corner of the zone to the south of Stratford Station.

The modern topography and drainage of the area has been much modified by man and bears little resemblance to the landscape of the zone in historic and prehistoric times. Modern ground raising has masked the natural land surface by approximately two to three metres of made ground. Similarly, very little remains in the modern landscape of the natural course of the Lea, which today flows through a series of mostly man-made canalised and culverted channels.

Modern ground level varies greatly across the zone, as a result of modern and historic ground raising associated with construction of the present railway, rail depots and station. Generally the modern land surface slopes down from c 8.9m OD at Temple Mills Lane in the north to c 6.3m OD in the south, adjacent to Stratford Station. The track bed in the vicinity of the station lies at c 6.6m OD.

The British Geological Survey Sheet 256, North London shows that the site lies mainly on alluvium, which represents a range of different wetland and dryland environments existing on the valley floor (floodplain) of the Lea from the Mesolithic period onwards. Although little archaeological work has previously been undertaken in the local area, excavation in the valley of the Thames and its tributaries suggests that archaeological remains of the prehistoric and earlier historic period are likely to lie within the alluvium.

2.1.9 Planning Delivery Zone Fourteen

The BGS Sheet 256, (North London) shows the site area located on the eastern side of the Lea Valley floodplain, on alluvium underlain by Lea Valley Gravels deposited following the scouring-out of the valley floor during the Pleistocene period. The gravels are the most recent in a series of Pleistocene river terrace deposits, which today form an irregular flight of steps in the valley side. The Kempton Park Gravels and older Taplow Gravels form the lowest of these river terraces, and are shown on the BGS map to outcrop at the edge of the valley to the immediate east of the site.

The underlying topography will have influenced the environments on the site for much of the prehistoric and early historic period, until it became obscured by the build-up of alluvium. As the river level rose during the historic period, previously dry land would have been more regularly subject to seasonal overbank flooding.

2.2 Early history: before the Great Eastern Railway and the impact of its arrival

Gascoyne's map of Stepney of 1703 shows the western bank of the River Lea, and the area through which the Eastern Counties Railway was later constructed, in the 1830s. The future course of the railway line passed to the north of Bow, adjacent to 'Mr Stanton's House' and formal gardens, and crossed the site of osier beds on the eastern bank of the River Lea. The area north of Bow Road and Stratford High Street was largely undeveloped; a plan dating to 1740 of land owned by the Bridge House Estate of the City of London, between the City Mill River and Stents Mill Pound (later the Waterworks River) shows that the layout of the fields, separated by drainage ditches crossed by footbridges, and wind- and water-powered mill complexes (Fig 4). A number of windmills in the vicinity of Stratford were demolished in order to allow the work on the railway to proceed. One agreement between the Eastern Counties Railway Company and a farmer near Stratford stipulated that 'the vendor shall be at liberty to remove as many of the mangel-wurzel plants as may now be growing on the said land as he may think proper' (Allen 1975, 5).

Rocque's map of 1746 is one of the earliest to show the whole of the Lea Valley, and like Gascoyne's map, shows that settlement of the area was largely confined to ribbon development along Bow Road and Stratford High Street (Fig 5). Stratford is shown as a small town, with pasture to the north and a number of farms, including the Hop Ground, Chobham, and 'Ruckholes House', through which the Cambridge branch of the railway would later pass (Fig 6). Chapman and André's map of Essex of 1777 shows a number of windmills along what became the route of the railway, in particular at the Pudding Mill River and the City Mill River.

Milne's land use map of 1800 shows that at this date the area north of Bow Road and Stratford High Street was still largely undeveloped, although there was an increased concentration of mills and other industrial buildings around Bow Bridge, Peghole Bridge and Michael's Bridge, which crossed the various watercourses of the Lea and Stratford Back Rivers. Milne's land use map of 1800 (Fig 7) indicates that the western side of the River Lea had mixed land use, with areas of market garden and arable farmland, with some paddocks and pasture for animal grazing. On the eastern side of the River Lea, the area around the Stratford Back Rivers comprised drained marshes, with pasture on the eastern side of the Channelsea River, to the north of Stratford. The future route of the Great Eastern Railway line to Cambridge crossed mixed pasture and meadows, making use of the higher ground on the eastern side of the Lea Valley.

Laurie and Whittle's map of 1819, and Greenwood's survey of 1824-26, both of the western side of the Lea, show the increasing expansion of settlement in Bow, especially the increasing industrialisation of the area. The East London Waterworks Company had established reservoirs adjacent to the Lea, to the north of the eventual route of the Great Eastern Railway, and a rope walk, tenter ground and dye house had also been constructed. The area still retained a rural air, however, with tea gardens next to the River Lea, north of Bow (Fig 8). Within a few years of the publication of Greenwood's survey, preparations were under way for the construction of one of London's earliest railways, which would bring considerable change to the Lower Lea Valley.

3 Development and function of the standing structures

3.1 The early passenger railways

The first railways in Britain were constructed in the 17th century for the transportation of coal from mines to canal wharfs, and used wooden rails; in the late 18th century the Coalbrookdale Company in Shropshire began to lay cast iron plates on top of the wooden rails to provide a more durable surface. Wagons were pushed or pulled along such plateways, until the steam locomotive was first demonstrated by the engineer Richard Trevithick in 1804.

The steam locomotive was not initially successful, and the first passenger railway, between Swansea and Mumbles, opened in 1806, with carriages drawn by horses. A railway connecting Middleton Colliery with Leeds was opened in 1812, and was the first to use a steam locomotive on a commercial basis. Various other enterprises used variations on such technology to provide transport, but the Stockton & Darlington Railway of 1825 and the Liverpool & Manchester Railway of 1830 were the two earliest successful enterprises linking cities.

The first railway to be built into London was the London & Greenwich Railway, with its terminus at London Bridge, which opened in 1836. Within the space of a few years, a number of railway companies had connected London with disparate parts of the country; the Great Western Railway and the London & Birmingham Railway Companies both opened termini at Paddington and Euston respectively in 1838.

3.2 The establishment of the Eastern Counties Railway

The Eastern Counties Railway (ECR) was intended to link the capital with Norwich, and was initially promoted as the Grand Eastern Counties Railway; a draft Bill was compiled in 1835, which detailed the various options for the course of the railway and the owners of the properties that would have to be demolished and the land through which the railway would pass (Fig 9 and Fig 10).

The 'Grand' part of the title was dropped before the Bill for its construction was introduced to the House of Commons on 19th February 1836. The Bill received stiff opposition from landowners and the promoters of two rival groups who wanted to build railways in the area, but opposition was overcome, and on 4th July 1836 The Eastern Counties Railway received the Royal Assent (Connor 1999, iv).

The directors of the Eastern Counties Railway were initially keen that their line be built in a similar manner to Isambard Kingdom Brunel's Great Western Railway, on a broad track gauge of seven feet $\frac{1}{4}$ inch, rather than the standard gauge of four feet eight inches; this would give passengers a smoother ride and allow trains to run faster. The company engineer, John Braithwaite, felt that this would prove too costly, and the idea was dropped. As there was initially no intention of making any physical connections with other railway lines, Braithwaite suggested that the tracks could be laid with a non-standard gauge of five feet, and this was duly accepted.

The ECR was undecided as to the best location for its London terminus, and considered various locations before settling on a site adjoining Shoreditch High Street (Fig 11). The line was carried from there on a brick viaduct a mile and a quarter in length with 160

arches. Although a viaduct was ordinarily more expensive to construct than an earthen embankment, the cost of purchasing and clearing properties in the crowded streets of the East End was such that it was a worthwhile exercise to construct a viaduct; the structure had a smaller footprint than an embankment, and the arches underneath the viaduct provided storage facilities for the railway company, or could be rented out at a profit. It appears, however, that the arches were initially left open, and enabled local people to continue to move around the area, rather than creating a barrier. An embankment was constructed between Bow and Stratford, which at the time was mostly farmland and drained marsh; however the construction proved to be more expensive than anticipated because of the unstable marshy nature of the local terrain, and the fact that the River Lea was often in flood. Temporary stages or 'tipping frames' had to be built into the marsh in order to provide a stable foundation for the embankment. Despite these efforts, 150,000 cubic metres of soil were absorbed into the marsh, and new staging had to be built over the top (Allen 1975, 5). One area of marsh across which the railway was constructed, between the City Mill River and Stent's Mill Pound, belonged to the Bridge House Estate of the City of London (Fig 12).

A second company received Royal Assent to construct a railway on the same day as the ECR. The Northern & Eastern Railway (N&ER) aimed to connect London with the towns of Bishops Stortford and Hertford, and the promoters originally envisaged that they would have their own City terminus. Lack of funds ruled this out, so before construction, the ECR and N&ER reached an agreement; the two railway lines would join at Stratford and share the line (including the section included in this report) and the terminus at Shoreditch. As a result, the N&ER had to conform to the five feet gauge (Connor 1999, v).

The ECR began operating on 18th June 1839; the line ran from Romford to a temporary terminus at Devonshire Street, Mile End, with intermediate stations at Ilford and Stratford (VCH 1966, 22). The terminus at Shoreditch opened on 1st July 1840, although building work was not yet finished; the Devonshire Street station was subsequently closed and later demolished. The N&ER began their services in September 1840. At first the railway companies only carried passenger traffic, as there were no freight facilities at Shoreditch, so a goods station, named Brick Lane, was constructed on either side of the approach tracks. At the eastern end of the line, the railway was extended to Brentwood in 1840 and Colchester in 1843 (VCH 1973, 63). By 1844, it became apparent that the non-standard track gauge used by the ECR and N&ER isolated both routes, and impede their future development, so the tracks were converted to standard gauge in September and October 1844 (Connor 1999, vi).

The Northern and Eastern Railway Company opened a line running northwards from Stratford Station to Broxbourne in Hertfordshire in 1840. The line was extended to Hertford in 1843 and then taken over by the Eastern Counties Railway in 1844; the line was extended to Cambridge the following year (Powell 1973, 61-3).

Railway engineering was an important industry for Stratford. The Eastern Counties Railway had a small repair depot at Stratford by 1839, and in 1847 the main engineering works were transferred there from Romford. By 1848 the works employed around 1,000 people; 300 houses were constructed to accommodate the workforce, and the settlement was dubbed 'Hudson's Town', after George Hudson, the chairman of the ECR (Connor 1999, vii). During the next 60 years the works were greatly enlarged; by 1906 the works occupied an area of 78 acres and employed over 6,000. The works manufactured and repaired locomotives and rolling stock, and during the late 19th century new wagon shops, a chemical laboratory and a printing works were constructed on the site; the works closed in 1963 (VCH 1973, 81) although some work repairing diesel engines continued until 1991.

Other railway companies shared lines with the ECR; including the London Tilbury & Southend Railway, established in 1854. With so many East Anglian railway companies inter-dependant on each other, an amalgamation soon took place. Following a Parliamentary Act of 7th August 1862, the ECR was grouped with the Eastern Union, East Anglian, East Suffolk and Norfolk Railway Companies to form the Great Eastern Railway (www.gersociety.org.uk). In 1865, Parliamentary authority was received to replace the London terminus in Shoreditch High Street (which was renamed 'Bishopsgate Station' in 1847). The first section of the new Liverpool Street terminus was opened in February 1874, and Bishopsgate station was closed for use as a goods station, being entirely rebuilt in 1876 (Connor 1999, vii).

3.3 The expansion of the Great Eastern Railway

The 1st, 2nd and 3rd editions of the Ordnance Survey illustrate the rapid acceleration of development brought by the railways:

- The 1st edition maps (Fig 13 and Fig 14) were surveyed in 1867, and show that Bow was already expanding within the limits provided by the River Lea. Ribbon development was still concentrated along Stratford High Street, but had begun to expand along former rear gardens and along the courses of the Stratford Back Rivers. Stratford had also expanded exponentially, with the construction of the New Town to house the employees of what was now the great Eastern Railway; the Eastern Counties Railway had merged with several smaller railway companies in 1862. Much of the marshland in the Lea Valley remained unsettled, however.
- The 2nd edition Ordnance Survey maps, revised in 1893 (Fig 15 and Fig 16), show that the railways themselves had expanded to accommodate the increase in traffic generated by the increasing settlement of the Lea Valley. In turn, the increased capacity on the railways drew businesses away from the crowded city to a location where they could expand and experiment with new technologies.
- The 3rd edition Ordnance Survey map, revised in 1914 (Fig 17), shows that east London had expanded still further into Essex, leaving only pockets of former marsh in the Lea Valley, land which due to the construction of a network of railway lines criss-crossing the network of river courses, led to some areas of the Lea Valley being left undeveloped until well into the 20th century.

The expansion of north-east London during the mid to late 19th century can be seen as being reflected in the architecture of the Great Eastern Railway. The construction of bridges required major engineering work to consolidate the ground, such as works which took place to reinforce and realign the banks of the River Lea during the initial construction of the railway in the 1830s (Fig 18). In order to meet the needs of the increased railway traffic, a fourth track was added to the line between Bow Junction and Stratford in 1877 (Connor 1999, vii), necessitating the widening of the railway line on its northern side; bridges and viaducts were expanded and embankments rebuilt (Fig 19 - Fig 22). The GER was expanded again in 1891 with the addition of tracks to the southern side of the railway.

The run-down condition of much of Britain's railway system after World War One led to The Railway Act of 1921; this was implemented from 1st January 1923, when the majority of railway companies were merged to form four large groups. Under this arrangement the GER ceased to exist as a separate entity and became part of the London & North Eastern Railway (Connor 1999, ix). An increase in funding meant that the railway line could be widened in 1923, and once more in 1936.

From 1st January 1948 the railway network was nationalised, and the line became part of the Eastern Region of British Railways. The post-Second World War period saw a decline

in investment in, and use of the railways, as passengers and freight took to the roads. The Bishopsgate Goods Yard, on the site of the original London terminus of the Eastern Counties Railway, closed after a fire in 1964. The Stratford locomotive works had seen the closure of its locomotive building operations in 1923, but continued to repair and maintain steam locomotives, and later diesel trains, until 1991. There was some revitalisation of the railways by the construction of the Docklands Light Railway (DLR) during the 1980s; the driverless trains are carried in part on dedicated tracks on the existing railway line, and in part on a specially constructed viaduct immediately to the south of the Stratford viaduct between Pudding Mill Lane and the City Mill River. The DLR line to Stratford opened in August 1987.

4 The standing building survey

4.1 Methodology

All archaeological analysis and recording during the investigation on site was carried out in accordance with the *Written Scheme of Investigation* (MoLAS-PCA, 2007), the *Museum of London Archaeological Site Manual* (1994) and MoLAS *health and safety policy* (2008).

The location of the Great Eastern Railway and the locations and exteriors of the viaduct and bridges were determined in outline on the modern Ordnance Survey plan. A photographic survey was undertaken which covered the extent and setting of the Great Eastern Railway from Fairfield Road in Bow in the London Borough of Tower Hamlets, to Stratford Railway Station in the London Borough of Newham, and the GER Cambridge Line from Stratford Station to the A12 East Cross Route in the London Borough of Waltham Forest. Plans of the bridges over the River Lea and Carpenter's Road, and of the viaduct between Pudding Mill Lane and the City Mill River (Fig 23–Fig 25) were drawn from a measured survey. Details of the construction, development and function of the internal and external elements of the structures were noted.

The site records comprise a total of 175 digital colour photographic images, 31 site drawings, site notes and notes on the documentary evidence. No objects or samples were collected. The site records will be deposited and indexed in due course in the Museum of London archaeological archive under the site codes OL-02407, OL-05307 and OL-05807.

4.2 OL-02407: photographic Survey of the Great Eastern Railway

4.2.1 Description of the standing structure

The Great Eastern Railway Mainline is carried across the Lea Valley on a variety of structures; to the west of the study area, the railway was raised on a brick viaduct that also carried the terminus at Shoreditch; the viaduct was costly to construct but minimised the number of homes and business premises that would have to be demolished in the crowded East End, and also gave the Eastern Counties Railway Company a source of income, as the arches could be let out for use as workshops, factory premises or storage. In the vicinity of Bow, the railway was raised on an earthen embankment, which was cheaper and quicker to build than a viaduct, and at the time of construction the railway crossed agricultural land.

The railway is carried over Fairfield Road in Tower Hamlets by a bridge constructed in a single phase during the early 20th century; this replaces an earlier bridge, and comprises two bridge abutments, constructed of mixed red and yellow stock brick, with dressed cap stones. The bridge deck is constructed of reinforced concrete and is topped by a steel railing on its northern and southern sides. The section of Fairfield Road that passes under the GER bridge, and its neighbour which was constructed for the London and Blackwall Railway, has been lowered so that vehicles can pass under both bridges (Plate 1).

To the east of Fairfield Road, the railway continues along a low brick viaduct, comprising two retaining walls constructed of yellow stock brick; the area between these two walls is probably infilled with earth, or rubble. The former Bryant and May match factory is located on the northern side of the viaduct, and was formerly served by railway sidings on the southern side of the main building; these have since been dismantled and removed (

Plate 2).

The railway is carried over Wick Lane by a bridge which was constructed in the early to mid 20th century to replace an earlier, possibly narrower, bridge. The bridge crosses two carriageways, separated by a central supporting pier. The bridge abutments are constructed of yellow stock brick and riveted composite wrought iron beams support the bridge deck, which has steel plate parapet walls (Plate 3). To the south of the Wick Lane railway bridge is a brick structure containing an emergency exit leading from the tunnels of the Central Line of the London Underground, which was extended from Liverpool Street to Stratford, opening in December 1946 (Plate 4). Wick Lane originally extended further to the south, when it was called Old Ford Road, and met Bow Road at a point north-east of Bow Church, but was truncated by the construction of the A12 Blackwall Tunnel Northern Approach in the 1970s.

The Great Eastern Railway Mainline is carried over the A12 Blackwall Tunnel Northern Approach road by a reinforced concrete bridge, with concrete abutments and a central pier which separates the north- and south-bound carriageways (Plate 5). Steel gantries accommodating overhead powerlines, which provide the electric power for trains, are positioned at regular intervals along the tracks; one such gantry is positioned on the bridge over the A12. The railway is then carried on a short earth embankment as far as the bridge over the River Lea, which will be reported separately below (Plate 6).

The Great Eastern Railway continues to be carried on an earth embankment with brick retaining walls, which is abutted to the south by the warehouses and commercial premises in Barbers Road (Plate 7), as far as Pudding Mill Lane, where a short viaduct carries the railway line over Pudding Mill Lane, the former course of the Pudding Mill River, Marshgate Lane, the Northern Outfall Sewer, and the City Mill River, a distance of approximately 200 metres. The viaduct between Pudding Mill Lane and the City Mill River will be reported separately below (

Plate 8).

From the City Mill River, the Great Eastern Railway Mainline continues in a north-easterly direction; a spur formerly led to a set of railway sidings on the peninsula formed by the City Mill River, Lea River, and the Waterworks River. The railway sidings had been constructed by 1948, and subsequent mapping shows their expansion throughout the 1950s. Entry to the sidings on foot or by vehicle was via an entrance in Carpenter's Road; the construction of the railway embankment cut the northern end of the Stratford Marsh peninsula from Stratford High Street to the south, limiting the potential for the use of this area of land until the mid 20th century.

The Great Eastern Railway Mainline is carried over the Waterworks River (Plate 9) and the adjacent Warton Road (

Plate 10) by two bridges, which have been previously recorded (MoLAS-PCA 2005), but the results of their investigation will be summarised below. From Warton Road, the railway line continues to the north-east along an embankment with brick retaining walls (Plate 11 and Plate 12). A bridge carries the railway over Carpenter's Road (Plate 13) and a spur leaves the northern side of the tracks to connect with the North London Line from Stratford to Hackney Wick and Homerton a little further to the north. An embankment with brick retaining walls carries the railway into Stratford Station (Plate 14); the embankment gradually lowers in height as the railway enters Stratford Station, which is located on

higher ground (Plate 15). The Great Eastern Railway Mainline continues to Romford, the early eastern terminus of the line, in a shallow cutting (

Plate 16); embankments and cuttings were constructed to create steady gradients on which the locomotives could run. An overbridge was constructed to allow Angel Lane to be carried over the Mainline (Plate 18); ramps were constructed on the northern and southern approaches to the bridge in order to increase the amount of space below the bridge deck, as the railway cutting was relatively shallow.

From Stratford Station (Plate 17) the Great Eastern Railway line to Cambridge branched to the north, passing through what had previously been the Stratford Locomotive Works, and is now Stratford International Railway Station; the Cambridge line is carried across the cutting which contains the station platforms by a bridge (Plate 19), and then proceeds in a north-westerly direction along the interface between the low marshy ground of the Lea Valley and the higher ground to the north of Stratford. A mid to late 20th century bridge (Plate 20), replacing an earlier, smaller bridge carries Temple Mill Lane over the Cambridge line, from which it is possible to see the changes that have been made to the railway line in order to accommodate the high-speed Eurostar trains that use this part of the infrastructure (Plate 21); the maintenance depot for Eurostar locomotives and rolling stock is located at Temple Mills, to the north of the study area, on the site of a former marshalling yard (Plate 22). In order to allow both high-speed and suburban services to use the railway line, a separate set of tracks has been constructed on the eastern side of the Cambridge line, and high security fences prevent intruders to this part of the railway network.

4.2.2 Discussion

It is possible to see how the Great Eastern Railway's Mainline and Cambridge line have been altered and adapted to meet the railway's changing needs; embankments, cuttings and viaducts have been widened to carry additional tracks, not just for domestic services between London and East Anglia but also for the needs of international services. As the railway embankments were widened they were frequently contained within brick or concrete retaining walls, in order to limit their footprint and provide additional structural integrity. When the Great Eastern Railway lines were first constructed they passed through what was then largely drained marsh or pasture, and there few other demands on land in the Lower Lea Valley. As Stratford increased in size from a small town to a major industrial centre, and the waterways of the Lea Valley were managed to prevent flooding, the Lea Valley became a more attractive place to establish factories and industrial undertakings. There was subsequently more demand for land, with factories being built up against the railway embankments.

4.3 OL-05307: Great Eastern Railway bridges from the Lea River to the City Mill River

4.3.1 Description of the standing structures

4.3.1.1 The Great Eastern Railway Bridge over the River Lea

The bridge carrying the Great Eastern Railway Mainline over the River Lea (Fig 23, Plate 24 and Plate 25) was apparently constructed in five phases, with some evidence for later repairs and the replacement of the bridge decks (Plate 26 - Plate 29)

The initial phase of construction was the elliptical arched bridge which is now located in the centre of the structure. This dates to the original construction of the railway between 1836 and 1839 to plans devised by John Braithwaite, the chief engineer of the Eastern Counties Railway. The bridge is constructed of a mixture of yellow and red stock brick, laid to stretcher bond; a stone impost band is visible at the waterline of the river; the abutments of this phase of the bridge could not therefore be examined, but comparison with other elements of the structure designed by John Braithwaite suggest that the abutments are also constructed of brick, laid to English bond. The vaulting is ten brick courses thick.

To meet the expansion of rail traffic in the late 19th century the GER Mainline was expanded in 1877, with the addition of a structure to the north. The bridge abutments were constructed of dark red purple engineering brick laid to English bond, with ashlar quoins on the northern external edges of the abutments. Ashlar blocks are incorporated into the abutments in order to carry the bridge deck, which is constructed of composite riveted wrought iron girders. The deck itself comprises trough-section steel plates, which are probably a late replacement.

The Great Eastern Railway became part of the London and North Eastern Railway in 1923, and there was an increase in expenditure in order to bring the railways up to standard, after a period of neglect when funds were diverted towards fighting the First World War. The mainline was twice widened, in 1923 and 1936, and these phases of expansion are visible on the southern side of the bridge. The bridge abutments of the 1923 phase, which abut the southern side of Braithwaite's bridge of 1839, were constructed of red stock brick laid to English bond. The subsequent expansion phase of 1936 was again constructed of red stock brick, laid to English garden wall bond, and the 1923 and 1936 phases were constructed to the same height. The bridge deck that was originally associated with the 1923 phase was removed in 1936, and concrete pads were placed on top of the bridge abutments to support the composite riveted steel plate bridge decks. The southern retaining wall for the embankment to the west of the River Lea was reconstructed some time after 1936. The GER bridge over the River Lea has been subject to considerable stresses since the 1830s (Plate 30) and has seen repairs and reinforcements; iron ties are visible in the structure of the Braithwaite arch, for example (Plate 31).

4.3.1.2 The Great Eastern Railway viaduct between Pudding Mill Lane and the City Mill River

The Stratford viaduct (

Plate 32 and Plate 33) is the only such structure between Bow and Stratford; while an extensive viaduct was constructed on the approach to the Bishopsgate terminus in east London, such structures were expensive to build, and in the Lea Valley there was less pressure on land in the 1830s. The area of land between Pudding Mill Lane and Marshgate Lane was perhaps chosen for such a structure because the ground was particularly wet, and the foundations for the viaduct could be built on bedrock. The Eastern Counties Railway had exceptional difficulties constructing embankments on the marshy ground of the Lea Valley, as the timber staging which was usually used as a foundation sank into the marsh.

The phasing of the construction of the viaduct is largely identical to that of the bridge over the Lea River, and is most readily visible at the bridge over Pudding Mill Lane (Plate 34 - Plate 43). The initial phase belongs to the period 1836 to 1839 when the Eastern Counties Railway was constructed to the designs of John Braithwaite, the Company's chief engineer. The viaduct was subsequently widened in 1877, and again in 1923 and 1936. The initial phase of the viaduct comprised a series of elliptical arches with stone impost bands; the

abutments were constructed of mixed red and yellow stock brick laid to English bond, and the vaulted arches which sprang from the impost bands were laid to stretcher bond, and were seven courses thick.

The railway viaduct was widened to the north in 1877, with the addition of a second series of wide segmental arches, constructed of dark red purple engineering brick laid in English bond with relatively low abutment walls, the tops of which were level with the top face of the impost band of the first phase to the south. A concrete reinforcement had been built against the base of the western abutment, perhaps a repair made to the bridge after a collision, or to mitigate against subsidence.

After 1877, probably in the 1890s or 1900s, the viaduct was widened once more to the north. This phase had flat abutment walls constructed of dark reddish purple engineering bricks and supported a bridge deck constructed of riveted steel plate girders.

During the 20th century the viaduct was twice widened, to the south. Flat abutment walls were constructed of mixed pink and yellow stock bricks, and carried riveted steel plate girders which supported the bridge deck. Between 1985 and 1987 the west abutment wall in Pudding Mill Lane was extended to the south, and a line of concrete pillars was constructed along the southern face of the viaduct to carry the Docklands Light Railway; Pudding Mill Lane station was constructed adjacent to the viaduct.

The three arches underneath the viaduct between Pudding Mill Lane and Marshgate Lane (Plate 44) appear to have been in use since their construction, unlike their counterparts under the Braithwaite viaduct in Shoreditch, which were originally open in order to allow uninterrupted passage. The western arch (Plate 45) originally contained the Pudding Mill River, which ran along the eastern edge of Pudding Mill Lane. Between 1931 and 1935 works were carried out by the Lea Conservancy Board to improve the drainage and navigation of the rivers; the Pudding Mill River may have been diverted at this point, although it still appears on mapping into the 1990s.

The central arch of the viaduct (Plate 46) was incorporated into a rope walk, as the premises of John Alderson & Sons, a rope and twine manufacturer, abutted the viaduct to the south. John Alderson & Sons, who probably had a factory in Marshgate Lane by 1861, remained there until 1934; it is likely that the eastern arch (Plate 47 and Plate 48) would have been used by them, perhaps for the storage of materials.

The GER bridge over Marshgate Lane (Plate 49 - Plate 56) exhibits the same sequence as the Pudding Mill Lane bridge, and the eastern abutment of the southern side of the bridge was extended in the 1980s in order to accommodate the new viaduct for the Docklands Light Railway. To the east of Marshgate Lane is the Northern Outfall Sewer, which cut through the railway embankment when it was constructed in the late 1850s. The most recent use of the Northern Outfall has been as a public foot- and cycle-path, and where the railway and the Northern Outfall meet, the footpath is diverted along Marshgate Lane and under the railway bridge.

The GER bridge across the City Mill River (Plate 57 - Plate 61) exhibits evidence for the same series of construction phases as its counterpart on the River Lea. The northern side of the bridge has a short stretch of retaining wall immediately to the west, which abuts the Northern Outfall (Plate 58 and Plate 59). The bridge is located on a bend in the river, and adaptations had to be made to the design of the bridge in order to accommodate this. Where each phase of the bridge crossed the river at an oblique angle, the vaulting of the brick arches at the northern end of the bridge was laid diagonally. When the bridge was widened in the 1920s, the use of steel girders for the bridge deck came into its own, as the material allowed a funnel-shaped opening to be constructed at the southern end of the bridge; this might not have been accomplished had brick been used.

4.4 OL-05807: Great Eastern Railway Bridges over the Waterworks River, Warton Road and Carpenter's Road

4.4.1 Description of the standing structure

4.4.1.1 The Waterworks River and Warton Road bridges

The bridges have been described in a separate report (MoLAS-PCA 2005) but will be summarised here. The GER bridge over the Waterworks River is a late replacement, probably dating to the 1930s. The bridge has a central pier and abutment walls of brick which carry the reinforced bridge deck. The Warton Road bridge (Plate 62 - Plate 65) was constructed in three phases. The bridge appears to have been rebuilt in the 1890s, the earlier bridge not being sufficiently wide for the increasing amounts of traffic generated by the industrial activities in Warton Road and the neighbouring area. The new bridge was constructed of yellow stock brick with riveted steel plate girders carrying the bridge deck. During the 1920s the street-level abutments were rebuilt in blue engineering brick, and within the last fifty years the bridge deck has been further strengthened by the addition of steel girders, to accommodate increases in train size.

4.4.1.2 Carpenter's Road Bridge

Like Warton Road Bridge, Carpenter's Road Bridge (Plate 66 - Plate 73) was rebuilt towards the end of the 19th century. Its width had to increase in order to accommodate the traffic generated by the increasing importance of Carpenter's Road as an industrial centre. The bridge abutments were built using yellow stock bricks, and they carry riveted composite steel plate girders which support the bridge deck. Like Warton Road, the bridge deck was reinforced and partially replaced at its northern end during the late 20th century; the replacement bridge decks are composed of steel girders which contain reinforced concrete; the concrete may have been cast in situ, or the bridge decks may have been assembled elsewhere and lifted into position by crane. A raised walkway with barrier is located on each side of the bridge in order to separate pedestrians from vehicles. At the northern end of the bridge, a railway line branches off the Mainline and connects with the North London Line from Stratford to Hackney Wick (Plate 73).

4.5 Conclusions

The examination of the structures associated with and integral to the Great Eastern Railway shows how the railway company responded to an increase in demand by widening embankments, bridges and cuttings, and expanding the railway network. The Eastern Counties Railway had been constructed as a response to the need for a railway connection between London and East Anglia, but a by-product of this was that it brought a fast transport connection to the Lea Valley, an area where previously the network of rivers enabled access, via the Thames, to the centre of London as well as coastal ports. The network of watercourses also hindered development of the area, to a large extent. The regular flooding of the Lea Valley meant that large expanses of land could not be used for anything other than pasture, made access overland difficult. The construction of the railway network enabled businesses, including several involved in the manufacture of food, where access to efficient transport was necessary, to move out of the crowded city and into an area where they could expand their premises.

5 Potential of the archaeology

5.1 Original research aims

The archaeological investigation has fulfilled the original research aims through the creation of a photographic and drawn record and written description of the Great Eastern Railway Mainline from the western bank of the River Lea to Stratford Station, and the Great Eastern Railway line to Cambridge, from Stratford Station to the A12 East Cross Route, and its related structures.

5.2 New research aims

The information in this document is extensive, robust and goes a substantial way towards understanding the origins and development of the Great Eastern Railway in Stratford, but further evidence documentary evidence in the form of photographs and memorabilia may exist for the construction and use of the Great Eastern Railway at the National Archives, London Metropolitan Archives, Tower Hamlets Local History Library, the National Railway Museum at York, and in the private collections of members of the Great Eastern Railway Society.

Further research will enhance the current understanding of these structures, as well as understanding the role that the Great Eastern Railway's engine works at Stratford played in the functioning of the railways, and in the expansion of Stratford from a small market town to a major local centre, the origins of other railway lines and related structures which were constructed in the area by the Great Eastern Railway, the North London Railway, and the Midland Railway, and by other enterprises who established railway siding to serve their businesses. Further research will enhance the current understanding of the railway network, its related structures and their context.

5.3 Significance of the data

The structures recorded are all associated with, and integral to, the Great Eastern Railway. As such, they have group value and contribute to the historic evolution of the site overall, whether focused on the railways alone or on the infrastructure related to the railways. The group value is an important part of its significance.

The arrival of the railways in Stratford was the impetus for the town's expansion; Stratford became a railway town, with the construction of houses, schools, churches and social facilities for the use of the railway workers of the Stratford engine works, and their families.

The railways also enabled the movement of materials and workers into factories of the Lea Valley, and the movement of finished goods away from the area, into the centre of London, via the Bishopsgate Goods Yard in Spitalfields, or south to the docks on the Woolwich branch of the Great Eastern Railway.

The railway network and its related structures demonstrate the development of the area; it was adapted to meet new demands and challenges. The use of the railways declined when the Stratford engine works closed, along with many of the factories served by the railways.

Significance derives from factors that may be considered singly or combined (English Heritage 2007, 23-37):

- Evidential value: relates to the potential of a place to yield primary evidence about past human activity
- Historical value: relates to the ways in which the present can be connected through a place to past people, events and aspects of life
- Aesthetic value: relates to the way in which people derive sensory and intellectual stimulation from a place
- Communal value: relates to the meanings of place for the people who relate to it, and those whose collective experience or memory it holds.

It is clear that these factors all apply to the features and area under discussion in this report. In particular, the site as a whole has high evidential value, presenting a landscape that illustrates how the railway network both expanded to meet new requirements, and also influenced the spread of industry and the expansion of Stratford.

Significance is also assessed in terms of local, regional and national significance.

The Great Eastern Railway and its integral features are of local significance, as they have defined the character of the locality and the nature of its development.

The Great Eastern Railway is regionally significant in that it is integral to the railway network in London, and also feeds into other transport networks, such as the road network, the waterways, and the ports on the Thames. The Great Eastern Railway was one of the earliest railways in London, and was instrumental in drawing industry to the Lea Valley, and was responsible for transforming Stratford from a market town to a large railway town.

The Great Eastern Railway, as one of the earliest railways in London in particular, and in Britain in general, can be seen as nationally significant. London was a world city, and the Great Eastern railway was instrumental in bringing goods and travellers to and from the eastern ports.

5.4 Salvaged fixtures, fittings and materials

There was no archaeological requirement to salvage any of the materials or fittings during the compilation of this report.

6 Publication and archiving

The site archive containing original records will be stored in accordance with the terms of the Written Schemes of Investigation (MoLAS-PCA, 2007i, 2007j & 2007k).

Information on the results of the survey will be made publicly available by means of a database in digital form, to permit inclusion of the site data in any future academic researches into the development of London.

It is also recommended that the results of this recording and analysis are assimilated into a site-wide assessment of all archaeological interventions to assign contextual significance and further refine the importance of the archaeological survival, and thereafter assimilated into any publication discussing/disseminating the results.

7 Acknowledgements

The archaeological survey and this report were commissioned by the Olympic Delivery Authority, whom the project manager and author wish to thank. They are grateful especially to Morrison, for facilitating access to the Olympic park, and to colleagues at Capita Symonds Ltd, both in and out of the field. The staff of Newham Local History Library, Tower Hamlets Local History Library, Hackney Archives Department, the London Metropolitan Archives and the Essex Records Office supplied documents and helpful information.

Archaeological analysis and recording, and pencil drawings, were by Emma Dwyer, Maria Utrero and Andrew Westman. James Dixon carried out the recording of the railway bridges over the Waterworks River and Warton Road. The archaeological photographs of the standing structures and their landscape setting were taken by Edwin Baker and Maggie Cox, assisted by Emma Dwyer and Maria Utrero. CAD drawings were by Monica Cortelletti.

8 Bibliography and references

Bacon, G W, 1900 *Map of the environs of London*

British Geological Survey (BGS), 1993 *1:50,000, England & Wales, solid and drift geology, sheet 256, North London*

Connor, J E, 1999 *Eastern Mainlines: Liverpool Street to Ilford* Middleton Press: Midhurst, West Sussex

Department of the Environment (DoE), 1990 *Planning Policy Guidance 16: archaeology and planning (PPG16)*

Department of the Environment (DoE), 1994 *Planning Policy Guidance 15: planning and the historic environment*

English Heritage, 1991 *Management of Archaeological Projects* (2nd edition)

English Heritage (Greater London Archaeological Advisory Service), 1998 *Archaeological guidance papers*

English Heritage, 2006 *Understanding Historic Buildings: A guide to good recording practice*

Gwyn, D & Palmer, M (eds), 2005 *Understanding the Workplace: A research framework for industrial archaeology in Britain* (*Industrial Archaeology Review* Vol XXVII, No 1)

Institute of Field Archaeologists (IFA), 2001 *Standard and guidance for archaeological investigation of standing buildings or structures*

Museum of London Archaeology Service, 2008 *Health and safety policy*

Museum of London, 1994 *Archaeological site manual* (3rd edition)

Museum of London, 2002 *A research framework for London archaeology 2002*

MoLAS-PCA, 2005 *An Historic Building Report For The Viaduct And Historic Road Alignment At Warton Road* MoLAS-PCA Unpublished Report

MoLAS-PCA. 2007a. *Lower Lea Valley Regeneration and Olympics Archaeological and Built Heritage Impact Assessment (Detailed Desk-based Assessment [DDBA]) Planning Delivery Zone One* MoLAS-PCA Unpublished Report

MoLAS-PCA. 2007b. *Lower Lea Valley Regeneration and Olympics Archaeological and Built Heritage Impact Assessment (Detailed Desk-based Assessment [DDBA]) Planning Delivery Zone Two* MoLAS-PCA Unpublished Report

MoLAS-PCA. 2007c. *Lower Lea Valley Regeneration and Olympics Archaeological and Built Heritage Impact Assessment (Detailed Desk-based Assessment [DDBA]) Planning Delivery Zone Three* MoLAS-PCA Unpublished Report

MoLAS-PCA. 2007d. *Lower Lea Valley Regeneration and Olympics Archaeological and Built Heritage Impact Assessment (Detailed Desk-based Assessment [DDBA]) Planning Delivery Zone Six* MoLAS-PCA Unpublished Report

MoLAS-PCA. 2007e. *Lower Lea Valley Regeneration and Olympics Archaeological and Built Heritage Impact Assessment (Detailed Desk-based Assessment [DDBA]) Planning Delivery Zone Seven* MoLAS-PCA Unpublished Report

MoLAS-PCA. 2007f. *Lower Lea Valley Regeneration and Olympics Archaeological and Built Heritage Impact Assessment (Detailed Desk-based Assessment [DDBA]) Planning Delivery Zone Eight* MoLAS-PCA Unpublished Report

MoLAS-PCA. 2007g. *Lower Lea Valley Regeneration and Olympics Archaeological and Built Heritage Impact Assessment (Detailed Desk-based Assessment [DDBA]) Planning Delivery Zone Nine* MoLAS-PCA Unpublished Report

MoLAS-PCA. 2007h. *Lower Lea Valley Regeneration and Olympics Archaeological and Built Heritage Impact Assessment (Detailed Desk-based Assessment [DDBA]) Planning Delivery Zone Eleven* MoLAS-PCA Unpublished Report

MoLAS-PCA. 2007i. *Lower Lea Valley Regeneration and Olympics Archaeological and Built Heritage Impact Assessment (Detailed Desk-based Assessment [DDBA]) Planning Delivery Zone Fourteen* MoLAS-PCA Unpublished Report

MoLAS-PCA, 2007j, Written Scheme of Investigation for Historic Photographic Building Recording of Great Eastern Railway (Planning Delivery Zones 1, 2, 3, 6, 7, 8, 9, 11 and 14)

MoLAS-PCA, 2007k, Written Scheme of Investigation for Historic Building Recording (Level 2) of Great Eastern Railway Bridges (Planning Delivery Zones 3 and 8)

MoLAS-PCA, 2007l, Written Scheme of Investigation For Historic Building Recording (Level 1) of Railway Bridges over Carpenter's Road, Warton Road and the Waterworks River (Planning Delivery Zones 1, 2 and 8)

Saunders, A, 2005 *The London County Council Bomb Damage Maps 1939-1945* (London Topographical Society)

Stanford, E, 1900 *Library map of London and its suburbs*

VCH, 1966 *The Victoria History of the Counties of England: Essex, Vol 5: West Ham* (ed W R Powell)

VCH, 1973 *The Victoria History of the Counties of England: Essex, Vol 6: West Ham* (ed W R Powell)

London Metropolitan Archives:

9 Appendix 1: NMR OASIS archaeological report forms

9.1 OL-02407

OASIS ID: molas1-49162

Project details

Project name	The Great Eastern Railway: a photographic survey		
Short description of the project	A photographic survey of the structures and setting of the Great Eastern Railway Mainline between Fairfield Road in Bow and Stratford Station, and the Great Eastern Railway line to Cambridge between Stratford Station and the A12 East Cross Route		
Project dates	Start: 01-06-2007 End: 31-10-2007		
Previous/future work	No / Not known		
Any project codes associated with reference	OL-02407 - Sitecode		
Type of project	Building Recording		
Site status	Conservation Area		
Site status	None		
Current Land use	Transport and Utilities 2 - Other transport infrastructure		
Monument type	RAILWAY EMBANKMENT Post Medieval		
Monument type	RAILWAY CUTTING Post Medieval		
Monument type	RAILWAY BRIDGE Post Medieval		
Monument type	RAILWAY VIADUCT Post Medieval		
Methods techniques	& 'Annotated Sketch','Photographic Survey','Survey/Recording Of Fabric/Structure'		
Prompt	Direction from Local Planning Authority - PPG15		

Project location

Country England
Site location GREATER LONDON TOWER HAMLETS BOW Great Eastern Railway
Site location GREATER LONDON NEWHAM STRATFORD Great Eastern Railway
Site location GREATER LONDON WALTHAM FOREST LEYTON Great Eastern Railway
Postcode E3
Study area 3.50 Kilometres
Site coordinates 537520 183320 537520 00 00 N 183320 00 00 E Line
Site coordinates 538800 184700 538800 00 00 N 184700 00 00 E Line
Lat/Long Datum Position derived from charts

Project creators

Name of MoLAS/PCA
Organisation

Project originator brief ODA

Project originator design MoLAS/PCA

Project director/manager Gary Brown

Project supervisor Emma Dwyer

Type of ODA
sponsor/funding body

Name of Olympic Delivery Authority
sponsor/funding body

Project archives

Physical Archive No
Exists?

Digital Archive LAARC
recipient

Digital Archive ID OL-02407

Digital available Media 'Images raster / digital photography'

Paper Archive LAARC
recipient

Paper Archive ID OL-02407

Paper available Media 'Drawing','Notebook - Excavation',' Research',' General
Notes','Photograph','Plan','Unpublished Text'

Project bibliography 1

Publication type Grey literature (unpublished document/manuscript)

Title Great Eastern Railway

Author(s)/Editor(s) Dwyer, E

Date 2008

Issuer or publisher MoLAS-PCA

Place of issue or London
publication

Description A4 paper report, combined with reporting for OL-05307 and OL-05807

Entered by Emma Dwyer (edwyer@molas.org.uk)

Entered on 1 October 2008

9.2 OL-05307

OASIS ID: molas1-49165

Project details

Project name	The Great Eastern Railway Bridges (Lea River - City Mill River)		
Short description of the project	A Level 2 Standing Structure Survey of the bridges associated with the Great Eastern Railway across the River Lea and City Mill River, and the Stratford Viaduct between Pudding Mill Lane and Marshgate Lane. The structures were built in 1839 and showed evidence for successive widening, relating to an increase in the use of the railway between the mid 19th and early 20th centuries; the railway line was partly adapted for use by the Docklands Light Railway in the 1980s.		
Project dates	Start: 01-09-2007 End: 31-10-2007		
Previous/future work	No / Not known		
Any project codes associated with reference codes	OL-05307 - Sitecode		
Type of project	Building Recording		
Site status	None		
Current Land use	Transport and Utilities 2 - Other transport infrastructure		
Monument type	RAILWAY BRIDGE Post Medieval		
Monument type	RAILWAY VIADUCT Post Medieval		
Methods techniques	&	'Annotated Sketch', 'Photographic Survey', 'Survey/Recording Of Fabric/Structure'	
Prompt	Direction from Local Planning Authority - PPG15		

Project location

Country	England		
Site location	GREATER LONDON NEWHAM STRATFORD Great Eastern Railway Bridges (Lea River - City Mill River)		

Postcode E15

Study area 0.50 Kilometres

Site coordinates 537578 183337 537578 00 00 N 183337 00 00 E Line

Site coordinates 537990 183708 537990 00 00 N 183708 00 00 E Line

Lat/Long Datum Position derived from charts

Project creators

Name of MoLAS/PCA
Organisation

Project originator brief ODA

Project originator design MoLAS/PCA

Project director/manager Gary Brown

Project supervisor Emma Dwyer

Type of ODA
sponsor/funding
body

Name of Olympic Delivery Authority
sponsor/funding
body

Project archives

Physical Archive No
Exists?

Digital Archive LAARC
recipient

Digital Archive ID OL-05307

Digital available Media 'Images raster / digital photography','Text'

Paper recipient Archive LAARC

Paper Archive ID OL-05307

Paper available Media 'Notebook - Excavation', 'Research', 'General Notes','Photograph','Plan','Unpublished Text'

Project bibliography 1

Publication type Grey literature (unpublished document/manuscript)

Title Great Eastern Railway

Author(s)/Editor(s) Dwyer, E

Date 2008

Issuer or publisher MoLAS-PCA

Place of issue or publication London

Description Paper report, combined with photographic survey of the Great Eastern Railway and Level 1 record of the railway bridge over Carpenter's Road

Entered by Emma Dwyer (edwyer@molas.org.uk)

Entered on 1 October 2008

9.3 OL-05807

OASIS ID: molas1-49166

Project details

Project name	Great Eastern Railway Bridge over Carpenter's Road
Short description of the project	Report for Level 1 standing structure survey of early 20th century bridge with later alterations that carries the Great Eastern Railway Mainline over Carpenter's Road.
Project dates	Start: 01-10-2007 End: 31-10-2007
Previous/future work	No / Not known
Any associated project reference codes	OL-05807 - Sitecode
Type of project	Building Recording
Site status	None
Current Land use	Transport and Utilities 2 - Other transport infrastructure
Monument type	RAILWAY BRIDGE Modern
Methods & techniques	'Annotated Sketch','Photographic Survey','Survey/Recording Of Fabric/Structure'
Prompt	Direction from Local Planning Authority - PPG15

Project location

Country	England
Site location	GREATER LONDON NEWHAM STRATFORD Great Eastern Railway Bridge over Carpenter's Road
Postcode	E15
Study area	500.00 Square metres
Site coordinates	538288 184086 538288 00 00 N 184086 00 00 E Point

Lat/Long Datum Position derived from charts

Project creators

Name of Organisation MoLAS/PCA

Project brief originator ODA

Project design originator MoLAS/PCA

Project director/manager Gary Brown

Project supervisor Emma Dwyer

Type of ODA sponsor/funding body

Name of Olympic Delivery Authority sponsor/funding body

Project archives

Physical Archive No
Exists?

Digital Archive LAARC
recipient

Digital Archive ID OL-05807

Digital Media available 'Images raster / digital photography'

Paper Archive LAARC
recipient

Paper Archive ID OL-05807

Paper Media available 'Drawing','Notebook - Excavation',' Research',' General
Notes','Photograph','Plan','Report'

Project bibliography

1

Publication type	Grey literature (unpublished document/manuscript)
Title	Great Eastern Railway
Author(s)/Editor(s)	Dwyer, E
Date	2008
Issuer or publisher	MoLAS-PCA
Place of issue or publication	London
Description	A4 paper report, combining data from photographic survey of the Great Eastern Railway and the Level 2 standing structure recording of the Great Eastern Railway Bridges (Lea River - City Mill River)

Entered by	Emma Dwyer (edwyer@molas.org.uk)
Entered on	1 October 2008

10 Appendix 2: Listed Building entry for the Braithwaite Viaduct

Building Name:	Braithwaite Viaduct	LBS Number:	488529
Parish:	Stepney	Grade:	II
County:	Greater London	Date Listed:	08 March 2002
Postcode:		Date of Last Amendment:	08 March 2002
		Date Delisted:	
		National Grid Reference:	

Listing Text:

TQ33748220 BRAITHWAITE VIADUCT

II

The surviving 260 metres of a viaduct built by the Eastern Counties Railway Company between 1839 and 1842 to a plan by John Braithwaite, the company architect. It was designed to carry trains into the terminus of Shoreditch Station (later called Bishopsgate Station, then superseded in 1875 by Liverpool Street Station). It was originally about 2 kilometres long and carried two lines of track on a series of broad elliptical vaults. The surviving section contains piers supporting 20 arches. It is built of stock brick from various sources, and the piers are decorated by stone impost bands and rendered plinths. The Gothic style of cross vaulting was an unusual choice, set against the Italianate style of the station building. The structure of the Viaduct is reminiscent of earlier canal architecture than it is of the more standardised railway architecture that was to follow. The piers are pierced by one, two or three pointed cross vaults which allowed pedestrian traffic to travel below the viaduct. This was intended to minimise the disruption to movement in the area and thus, lessen the impact of the railway line on local life. Shoreditch Station was remodelled between 1877 and 1881, and that new development encased the Viaduct between extensive vaults to north and south, the whole supporting a vast goodsyard on the upper deck. The surviving section of the Viaduct was reduced by approximately 2 metres before the bonding of the new vaults to its current width of 14 metres, although the foundations of the original piers survive to their full width.

The Braithwaite Viaduct is a very early and rare example of a railway viaduct associated with a first generation London Terminus. Its unusual and individual design and use of materials set it apart both structurally and visually from the more standard forms of railway architecture. It is associated with an important phase of railway development and bridges the period between distinct canal and later distinct railway engineering forms. The gates and forecourt walls of the Goodsyards are already listed. None of the other buildings or structures on the site (including structures adjoining the Viaduct) are of special interest.

11 Appendix 3: list of archaeological photographs

Image number	Description
18205001	Southern side of the GER bridge over Warton Road, looking north-west
18205002	Southern side of the GER bridge over Warton Road, looking north-west
18205003	Southern side of the GER bridge over the Waterworks River, looking north-west
18205004	Warton Road, looking south-east
18205005	Northern side of the GER bridge over Warton Road, looking south
18205007	Warton Road, looking north
18205008	Warton Road, looking south
18205009	Warton Road, looking north
18205010	Warton Road, looking south
27707588	Northern parapet wall of the bridge carrying Temple Mill Lane over the former GER (Cambridge Line), looking west
27707589	Southern parapet wall of the bridge carrying Temple Mill Lane over the former GER (Cambridge Line), looking south-west
27707593	Northern parapet wall of the bridge carrying Temple Mill Lane over the former GER (Cambridge Line), looking north-east
27707594	Southern parapet wall of the bridge carrying Temple Mill Lane over the former GER (Cambridge Line), looking south-east
27707595	Detail of graffiti on the southern parapet wall of the bridge carrying Temple Mill Lane over the GER (Cambridge Line), looking south
27707597	Detail of graffiti on the southern parapet wall of the bridge carrying Temple Mill Lane over the GER (Cambridge Line), looking south
27707598	Western parapet wall of the bridge carrying Angel Lane over the GER, looking south-west
27707599	Western parapet wall of the bridge carrying Angel Lane over the GER, looking south-west
27707600	Western parapet wall of the bridge carrying Angel Lane over the GER, looking south-west
27707601	Eastern parapet wall of the bridge carrying Angel Lane over the GER, looking south-east
27707602	Eastern parapet wall of the bridge carrying Angel Lane over the GER, looking south-east
27707603	Western parapet wall of the bridge carrying Angel Lane over the GER, looking north-west
27707604	Eastern parapet wall of the bridge carrying Angel Lane over the GER, looking north
27707605	Detail of a cast iron notice plate at the southern end of the western parapet wall of the bridge carrying Angel lane over the GER, looking west
27707606	Detail of the stencilled design on the western parapet wall of the bridge carrying Angel Lane over the GER, looking west
27707607	Northern side of the DLR and GER bridge over Carpenter's Road, looking south-east
27707608	Northern side of the DLR and GER bridge over Carpenter's Road, looking south-east
27707609	Northern end of the eastern bridge abutment for the GER bridge over Carpenter's Road, looking north-east
27707610	Northern end of the eastern bridge abutment for the GER bridge over Carpenter's Road, looking north-east
27707611	Northern end of the eastern bridge abutment for the GER bridge over Carpenter's

	Road, looking north-east
27707612	Centre of the eastern bridge abutment for the GER bridge over Carpenter's Road, looking north-east
27707613	Centre of the eastern bridge abutment for the GER bridge over Carpenter's Road, looking north-east
27707614	Centre of the eastern bridge abutment for the GER bridge over Carpenter's Road, looking north-east
27707615	Southern end of the eastern bridge abutment for the GER bridge over Carpenter's Road, looking north-east
27707616	Southern end of the eastern bridge abutment for the GER bridge over Carpenter's Road, looking north-east
27707617	Southern end of the eastern bridge abutment for the GER bridge over Carpenter's Road, looking north-east
27707618	Southern end of the western bridge abutment for the GER bridge over Carpenter's Road, looking west
27707619	Centre of the western bridge abutment for the GER bridge over Carpenter's Road, looking west
27707620	Northern end of the western bridge abutment for the GER bridge over Carpenter's Road, looking south
27707621	Northern side of the DLR and GER bridge over Carpenter's Road, looking south-east
27707622	Western bridge abutment for the GER bridge over Carpenter's Road, looking south-east
27707623	Western bridge abutment for the GER bridge over Carpenter's Road, looking south-east
27707624	Detail of a benchmark carved into the masonry of the eastern bridge abutment for the GER bridge over Carpenter's Road, looking north-east
27707625	Detail of a benchmark carved into the masonry of the eastern bridge abutment for the GER bridge over Carpenter's Road, looking north-east
27707626	Aluminium emergency sign and cast iron bridge number plate at the southern end of the eastern bridge abutment for the GER bridge over Carpenter's Road, looking north-east
27707627	Southern end of the western bridge abutment for the GER bridge over Carpenter's Road, looking south-west
27707628	Southern side of the GER bridge over Carpenter's Road, looking north-west
27707629	Northern side of the GER bridge over Carpenter's Road, looking south-east
27707630	Northern side of the GER bridge over Warton Road, looking south-east
27707631	Northern side of the GER bridge over Warton Road, looking south-east
27707632	Northern end of eastern bridge abutment for the GER bridge over Warton Road, and part of the 'Japanese Car Spares' warehouse, looking south-west
27707633	Northern end of eastern bridge abutment for the GER bridge over Warton Road, looking south-west
27707634	Centre of the eastern abutment for the GER bridge over Warton Road, and possible highways equipment cupboard, looking south-east
27707635	Centre of the eastern abutment for the GER bridge over Warton Road, and possible highways equipment cupboard, looking south-east
27707636	Southern end of the eastern abutment for the GER bridge over Warton Road, looking south-east
27707637	Southern end of the eastern abutment for the GER bridge over Warton Road, looking south-east
27707638	Southern side of the GER bridge over Warton Road, looking north-west
27707639	Access staircase and overhead power line gantry to the north-west of the GER bridge over Warton Road, looking north
27707640	Detail of the riveted steel plate parapet on the southern side of the GER bridge over Warton Road, looking north

27707641	Northern end of the western abutment for the GER bridge over Warton Road, looking west
27707642	Northern end of the western abutment for the GER bridge over Warton Road, looking south-west
27707643	Northern side of the GER bridge over Warton Road, looking east
27707644	Southern side of the GER bridge over the Waterworks River, looking north-west
27707645	Southern side of the GER bridge over the Waterworks River, looking north-west
27707646	Southern side of the GER bridge over the City Mill River as seen from the Greenway, looking north-west
27707647	Southern side of the GER bridge over the City Mill River as seen from the Greenway, looking north-west
27707648	A DLR train crossing the GER bridge over the City Mill River as seen from the Greenway, looking north-west
27707649	A C2C train crossing the GER bridge over the City Mill River as seen from the Greenway, looking north-west
27707650	Northern end of the eastern abutment wall for the GER bridge over Marshgate Lane, looking south-east
27707651	Northern end of the eastern abutment wall for the GER bridge over Marshgate Lane, looking south-east
27707652	Northern side of the 1839 Braithwaite bridge over Marshgate Lane, looking south-east
27707653	Eastern side of the 1839 Braithwaite bridge over Marshgate Lane, looking south-east
27707654	Southern end of the eastern abutment wall for the GER bridge over Marshgate Lane, looking south-east
27707655	Detail of a rainwater hopper-head and down pipe incorporated into the masonry of the northern end of the eastern abutment wall for the GER bridge over Marshgate Lane, looking north
27707656	Detail of the junction between two phases of construction of the GER bridge over Marshgate Lane, looking north-east
27707657	Northern side of the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking south-east
27707658	Northern side of the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking south-east
27707659	Northern side of the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking south-east
27707660	Northern side of the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking south-east
27707661	Retaining wall for the embankment at the eastern end of the Stratford viaduct, looking south-east
27707662	Northern end of the western abutment wall for the bridge over Marshgate Lane, looking south-west
27707663	Northern end of the western abutment wall for the bridge over Marshgate Lane, looking south-west
27707664	Western side of the 1839 Braithwaite bridge over Marshgate Lane, looking south-east
27707665	Southern end of the western abutment wall for the GER bridge over Marshgate Lane, looking south-west
27707666	Southern end of the western abutment wall for the GER bridge, and the DLR bridge over Marshgate Lane, looking south-west
27707667	Southern end of the western abutment wall for the GER bridge, and the DLR bridge over Marshgate Lane, looking west
27707668	Southern end of the eastern abutment wall for the GER bridge over Marshgate Lane, looking north
27707669	Southern side of the GER bridge over Marshgate Lane, looking north-west

27707670	Southern side of the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking west
27707671	Interior of the western arch of the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking north-west
27707672	Interior of the central arch of the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking south-east
27707673	Northern side of the eastern arch of the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking south-east
27707674	Northern side of the central arch of the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking south-east
27707675	Northern side of the western arch of the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking south-east
27707676	Northern side of the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking south-east
27707677	Greenway signage on the northern side of the GER bridge over Marshgate Lane, looking north
27807048	North side of the GER bridge over Pudding Mill Lane, looking south-east
27807049	North side of the GER bridge deck over Pudding Mill Lane, showing the riveted and bolted cast iron beams, looking south
27807050	Northern end the of the west abutment of the GER bridge over Pudding Mill Lane, looking south-west
27807051	Northern end the of the west abutment of the GER bridge over Pudding Mill Lane, looking south-west
27807052	Western side of the arch of the Braithwaite viaduct of 1839 in Pudding Mill Lane, looking south-west
27807053	Southern end of the west abutment of the GER bridge over Pudding Mill Lane, looking south-west
27807054	Southern end of the west abutment of the GER bridge over Pudding Mill Lane, looking south-west
27807055	Southern end of the west abutment of the GER bridge over Pudding Mill Lane, looking south-west
27807056	Western side of the DLR viaduct over Pudding Mill Lane, looking south-west
27807057	Southern side of the arch of the Braithwaite viaduct of 1839 in Pudding Mill Lane, looking north-west
27807058	Eastern side of the DLR viaduct over Pudding Mill Lane, looking north-east
27807059	Southern end of the east abutment of the GER bridge over Pudding Mill Lane, looking north-east
27807060	Eastern side of the arch of the Braithwaite viaduct of 1839 in Pudding Mill Lane, looking north-east
27807061	Northern end of the east abutment of the GER bridge over Pudding Mill Lane, looking north-east
27807062	Northern end of the east abutment of the GER bridge over Pudding Mill Lane, looking north-east
27807063	Detail of the riveted and bolted cast iron plate girders in the bridge deck on the northern side of the bridge over Pudding Mill Lane, looking south-east
27807064	Crack in the masonry at the northern end of the eastern abutment of the bridge over Pudding Mill Lane, looking north-east
27807065	Detail of damage made by tall vehicles to the brick vaulting of part of the bridge over Pudding Mill Lane, looking south-west
27807066	Detail of the junction between the Braithwaite viaduct of 1839 and later widening, probably in 1877, looking north-east
27807067	Detail of niche carved into the impost band of the 1839 Braithwaite viaduct, looking north-east
27807068	Detail of a benchmark carved into the impost band of the 1839 Braithwaite viaduct, looking north-east

27807069	Oblique view of the eastern abutment of the bridge over Pudding Mill Lane, looking north
27807070	Oblique view of the eastern abutment of the bridge over Pudding Mill Lane, looking west
27807071	Oblique view of the western abutment of the bridge over Pudding Mill Lane, looking south
27807072	Southern side of the DLR and GER bridges over Pudding Mill Lane, looking north-west
27807073	Southern side of the GER bridge over Pudding Mill Lane, looking north-west
27807074	Southern side of the DLR and GER bridges over Pudding Mill Lane, looking north-west
27807075	The GER and DLR viaduct between Pudding Mill Lane and Marshgate Lane, looking north-east
27807076	The GER and DLR viaduct between Pudding Mill Lane and Marshgate Lane, looking north-east
27807077	The River Lea and the GER bridge, looking north-west
27807078	The River Lea and the GER bridge, looking north-west
27807079	The River Lea and the GER bridge, looking north-west
27807081	Southern side of the GER bridge over the River Lea, looking north-west
27807082	Southern side of the GER bridge over the River Lea, looking north-west
27807083	Southern side of the GER bridge over the River Lea, looking north-west
27807084	Southern side of the GER bridge over the River Lea, looking north-west
27807085	Southern side of the GER bridge over the River Lea, looking west
27807086	Southern end of the western bridge abutment of the GER bridge over the River Lea, looking south-west
27807087	Southern end of the western bridge abutment of the GER bridge over the River Lea, looking south-west
27807088	Western side of the 1839 Braithwaite bridge over the River Lea, looking south-west
27807089	Western side of the 1839 Braithwaite bridge over the River Lea, looking south-west
27807090	Northern end of the western bridge abutment of the GER bridge over the River Lea, looking south-west
27807091	Northern end of the western bridge abutment of the GER bridge over the River Lea, looking south-west
27807092	The western side of the abutment of the GER bridge over the River Lea, looking south
27807093	Northern side of the 1839 Braithwaite bridge over the River Lea, looking south
27807094	Detail of the point where the bridge was widened c1891, looking south-east
27807095	Detail of crack in the masonry near the point where the bridge was widened c1891, looking east
27807096	Detail of the bolted and riveted steel plate bridge deck on the northern side of the bridge over the River Lea, looking south
27807097	Detail of the pad stones carrying the deck on the northern side of the bridge over the River Lea, looking south
27807098	Detail of the pad stones carrying the deck on the northern side of the bridge over the River Lea, looking south
27807099	Detail of a cast iron tie on the northern side of the 1839 Braithwaite bridge over the River Lea, looking south-east
27807100	Northern end of the eastern bridge abutment of the GER bridge over the River Lea, looking east
27807101	Northern end of the eastern bridge abutment of the GER bridge over the River Lea, looking east
27807102	Underside of the GER bridge over the River Lea, looking south-west
27807103	Detail of the projecting impost on the northern side of the 1839 Braithwaite bridge

	over the River Lea, looking south-west
27807104	Detail of the iron reinforcing straps on the underside of the 1839 Braithwaite bridge over the River Lea
27807105	Detail of the Riveted and bolted steel plate bridge deck on the northern side of the GER bridge over the River Lea, looking south-west
27807106	Southern side of the 1839 Braithwaite bridge over the River Lea, looking north-west
27807107	Detail of the riveted and bolted steel plate bridge decks on the southern side of the GER bridge over the River Lea, looking north-west
27807108	The riveted and bolted steel plate bridge decks on the southern side of the GER bridge over the River Lea, looking west
27807109	Detail of the graffiti at the southern end of the eastern bridge abutment of the GER bridge over the River Lea, looking north-west
41807001	Northern end of the west abutment wall of the GER bridge over Marshgate Lane, looking south-west
41807002	Northern end of the west abutment wall of the GER bridge over Marshgate Lane, looking south
41807003	Northern end of the west abutment wall of the GER bridge over Marshgate Lane, looking south
41807004	The elliptical arch of the Braithwaite viaduct of 1839, abutted by later railway structures in Marshgate Lane, looking north-west
41807005	Southern end of the west abutment wall of the GER bridge over Marshgate Lane, looking south-west
41807006	Eastern side of the Braithwaite viaduct of 1839, in Marshgate Lane, looking north-east
41807007	The interior of a railway arch under the Stratford viaduct between Pudding Mill Lane and Marshgate Lane, looking south-east
41807008	The GER bridge over Wick Lane, looking south-east
41807009	The GER bridge over Wick Lane and the ground level end of an emergency exit from the Central Line of the London Underground, looking north
41907001	The GER bridge in Fairfield Road, looking south-east
41907002	The GER bridge in Fairfield Road, with the bridge of the Blackwall Extension Railway beyond, looking south-east
41907003	The Blackwall Extension Railway bridge in Fairfield Road, with the GER bridge beyond, looking north-west
41907004	The GER embankment with the former Bryant & May match factory beyond, looking north-west
41907005	The GER bridge over the Blackwall Tunnel Northern Approach (A12), looking north-west
42507001	The northern side of the GER bridge over the City Mill River, looking south-west
42507002	The underside of the GER bridge over the City Mill River, looking south-west
42507003	The underside of the GER bridge over the City Mill River, looking south
42507004	The northern side of the GER bridge over the City Mill River, looking south
42507006	The underside of the GER bridge over the City Mill River, looking south-west

12 Appendix 4: list of working drawings made on site

Drawing	Description
1	East facing sectional elevation through the Lea River bridge
2	Detail drawings of the composite riveted steel plate beams in the late 19th century extension to the northern side of the Lea River bridge
3	Detail drawings of the composite steel plate beams in the early 20th century extension to the southern side of the Lea River Bridge
4	Measured sketch plan of the Lea River bridge
5	Measured sketch plan of the bridge over Pudding Mill Lane
6	East facing sectional elevation of the 1839 bridge over Pudding Mill Lane
7	South facing elevation of the 1839 bridge over Pudding Mill Lane
8	North facing elevation of the 1877 extension to the northern side of the bridge over Pudding Mill Lane
9	Detail of the structural steelwork in the bridge deck of the late 19th century extension to the northern side of the bridge over Pudding Mill Lane
10	North facing elevation of the railway arches between Pudding Mill Lane and Marshgate Lane
11	North facing elevation of the railway arches between Pudding Mill Lane and Marshgate Lane
12	Detail drawings of the composite riveted steel plate beams in the bridge deck of the late 19th century extension to the northern side of the bridge over Marshgate Lane
13	Plan of the steel bridge deck of the 1923 and 1936 extensions to the southern side of the bridge over Marshgate Lane
14	Detail of a rainwater drainpipe hopper head on the north-facing elevation of the viaduct between Pudding Mill Lane and Marshgate Lane
15	West-facing elevation of the 1923 and 1936 extensions to the southern side of the bridge over Pudding Mill Lane
16	West-facing elevation of the 1877 extension to the northern side of the bridge over Pudding Mill Lane
17	West-facing elevation of the late 19th century extension to the northern side of the bridge over Pudding Mill Lane
18	Measured plan of the western and central arches between Pudding Mill Lane and Marshgate Lane
19	Measured plan of the eastern arch between Pudding Mill Lane and Marshgate Lane
20	Measured plan of the eastern arch between Pudding Mill Lane and Marshgate Lane
21	East-facing elevation of the late 19th century extension to the northern side of the bridge over Marshgate Lane
22	East-facing elevation of the 1877 extension to the northern side of the bridge over Marshgate Lane
23	East-facing elevation of the 1839 bridge over Marshgate Lane
24	East-facing elevation of the 1923 and 1936 extensions to the southern side of the bridge over Marshgate Lane
25	Measured plan of the bridge over the City Mill River
26	East-facing elevation of the late 19th century extension to the northern side of the bridge over the City Mill River
27	East-facing elevation of the 1877 extension to the northern side of the bridge over the City Mill River
28	East-facing elevation of the 1839 bridge over the City Mill River
29	East-facing elevation of the 1923 and 1936 extensions to the southern side of the bridge over the City Mill River
30	Detail drawings of the composite riveted steel girders of the bridge over the City Mill River

31	Measured plan of the bridge Carpenter's Road
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13 Appendix 5: figures

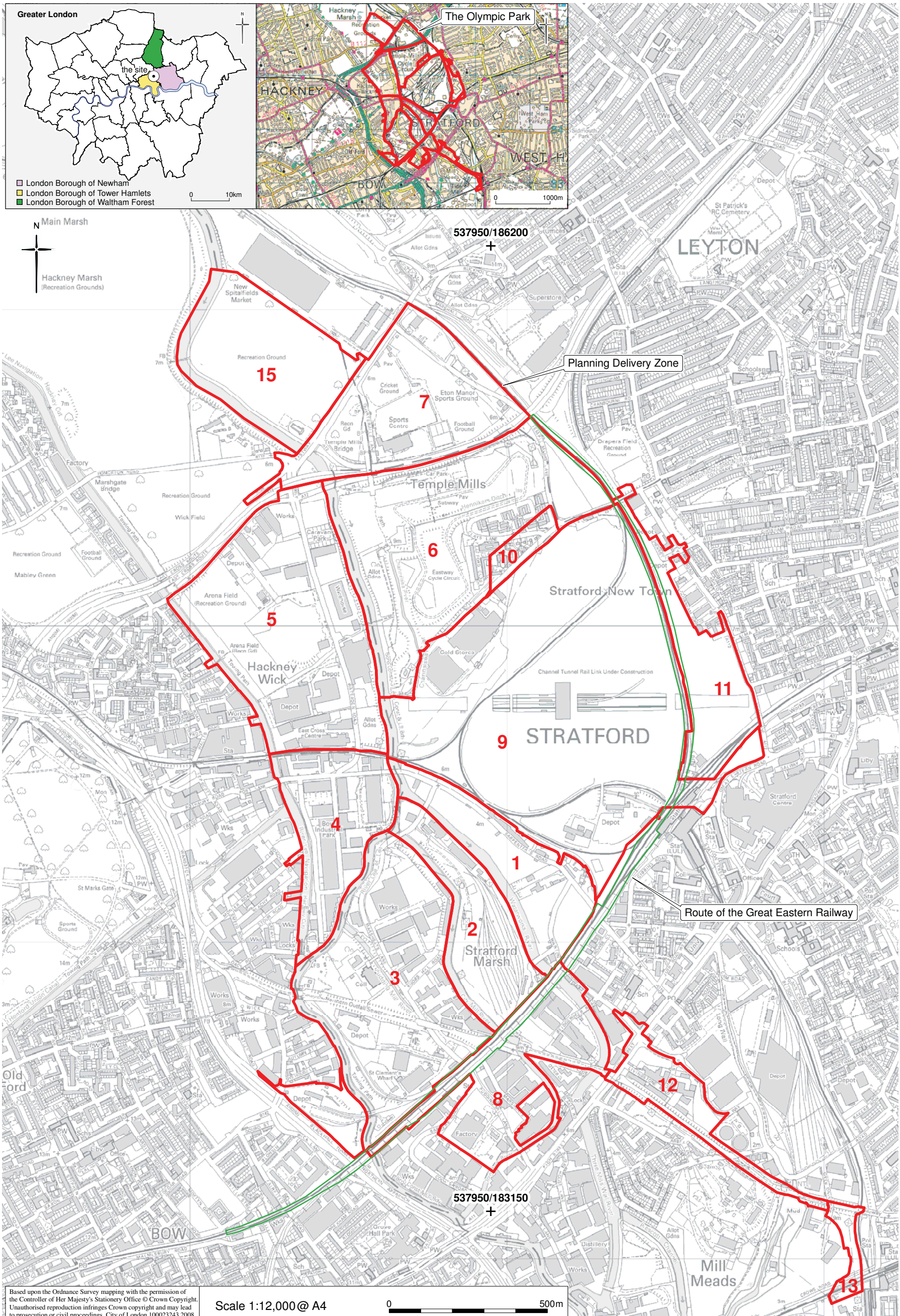
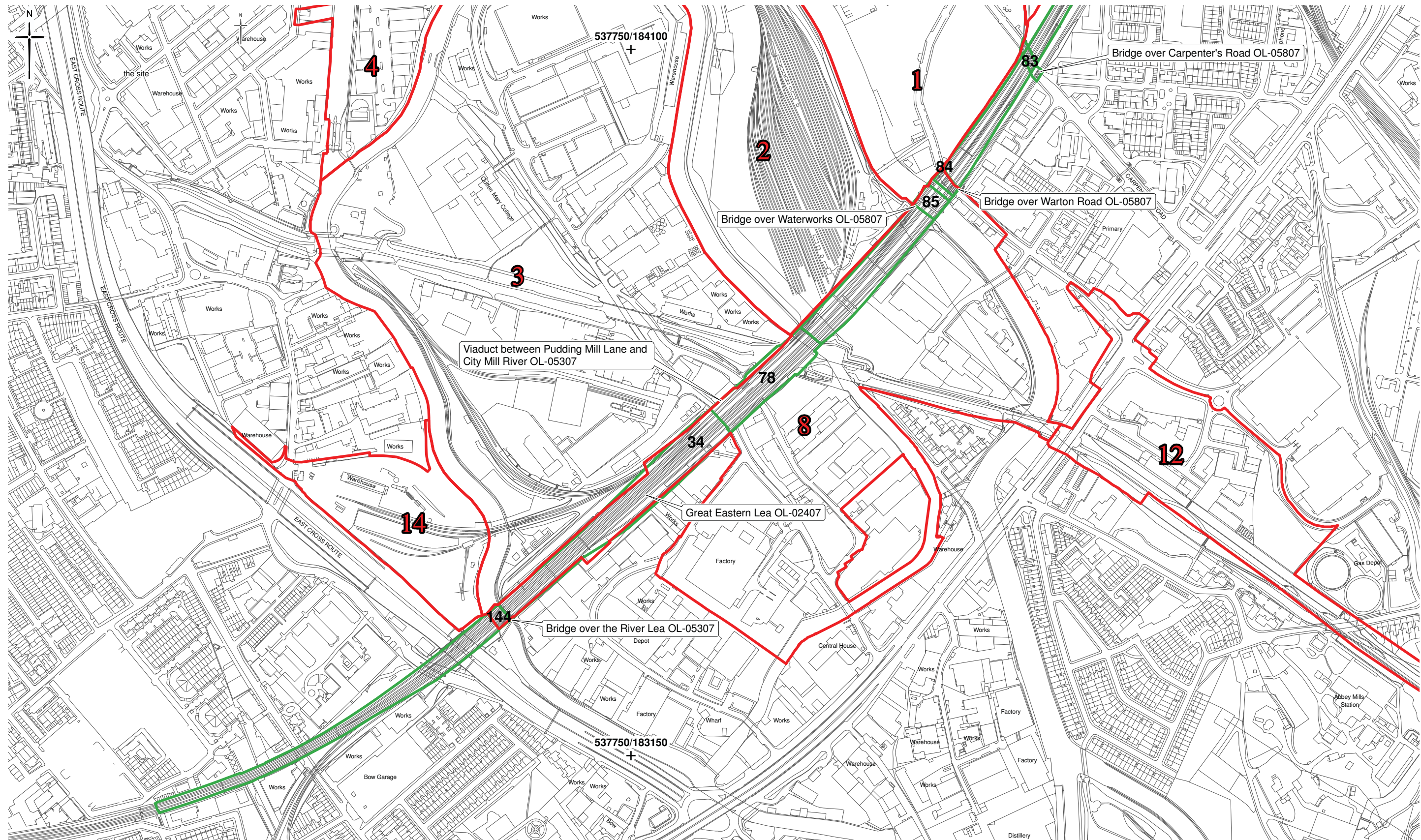


Fig 1 Site location plan



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Scale 1:5,000 @ A4

0 200m

Fig 2 Location plan of the Great Eastern Railway Mainline

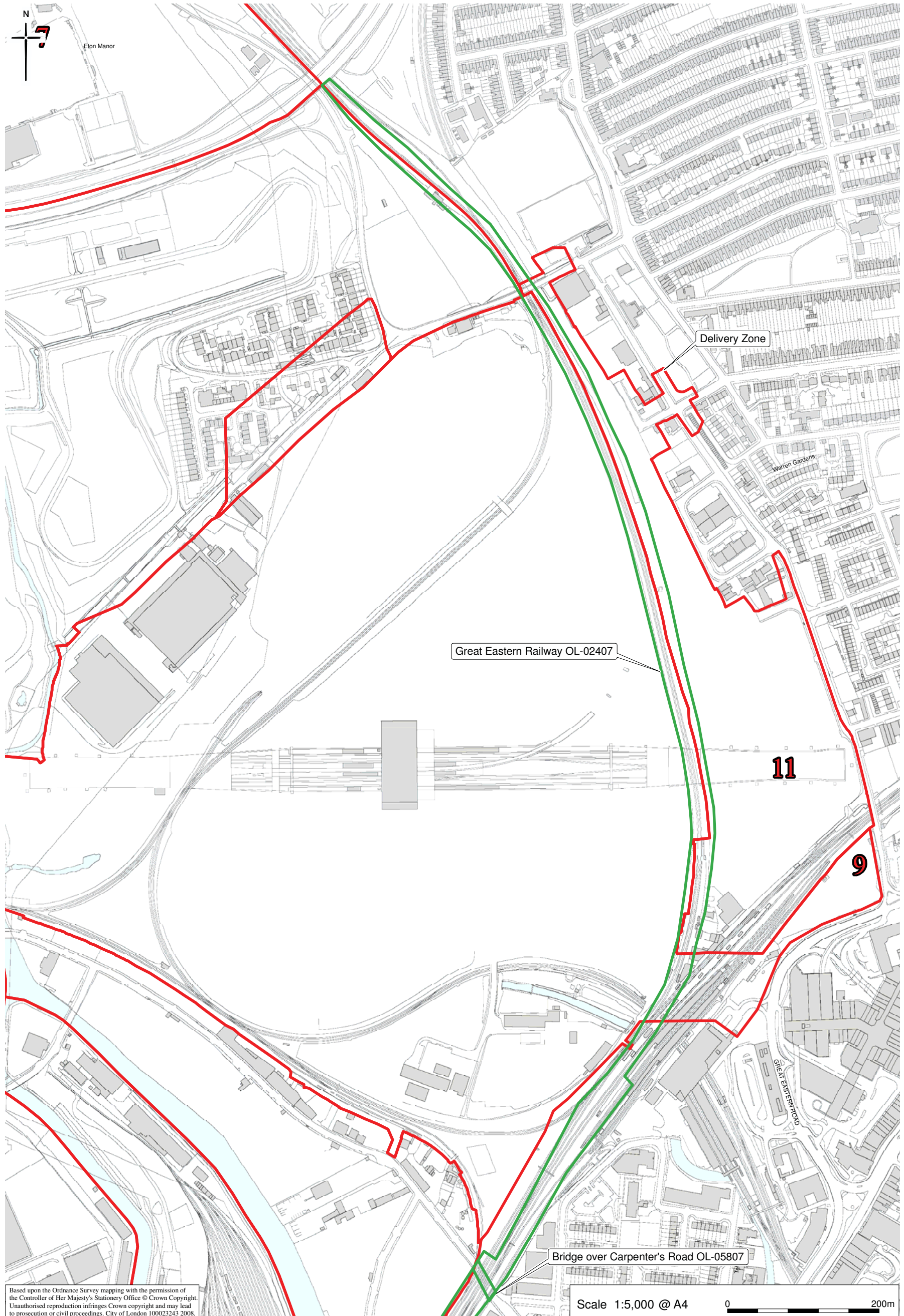


Fig 3 Location plan of the Great Eastern Railway Cambridge line



Fig 4 A correct plan of the Estate belonging to the Honourable City of London and Bridge House situate at Stratford, Essex, 1740. Surveyed by Thomas Holden (COL/CCS/PL/01/050)



Fig 5 The route of the Great Eastern Railway Mainline on Rocque's map of 1746

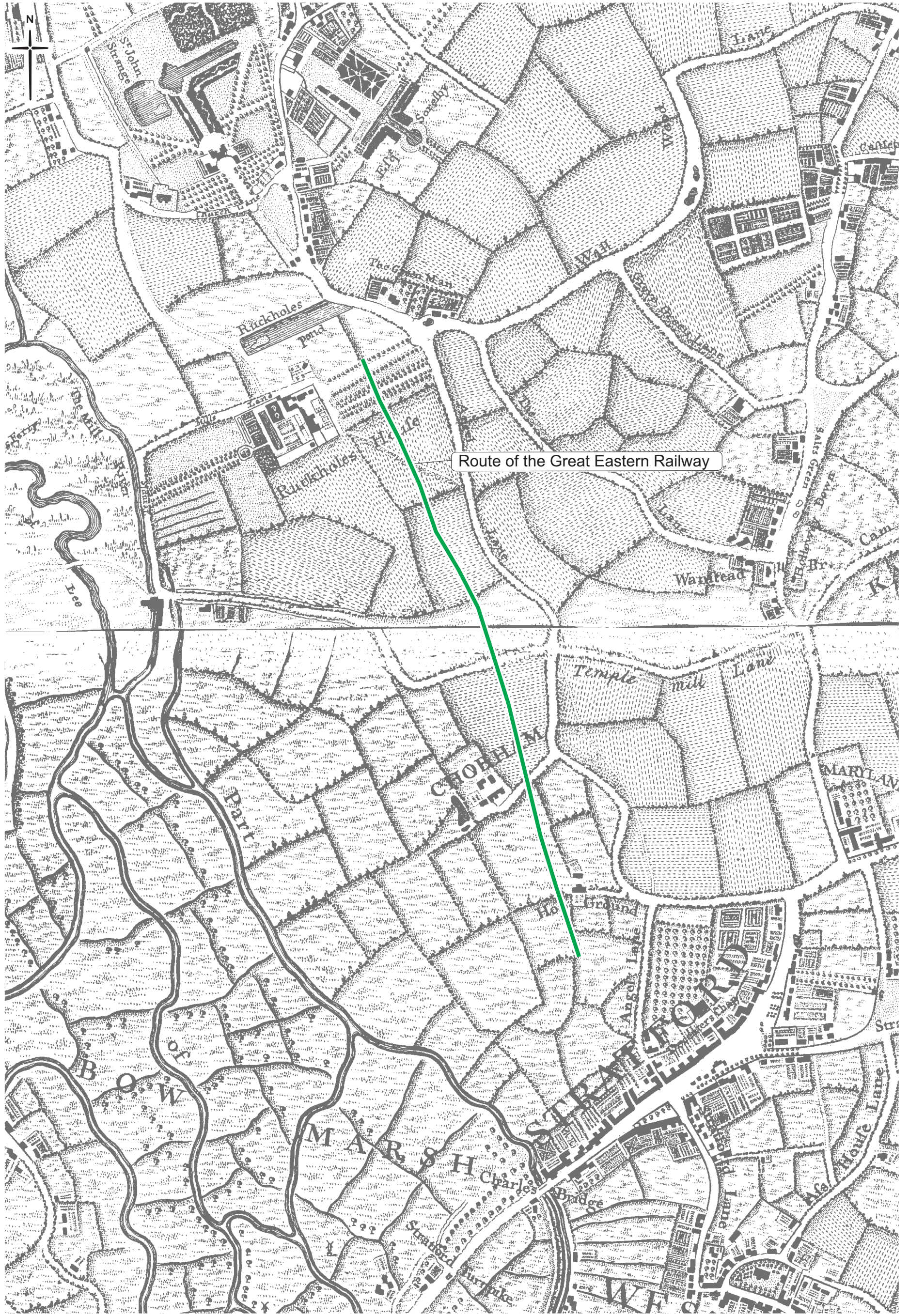


Fig 6 The route of the Great Eastern Railway line to Cambridge on Rocque's map of 1746

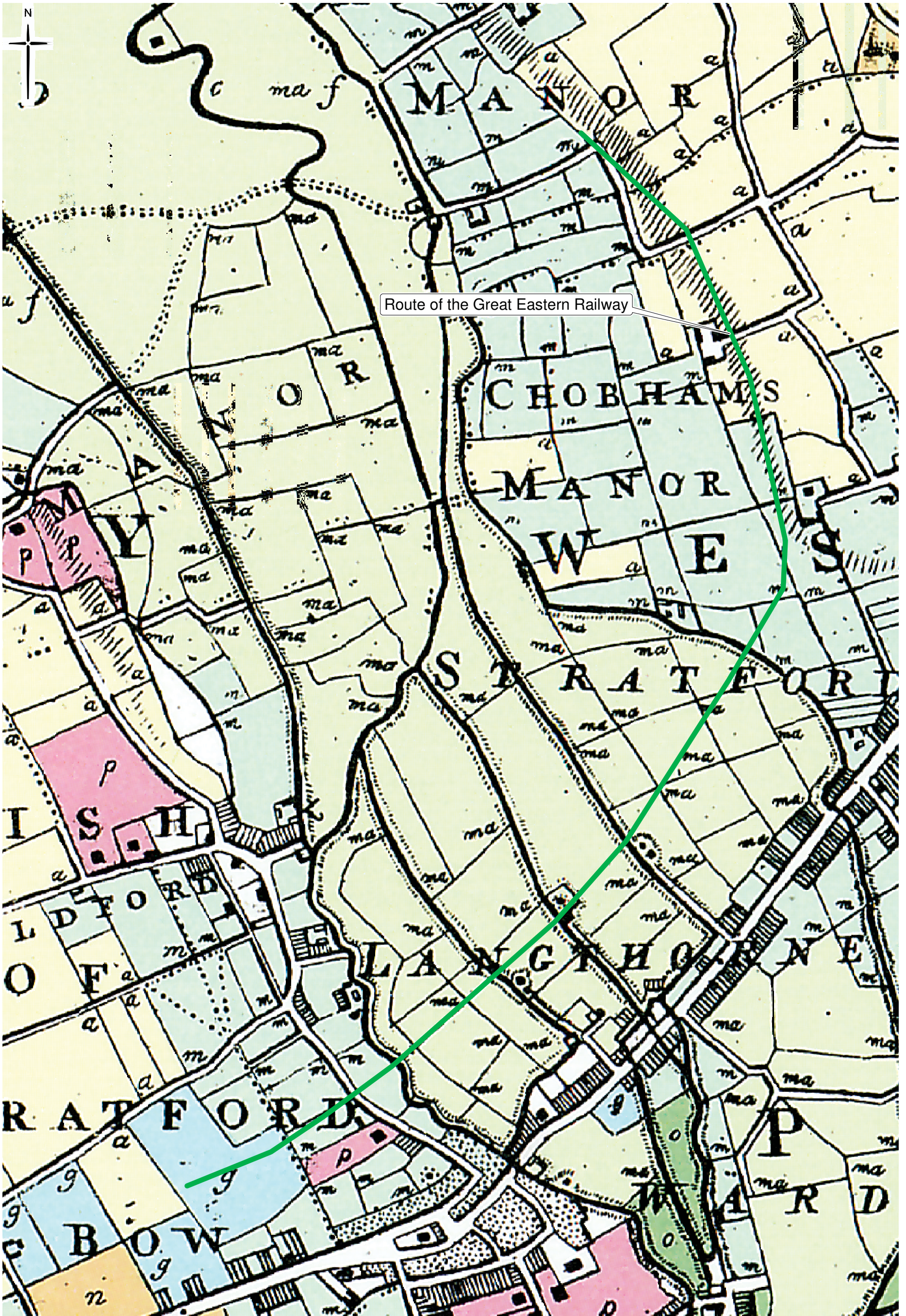


Fig 7 The route of the Great Eastern Railway Mainline and Cambridge line on Milne's land use map of 1800



Fig 8 The route of the Great Eastern Railway Mainline on Greenwood's map of London of 1824-26

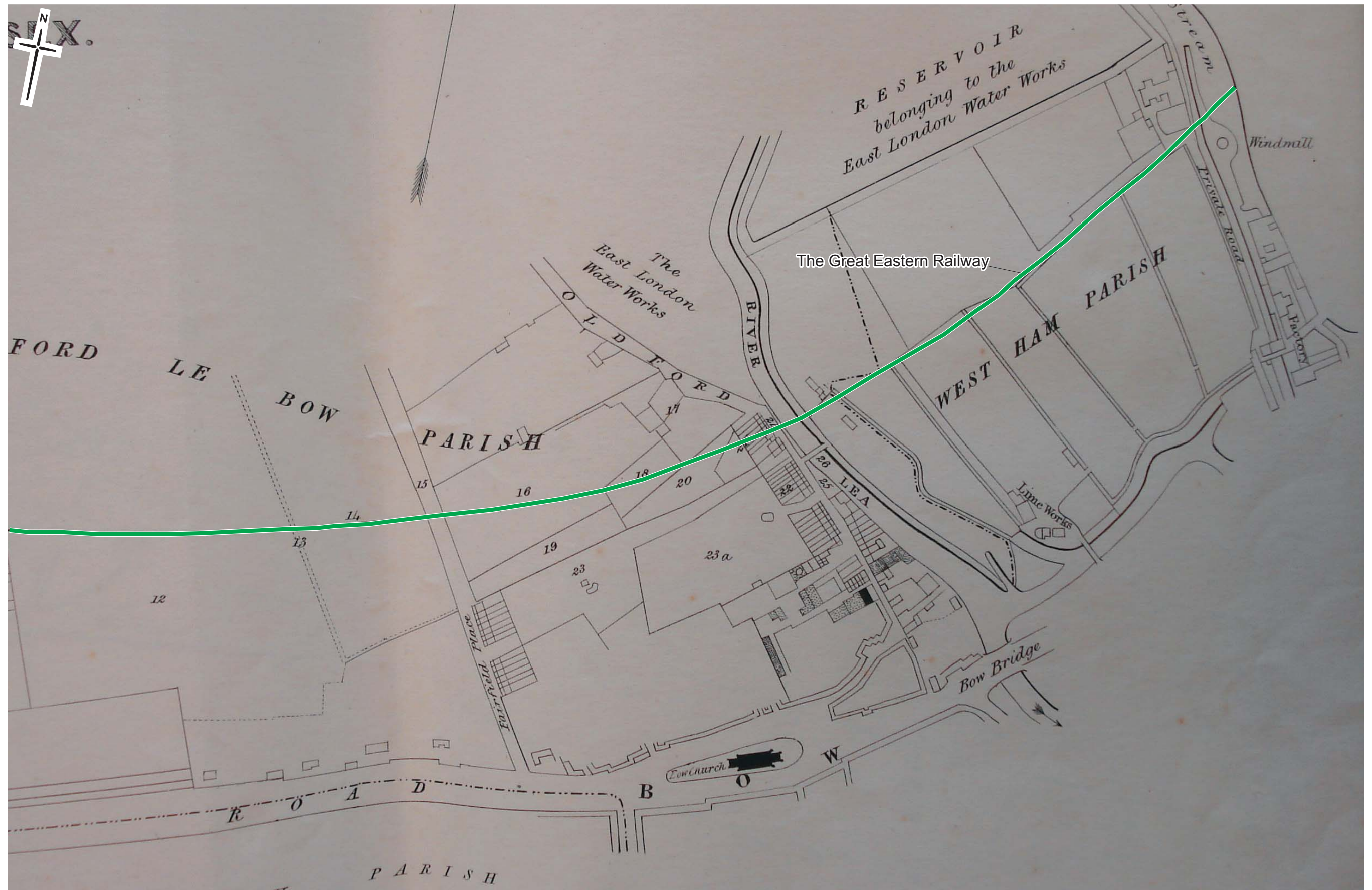


Fig 9 The proposed route of the Great Eastern Railway through Bow, 1835 (Essex RO D/P 134/28/1)

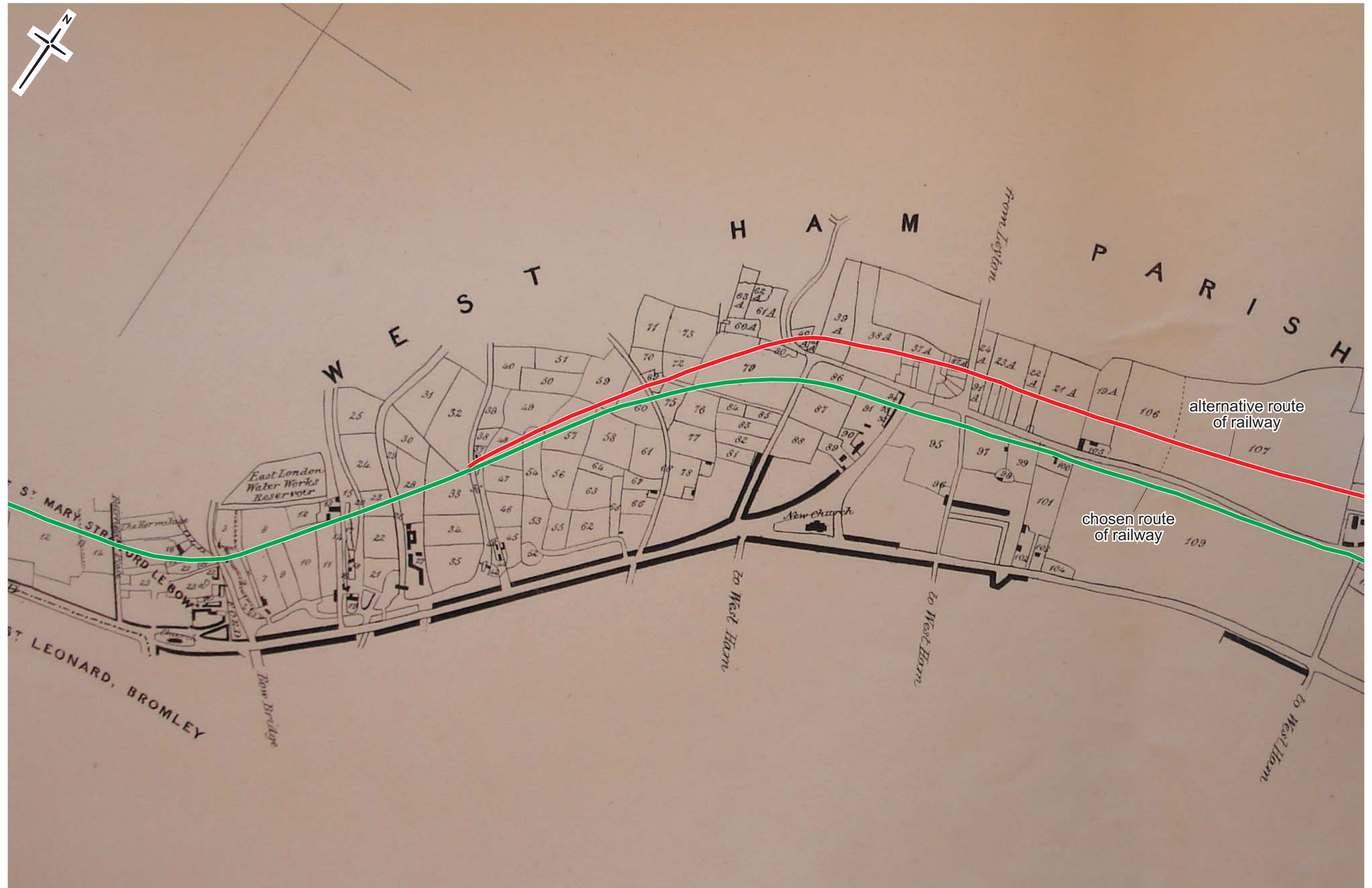


Fig 10 The proposed route of the Great Eastern Railway through West Ham Parish, 1835 (Essex RO D/P 134/28/1)



Fig 11 The Bishopsgate terminus in 1850



Fig 12 Plan of the intended route of the Eastern Counties Railway across the Bridge House Estate at Stratford, 1837 (COL/CCS/PL/01/048)



MULTI10725BR08#13

OL-2407, OL-05307, OL-05807 Standing structure survey ©MoLAS-PCA 2008

Fig 13 The Great Eastern Railway shown on the 1st edition Ordnance Survey map, surveyed in 1867

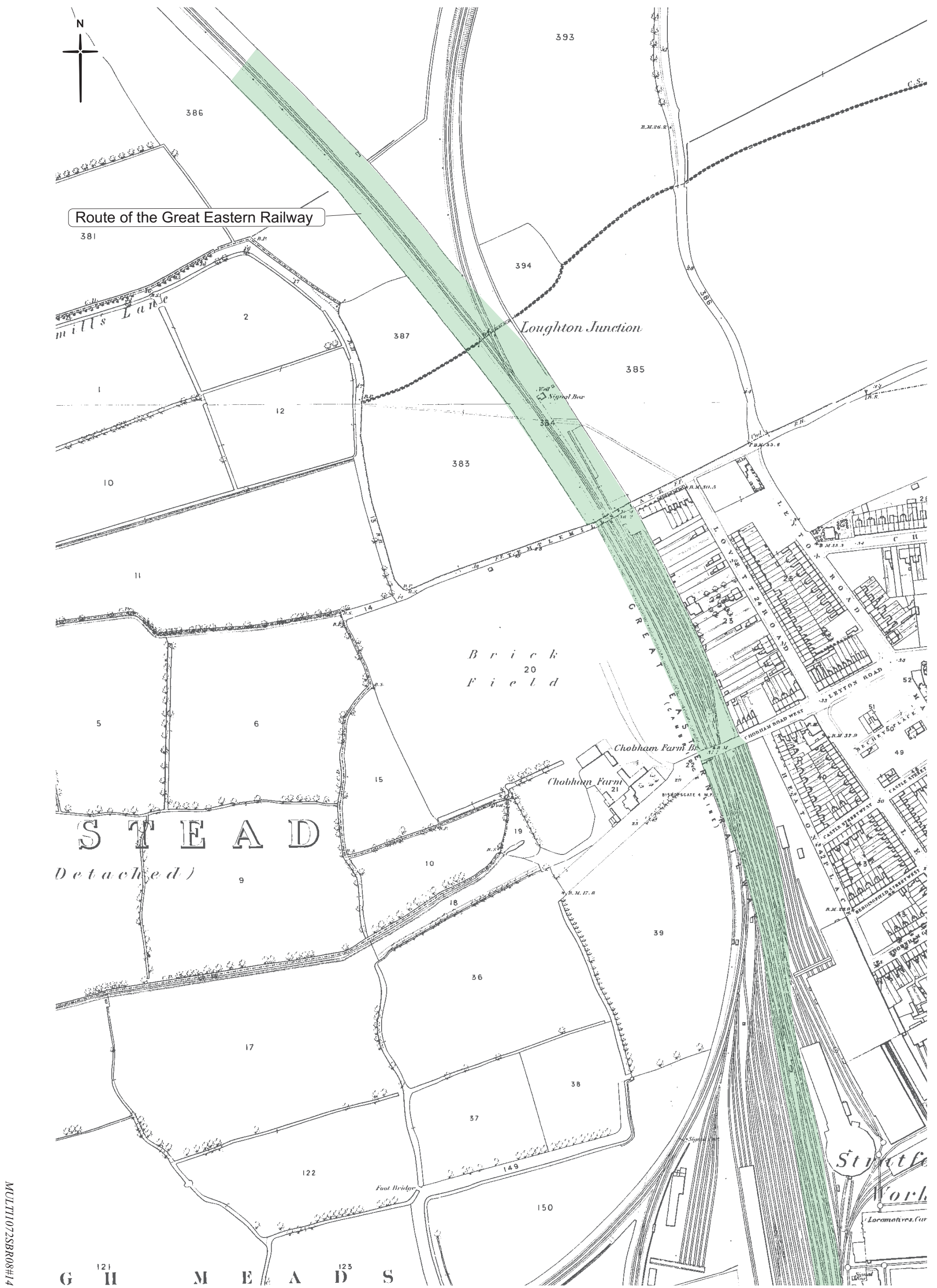


Fig 14 The Great Eastern Railway line to Cambridge shown on the 1st edition Ordnance Survey map, surveyed in 1867

MULTI10725BR08#14

OL-2407, OL-05307, OL-05807 Standing structure survey ©MoLAS-PCA 2008



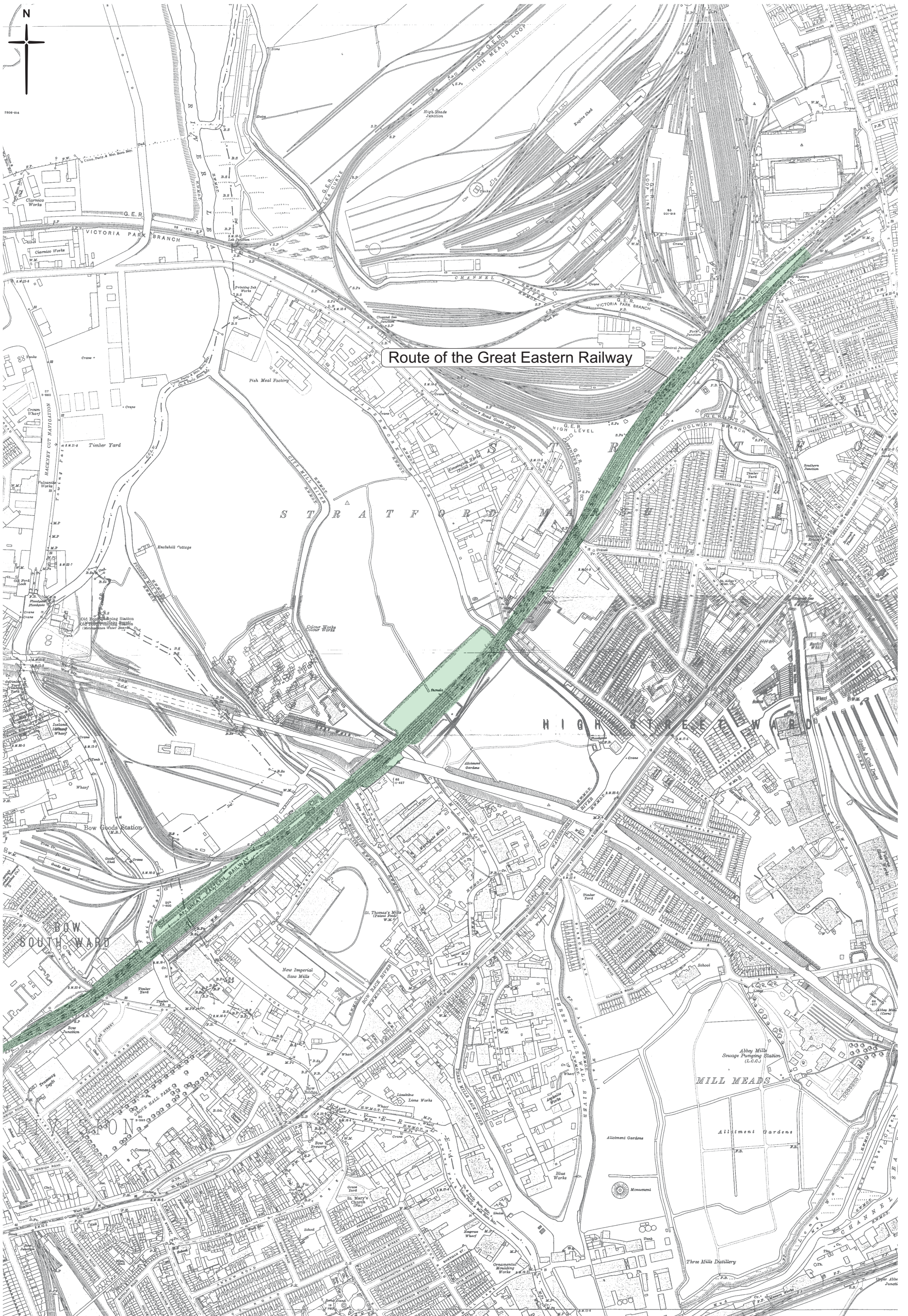
Fig 15 The Great Eastern Railway shown on the 2nd edition Ordnance Survey map, revised in 1893



Fig 16 The Great Eastern Railway line to Cambridge shown on the 2nd edition Ordnance Survey map, revised in 1893

MULTI10725BR08#16

OL-2407, OL-05307, OL-05807 Standing structure survey ©MoLAS-PCA 2008



Route of the Great Eastern Railway

OL-2407, OL-05307, OL-05807 Standing structure survey ©MoLAS-PCA 2008

MULTI10725BR08#17

Fig 17 The Great Eastern Railway shown on the 3rd edition Ordnance Survey map, revised in 1914

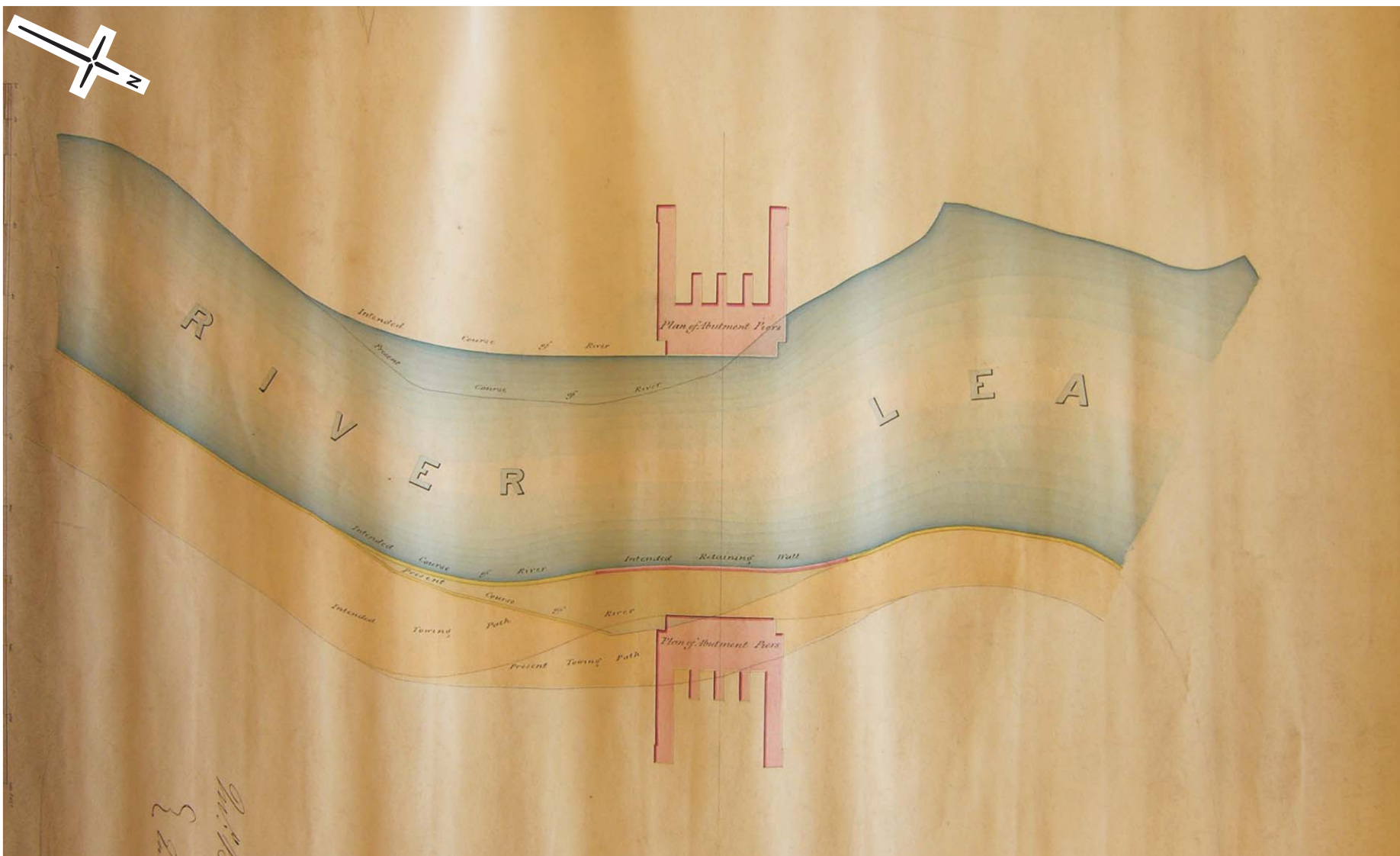


Fig 18 Plan of the new river walls and abutments for the Eastern Counties Railway bridge over the River Lea (ACC/2423/P/0714)

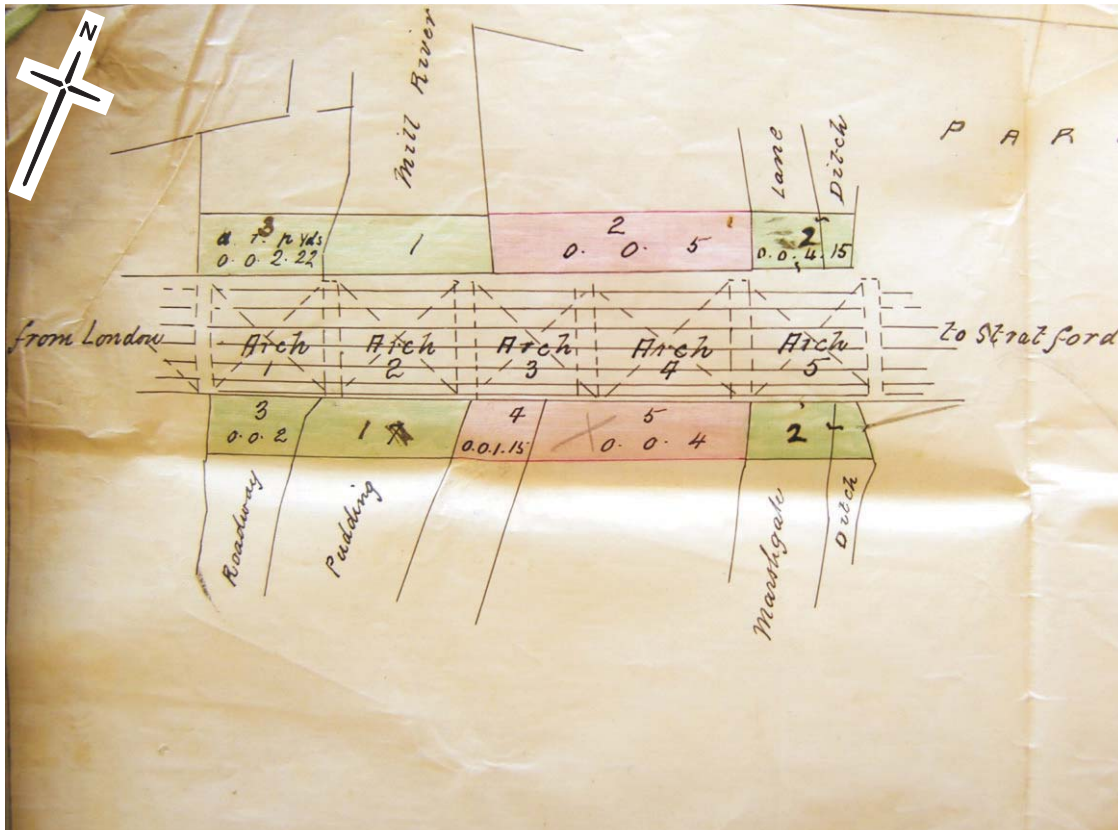


Fig 19 Plan of the proposed widening of the viaduct between Pudding Mill Lane and Marshgate Lane, 1876 (ACC/2423/P/0714)

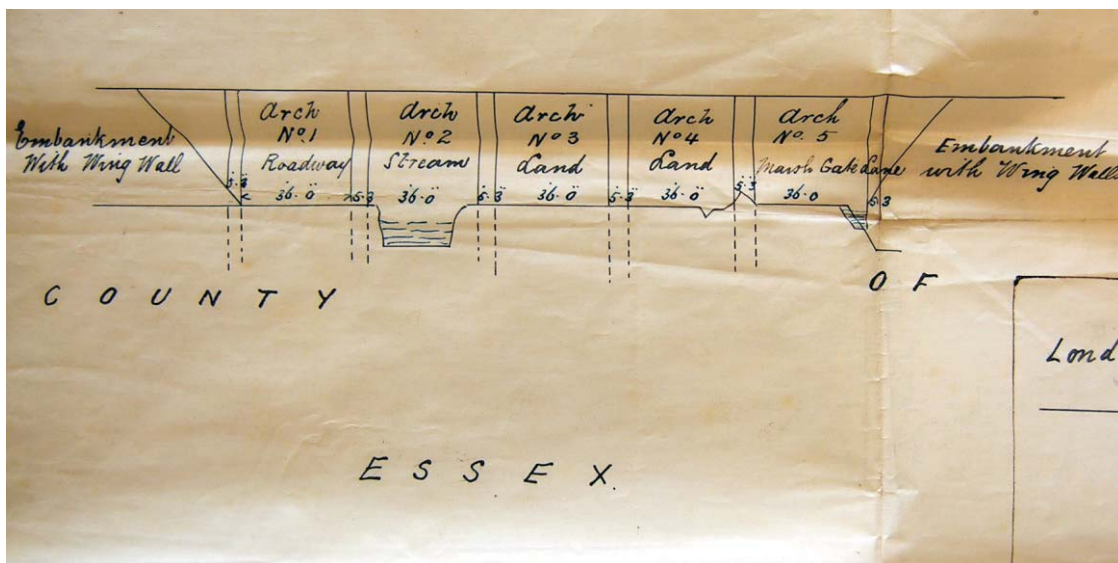


Fig 20 Elevation of the proposed widening of the viaduct between Pudding Mill Lane and Marshgate Lane, 1876 (ACC/2423/P/0714)

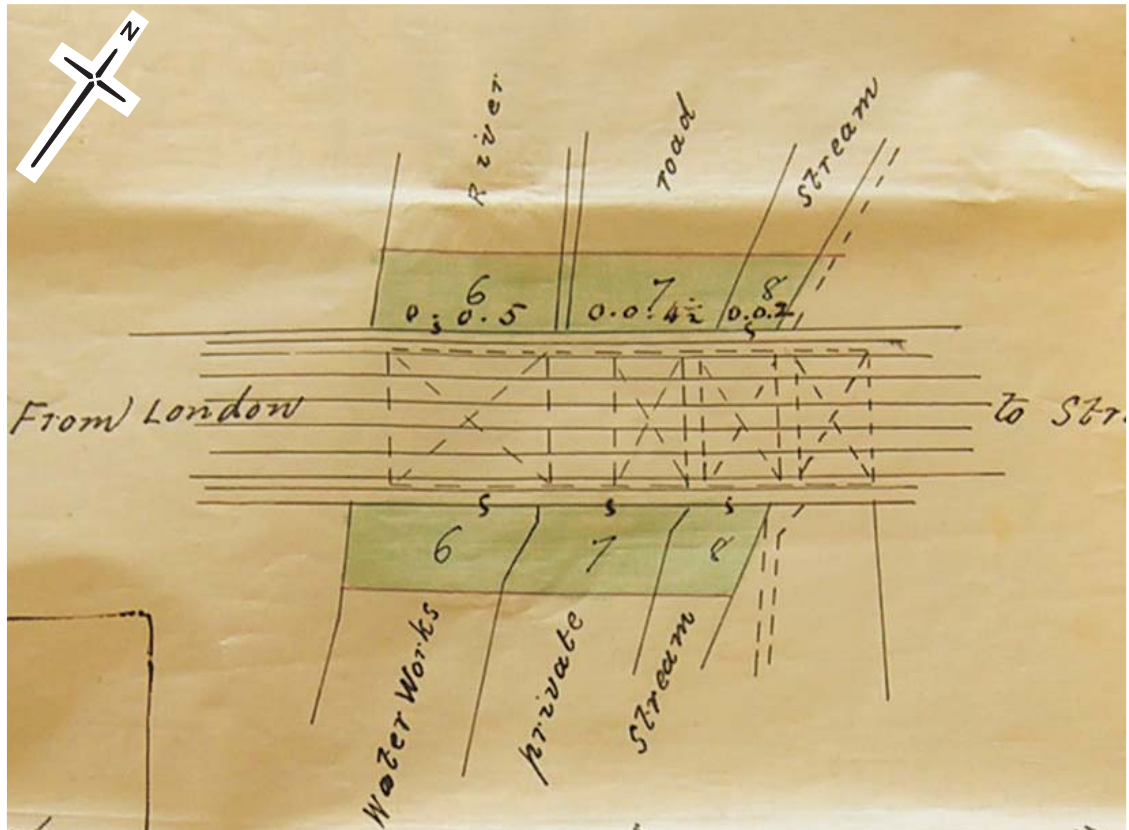


Fig 21 Plan of the proposed widening of the viaduct crossing the Waterworks River and Warton Road, 1876 (ACC/2423/P/0714)

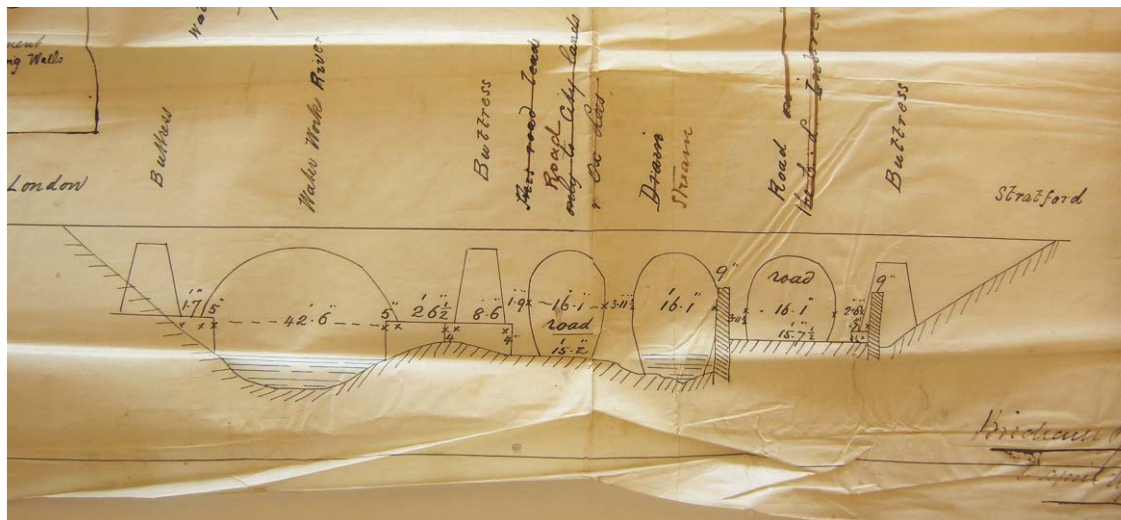


Fig 22 Elevation of the proposed widening of the viaduct crossing the Waterworks River and Warton Road, 1876 (ACC/2423/P/0714)

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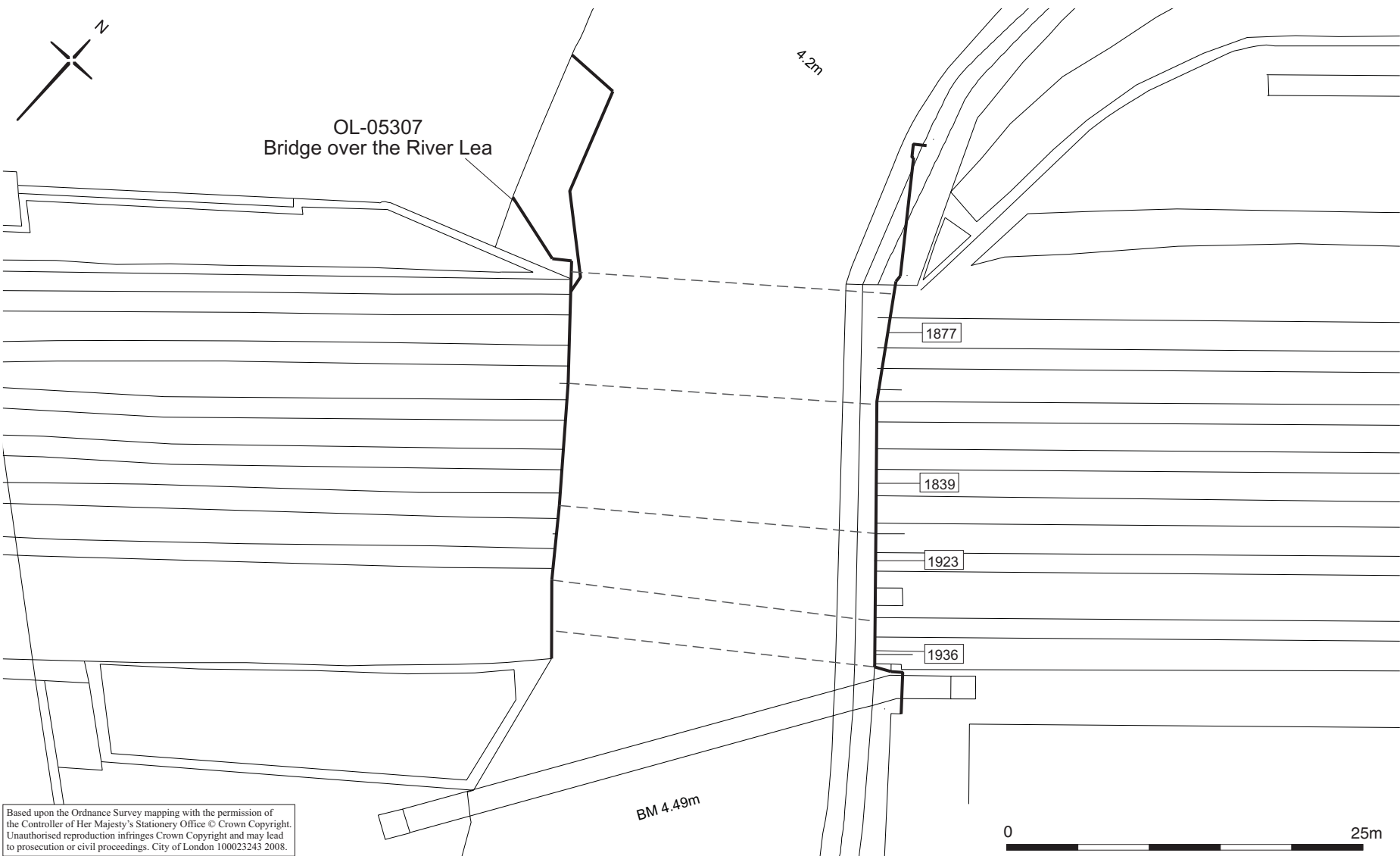


Fig 23 Plan of the railway bridge over the River Lea

OL-02407, OL-05307, OL-05807 Standing structure survey © MoLAS-PCA 2008

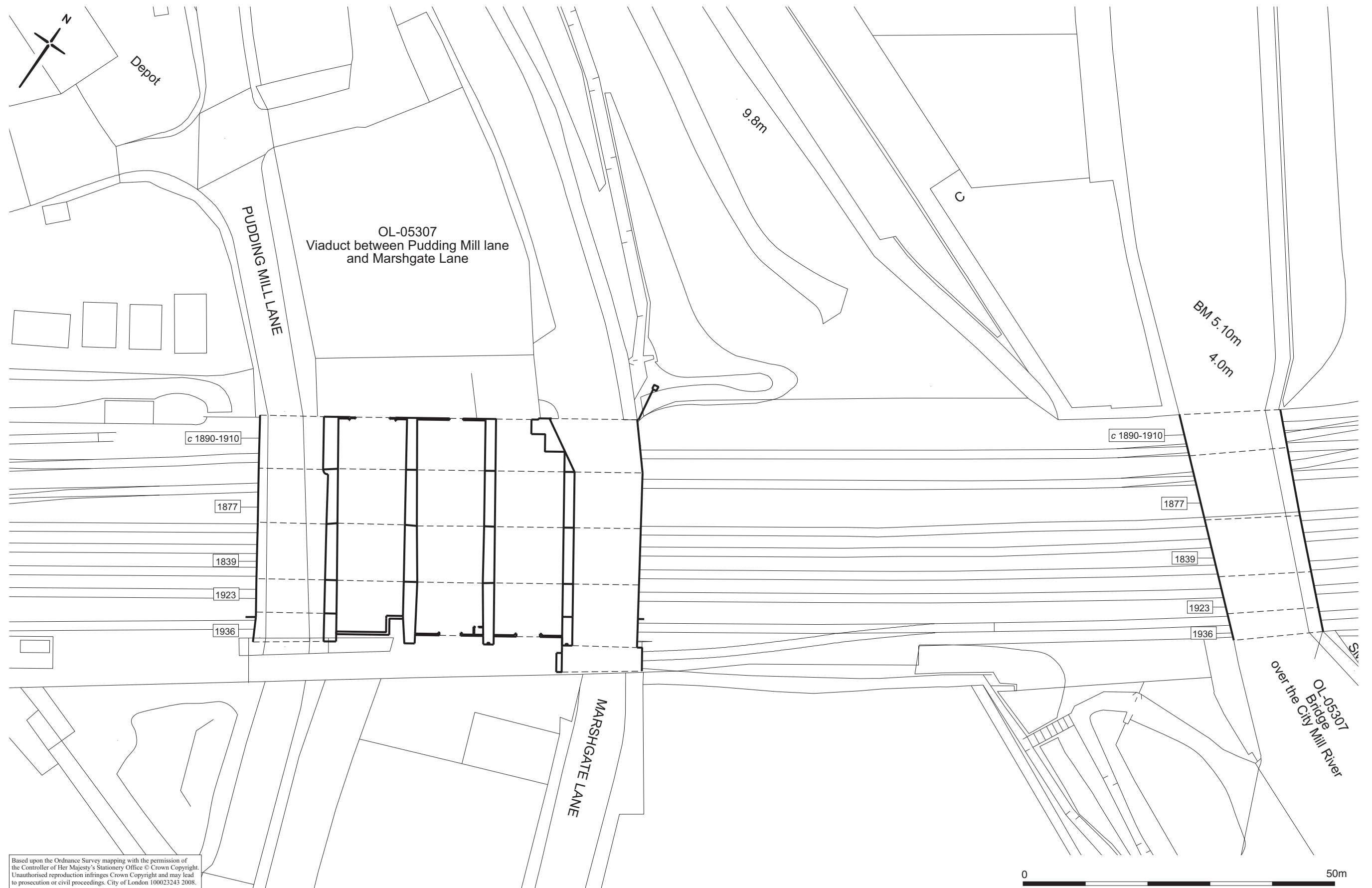


Fig 24 Plan of the viaduct between Pudding Mill Lane and Marshgate Lane and the bridge over the City Mill River

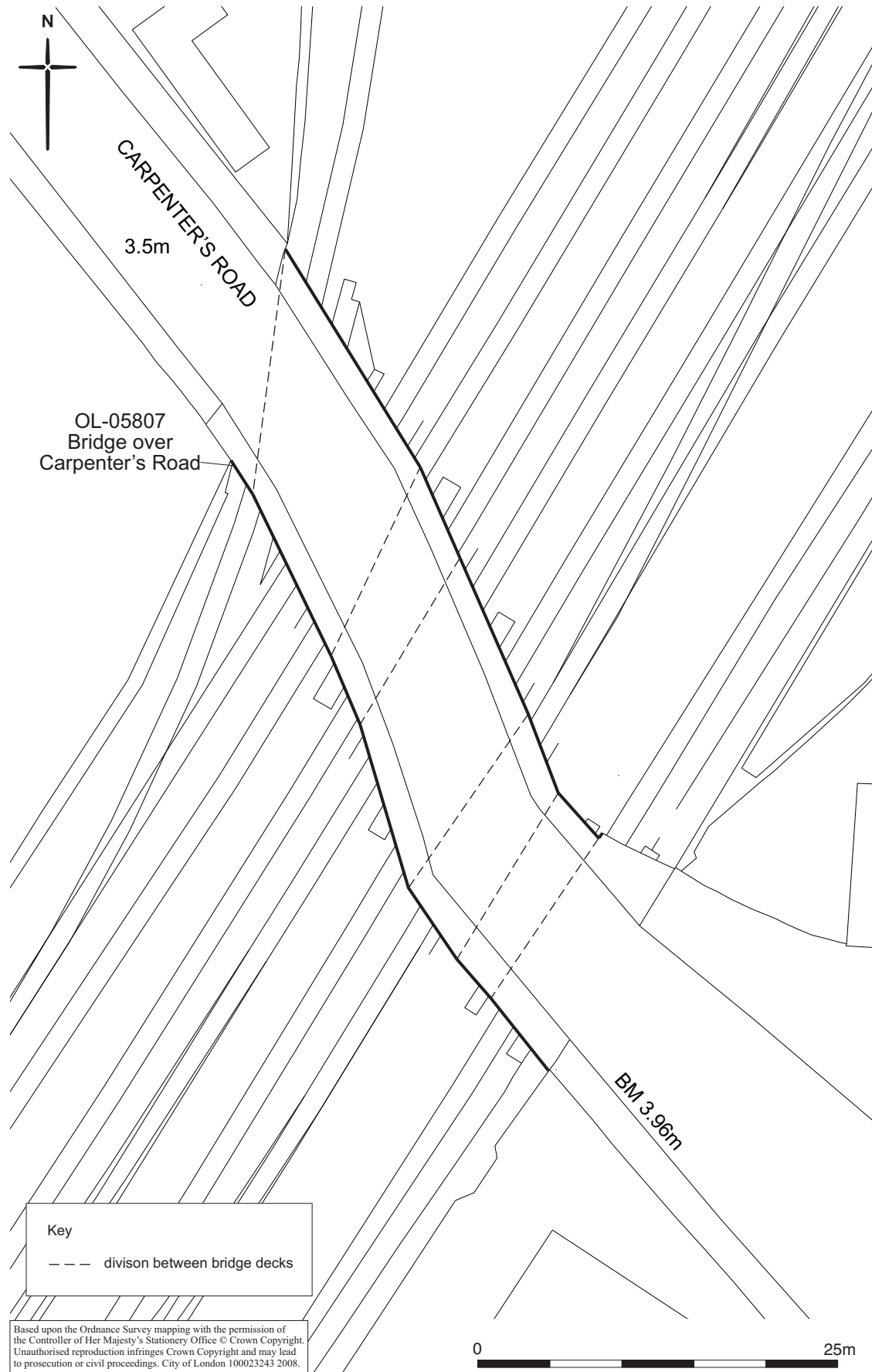


Fig 25 Plan of the railway bridge over Carpenter's Road, showing bridge deck sections

14 Appendix 6: plates



Plate 1 The GER bridge over Fairfield Road in Bow, looking south



Plate 2 The low brick viaduct carrying the GER past the former Bryant and May match factory, looking north



Plate 3 The GER bridge over Wick Lane, looking south



Plate 4 The emergency exit for the Central Line, adjacent to Wick Lane bridge, looking north-east



Plate 5 The GER bridge over the A12 Blackwall Tunnel Northern Approach, looking north



Plate 6 The GER embankment and bridge over the River Lea, looking north-west



Plate 7 The GER embankment between the River Lea and Pudding Mill Lane



Plate 8 Part of the GER Stratford viaduct, between Pudding Mill Lane and Marshgate Lane, seen from the Greenway, looking south



Plate 9 The GER bridge over the Waterworks River, looking north



Plate 10 The GER bridge over Warton Road, looking south-east



Plate 11 The GER embankment between Warton Road and Carpenter's Road, looking north-east



Plate 12 The GER embankment, from Carpenter's Road, looking north-west



Plate 13 The GER bridge over Carpenter's Road, looking south-east



Plate 14 The GER embankment, from Carpenter's Road, looking north-east



Plate 15 The GER line to Stratford Station, looking west from Angel Lane



Plate 16 The GER line to Romford, looking east from Angel Lane



Plate 17 Stratford Station, looking west



Plate 18 Angel Lane Bridge looking south-east



Plate 19 The GER line to Cambridge, crossing the cutting for Stratford International Station, looking west from Angel Lane



Plate 20 Temple Mill Lane bridge, looking south-west



Plate 21 The GER line from Cambridge, looking south towards Stratford



Plate 22 The GER line to Cambridge, looking north-west towards Leyton



Plate 23 The GER line to Cambridge, looking east from Temple Mill Lane



Plate 24 The southern side of the GER bridge over the River Lea, looking north-east



Plate 25 The northern side of the GER bridge over the River Lea, looking south-west



Plate 26 The western bridge abutments of the GER bridge over the River Lea, looking south-west



Plate 27 The southern end of the western abutment of the GER bridge over the River Lea, looking west



Plate 28 The western side of the of the Braithwaite arch, the primary phase of construction, looking south-west



Plate 29 The northern end of the western abutment of the GER bridge over the River Lea, looking south-west

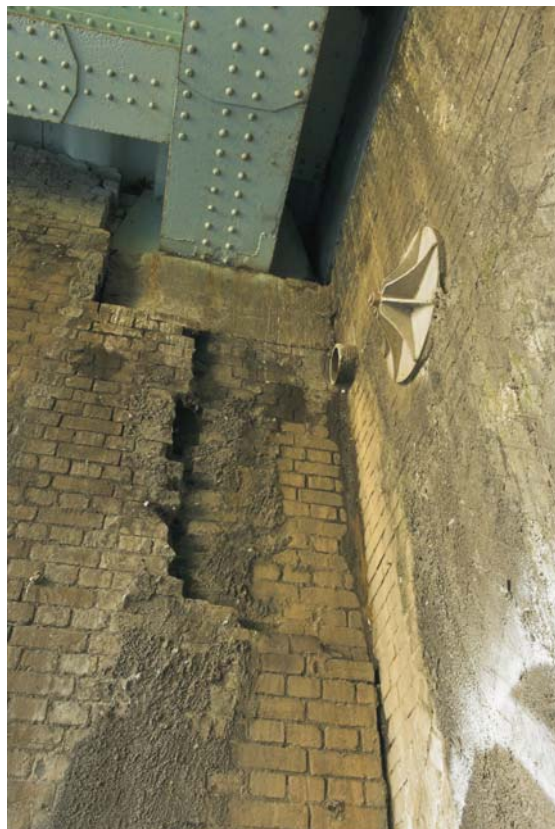


Plate 30 Detail of the junction between the primary construction phase (right) of the GER bridge over the River Lea, and the late 19th century expansion, looking north-east



Plate 31 The towpath along the eastern side of the River Lea, looking north



Plate 32 The southern side of the GER Stratford viaduct, looking north-east



Plate 33 The northern side of the GER Stratford viaduct, looking south



Plate 34 The northern side of the GER bridge across Pudding Mill Lane, looking south-east



Plate 35 The southern side of the GER bridge across Pudding Mill Lane, looking north-west



Plate 36 The elliptical Braithwaite arch of the primary phase of construction of the GER bridge over Pudding Mill Lane, looking north-west



Plate 37 The northern end of the western abutment of the GER bridge across Pudding Mill Lane, looking south-west



Plate 38 The northern end of the western abutment of the GER bridge across Pudding Mill Lane, looking south-west



Plate 39 The centre of the western abutment of the GER bridge across Pudding Mill Lane, looking south-west



Plate 40 The southern end of the western abutment of the GER bridge across Pudding Mill Lane, looking south-west



Plate 41 The southern end of the western abutment of the GER bridge across Pudding Mill Lane, looking south-west

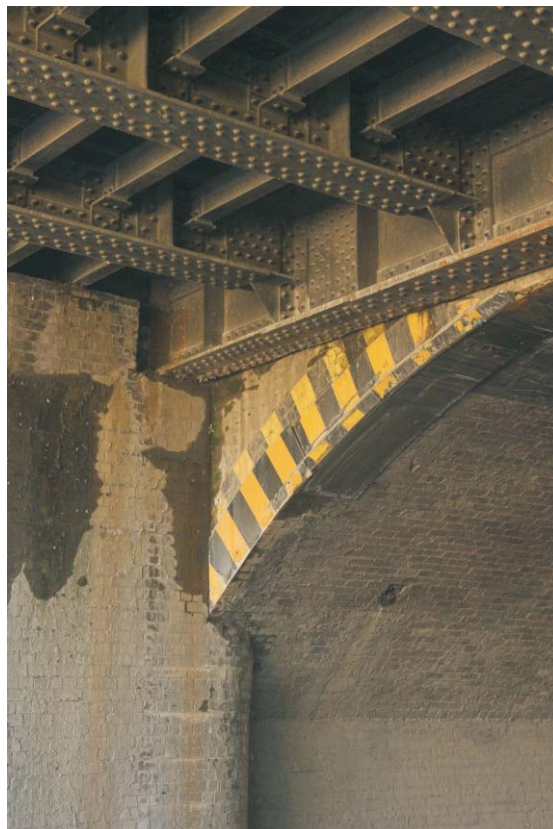


Plate 42 Detail of the junction between the late 19th and early 20th century additions to the northern side of the bridge, looking east



Plate 43 Detail of a benchmark carved into the impost band of the primary phase of construction of the GER bridge across Pudding Mill Lane, looking south-west



Plate 44 The north-facing external elevation of the viaduct arches between Pudding Mill Lane and Marshgate Lane, looking south-east



Plate 45 The exterior of the western arch of the Stratford viaduct, looking south-east



Plate 46 The exterior of the central arch of the Stratford viaduct, looking south-east



Plate 47 The exterior of the eastern arch of the Stratford viaduct, looking south-east



Plate 48 The interior of the central arch of the Stratford viaduct, looking north



Plate 49 The southern side of the GER bridge over Marshgate Lane, looking north-west



Plate 50 The southern side of the east abutment of the GER bridge over Marshgate Lane, looking north



Plate 51 The southern side of the west abutment of the GER bridge over Marshgate Lane, looking north-west



Plate 52 The southern end of the west abutment of the GER bridge over Marshgate Lane, looking south-west



Plate 53 The centre of the west abutment of the GER bridge over Marshgate Lane, looking south-west



Plate 54 The northern end of the west abutment of the GER bridge over Marshgate Lane, looking south-west



Plate 55 The northern end of the west abutment of the GER bridge over Marshgate Lane, looking south-west



Plate 56 The brick retaining wall of the embankment to the east of Marshgate Lane, looking south-east



Plate 57 The southern side of the GER bridge over the City Mill River, looking north-west



Plate 58 The northern side of the GER bridge over the City Mill River, looking south-west



Plate 59 The northern side of the GER bridge over the City Mill River, looking south



Plate 60 The southern end of the western abutment of the GER bridge over the City Mill River, looking south-west



Plate 61 The northern end of the western abutment of the GER bridge over the City Mill River, looking south-west

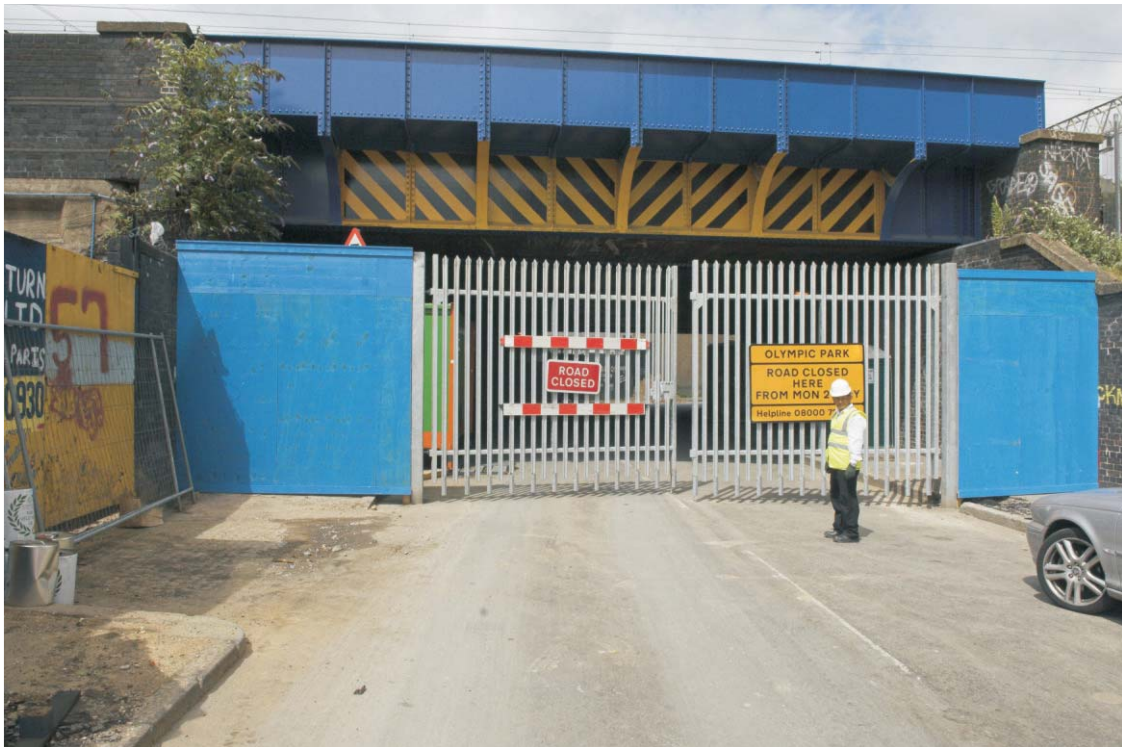


Plate 62 The southern side of the GER bridge over Warton Road, looking north-west

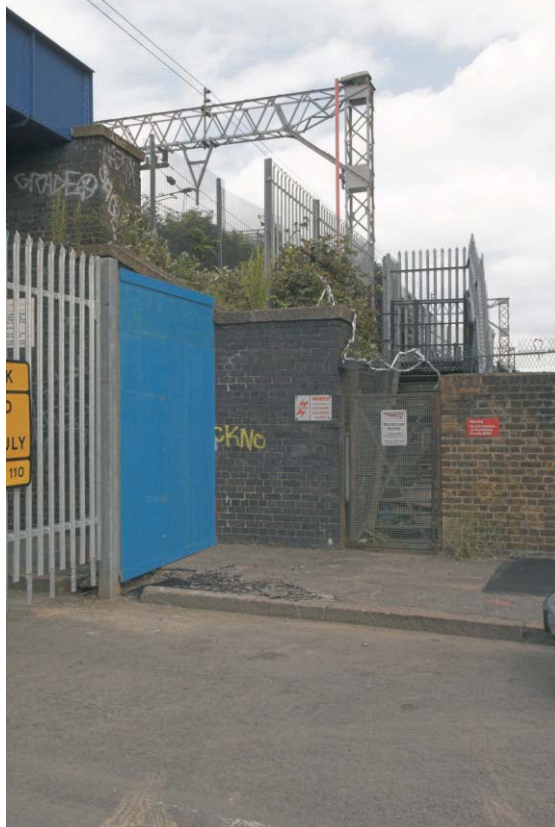


Plate 63 Stairs leading from the street to the deck of the GER bridge over Warton Road, looking north



Plate 64 The northern side of the GER bridge over Warton Road, looking south-east



Plate 65 The northern end of the eastern abutment of the GER bridge over Warton Road, looking north-east



Plate 66 The southern side of the GER bridge over Carpenter's Road, looking north-west



Plate 67 The northern side of the GER bridge over Carpenter's Road, looking south-east



Plate 68 The northern end of the west abutment of the GER bridge over Carpenter's Road, looking south



Plate 69 The northern end of the east abutment of the GER bridge over Carpenter's Road, looking south-east



Plate 70 Detail of a benchmark carved into a brick at the northern end of the east abutment of the GER bridge over Carpenter's Road, looking north-east



Plate 71 Detail of the steel decks on the northern side of the GER bridge over Carpenter's Road

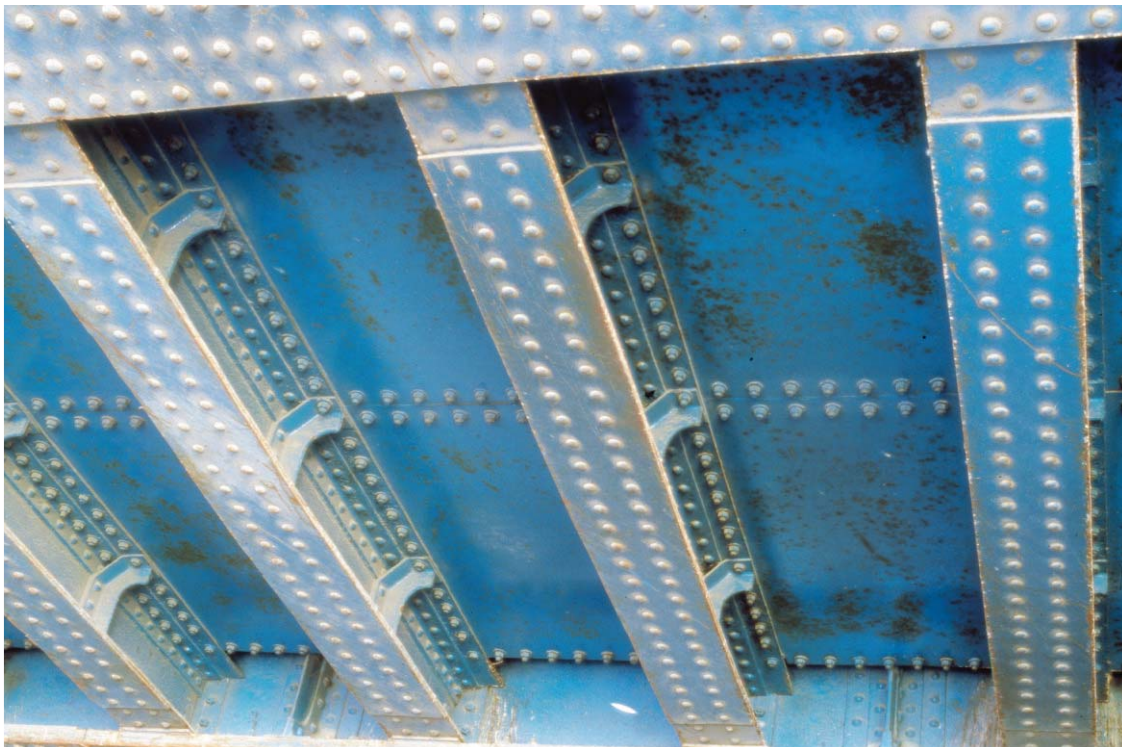


Plate 72 Detail of the riveted steel plate and composite girder deck on the southern side of the GER bridge over Carpenter's Road



Plate 73 The brick retaining wall of the viaduct of the North London Line, looking north-east