

**LOWER LEA VALLEY OLYMPIC LEGACY POWERLINES
UNDERGROUNDING SCHEME
FORMER HACKNEY STADIUM
Hackney Wick
London
E15**

London Boroughs of Hackney and Tower Hamlets

A report on archaeological and geotechnical monitoring
of geotechnical pits and boreholes

September 2005



MUSEUM OF LONDON

Archaeology Service

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Site Code: OL-00205
National Grid Reference: 537335 184980

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Summary (non-technical)

This report presents the results of a monitoring exercise carried out by the Museum of London Archaeology Service between 15/8/2005 and 25/8/2005 on geotechnical trial pits, window samples and boreholes at the site of the former Hackney Stadium, west of Waterden Road, London, E15.

The report summarises the archaeological potential of the site, and the likely impact on this of the proposed redevelopment, the main component of which is the construction of multi-sport arenas for the 2012 Olympics.

The report was commissioned from MoLAS by Capita Symonds Ltd.

The deposits observed within the trial pits and window samples indicate the presence of 19th to 20th century dumping of industrial waste (from varied industrial activities such as furnace works, glass works and also possible gas works waste) across the whole site. Finds evidence suggests that it probably dates from the first quarter of the 20th century. The deposit has a depth of between 7m and 11m below current ground level. Underlying this were deposits with palaeoenvironmental or archaeological potential: an active flowing channel of the Lea flowed through this area at least until the Late Mesolithic\Early Neolithic periods. The length of time that the channel was active and the subsequent development of the alluvial clays has implications for the survival and occurrence of human occupation. The overlying alluvial clays suggest that a mudflat environment developed once channel migration had occurred. A large expanse of mudflats would not have been an attractive location for later prehistoric occupation. If sudden abandonment of the channel occurred rather than gradual migration, exposed gravel bars and ridges may have been quickly buried by the alluvial clays leading to greater preservation of occupation surfaces. If however the channel was still active for sometime, such occupation surfaces are likely to have been disturbed by later fluvial action.

Whilst the archaeological remains are of local significance in characterising the nature of the depositional sequence at the site, there is nothing to suggest that the deposits are of regional or national importance.

If any ground works in any proposed scheme should impinge on the higher areas of the gravels, an evaluation should be undertaken to examine whether these zones contain any in situ flint scatters.

However, in general, the deposits of archaeological and environmental potential are buried below significant deposits of made ground – up to 11m thick across the site. Such a depth of overlying material, if retained undisturbed, will protect the archaeological resource.

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1 Introduction

1.1 Site background

The monitoring took place at the site of the former Hackney Stadium (hereafter called 'the site'). It lies within a plot of land bounded by Waterden Road to the east, by depot buildings to the south, by the A106 Eastway to the north and the Hackney Cut canal to the west. See Fig 1 for location.

Although these works were associated with a scheme to place the Lea Valleys overhead transmission lines into underground tunnels, the site lies within Construction Zone 5 of the proposed Olympics development area, as shown on Capita Symonds drawing number 62272/REMS/001_A3 rev. 1, dated 04/01/05. Therefore, any heritage expectations/implications associated with Construction Zone 5 apply equally to this scheme.

A desk-top *Archaeological impact assessment* for Construction Zone 5 was previously prepared by MoLAS-PCA, which covers the whole area of the site (Corcoran et al, 2005). This document should be referred to for information on the natural geology, archaeological and historical background of the site, and the initial interpretation of its archaeological potential.

The OS National Grid Ref. for centre of site is 537335 184980. Pavement level to the east of the site lies between 9.90m and 10.20m OD and ground level in the centre of the site is at 10.50m OD.

1.2 Planning and legislative framework

Although this site lies within the zone affected by the Olympic development, the geotechnical work was undertaken in relation to another Olympic-related planning application, a scheme to facilitate the future development in the Lower Lea Valley by diverting overhead power transmission cables into twin tunnels of 4.0m and 3.6m diameter. The tunnels will carry the cables from the existing West Ham Sub-Station to Hackney Sub-Station, a distance of around 6 km.

It is proposed that this site becomes a temporary stockpiling area for material excavated during this tunnelling scheme. The planning and legislative background to the scheme is summarised in the *Archaeological impact assessment* for the tunnelling project (Burton et al, 2005). That document should be referred to for information on the planning and legislative background.

1.3 Origin and scope of the report

This report has been commissioned from MoLAS-PCA by Capita Symonds on behalf of the London Development Agency (LDA). It has been requested in advance of the possible redevelopment of the site and may be required in relation to the planning process in order that the local authority can formulate appropriate responses in the light of any identified archaeological resource.

Monitoring of test/trial pits or boreholes, even when these are not primarily designed for archaeological evaluation, may nevertheless be able to provide useful information on the nature and extent of archaeological deposits. According to the most recent English Heritage guidelines (English Heritage, 1998) this will contribute to the:

- formulation of a strategy for the preservation or management of those remains; and/or
- formulation of an appropriate response or mitigation strategy to planning applications or other proposals which may adversely affect such archaeological remains, or enhance them; and/or
- formulation of a proposal for further archaeological investigations within a programme of research

1.4 Aims and objectives

All research is undertaken within the priorities established in the Museum of London's *A research framework for London Archaeology, 2002*

Monitoring of the trial pits, window samples and boreholes was intended to address the following broad objectives and archaeological research aims:

- What is the level of truncation caused by earlier developments in this area?
- What is the nature and significance of the surviving archaeological remains?
- What are the levels and the characteristics of the alluvial deposits and how do these compare to adjacent sites?
- To what extent can the previous geoarchaeological deposit model be refined, and inform on possible areas of prehistoric activity?

2 Topographical and historical background

A detailed description of the history of the site was provided in the earlier *Construction Zone 5 Archaeological impact assessment* (Section 3, Corcoran et al, 2005).

The earliest detailed map of the area dates from 1745 and shows the site as open land (Fig 2). Although the site was subject to ground raising in the early 20th century (Corcoran et al, 2005, Fig 19), otherwise it remained largely undeveloped until the mid 20th century (Fig 3). This lack of known development means that the major focus of interest in the site was on its geoarchaeological potential, discussed below.

2.1 Geoarchaeological background and topography

The British Geological Survey (BGS) solid and drift geology map no. 257 shows that the former Hackney Stadium site falls within the flood plain of the Lower Lea Valley. The deposits here consist of floodplain alluvium and gravels, which overlie tertiary deposits consisting of the Woolwich and Reading beds. This part of the Lea Valley was the subject of a previous archaeological desk based assessment, which examined a parcel of land known as Construction Zone 5 (Corcoran et al, 2005). The former Hackney Stadium site occupies the central part of this construction zone.

Geotechnical borehole data was taken from the Lea Valley Mapping Project (Burton et al, 2004) to create a topographical model of the area divided into Landscape zones where similar sequences could be expected to occur (Fig 4). The area around the Hackney Stadium was designated as falling into a zone was characterised by low-lying Pleistocene gravels, which suggested that this part of the landscape had once formed an ancient course of the River Lea (landscape zone 3: Fig 5). It was suggested that a Pleistocene channel had probably flowed across the site diagonally in a north-west to south-east direction. This Pleistocene channel would have formed a shallow valley in the Holocene landscape, which was probably exploited by later prehistoric and historic streams. However, this interpretation of the landscape zone was inferred from borehole logs situated at the periphery the area, as no geotechnical data was available for this part of the site itself.

From this model it was suggested that the surface of the gravels deposited within this low-lying area may undulate between 1m and 2m OD, with the surface of the overlying alluvium occurring at around 3.50m to 4m OD, and measuring between 1.50 and 2m thick.

Immediately west of the former Hackney Stadium, an area of land was designated as falling into landscape zone 2 (Fig 5). Although the majority of the site appears to fall within landscape zone 3, deposits and geomorphological features as defined by landscape zone 2 may occur towards the far western part of the site.

landscape zone 2 was characterised by higher gravels but with an irregular and undulating surface (Fig 5). This would have formed a diverse landscape in the Holocene period with a mosaic of small islands of high ground separated by channels and wetland areas. It is thought that the Hackney Brook flowing from the west may have reached a confluence with the Lea in this area. The higher areas of gravel in this zone are likely to occur at around 4m OD, with lower lying wetland areas possibly associated with the Hackney Brook occurring at around 0.50m OD. The overlying alluvial deposits may be expected to occur at around 3.50 to 4.50m OD, and maybe no more than 0.50m and 1m thick.

3 The trial pits and boreholes monitoring

3.1 Methodology

3.1.1 Monitoring of trial pits and window samples

A total of 14 trial pits were machine excavated and a further eight window samples were completed during the site investigation. Eight boreholes were also completed (see below).

The trial pits were machine excavated and the window samples taken by mobile percussion rig under the supervision of White Young Green Environmental Ltd. The works were monitored by MoLAS.

All archaeological recording during the monitoring was carried out in accordance with the Archaeological Site Manual (MoLAS, 1994).

White Young Green Environmental Ltd provided the trial pit and window sample locations and a levelled CAD survey of the site.

The monitoring exercise has produced: a trial pit, window sample and borehole location plan; 20 context records; 14 section drawings at 1:50; and a series of digital photographs. In addition one box of finds were recovered from the site.

The site finds and records can be found under the site code OL-00205 in the MoL archive.

3.1.2 Monitoring of boreholes

Four boreholes were drilled by Jackson Drilling Ltd with a cable percussion-drilling rig. A MoLAS geoarchaeologist monitored the boreholes on site. All the boreholes were drilled to a depth of 25m, although the deposits were only recorded up to the base depth of the floodplain gravels.

The deposits recovered from each core were cleaned and described, using standard sedimentary criteria, as outlined in Jones et al (1999). This attempts to characterise the visible properties of each deposit, in particular relating to its colour, compaction, texture, structure, bedding, inclusions, clast-size and dip. The depths and nature of the interfaces were noted and a provisional on-site interpretation made. For each profile, every distinct unit was given a separate number (e.g.: for BH101: 1.1, 1.2 etc from the top down)

One ¹⁴C sample was recovered from unit 4.6 in BH104.

3.2 Results

In total, 14 trial pits and eight window samples were completed. These have been numbered consecutively. A brief description of the deposits recorded follows.

See Fig 6 for all trial pit, window sample and borehole locations,.

3.2.1 Trial pit 101

Location	537251 185045
Dimensions	3.20m N/S by 0.70m E/W
Modern ground level/top of slab	9.09m OD
Base of modern fill/slab	8.14m OD
Depth of archaeological deposits seen	3.30m
Level of base of deposits observed	4.99m OD (not bottomed)
Natural observed	N/A

Table 1 Details of trial pit 101

Trial pit 101 was located in a yard area in the north-west corner of the site and was excavated to a depth of 4m below the present tarmac surface.

A dumped deposit [1] of 19th-20th century industrial waste was excavated, but not bottomed, to a depth of 3.30m. This deposit consisted of loose, dark brown to black, ash, iron slag and sandy clay. The deposit, which was oily and contaminated with petro-chemicals, included frequent 19th-20th century brick rubble, small to medium flint pebbles, occasional concrete rubble and fragments of York stone slabs. This deposit, which was not fully excavated, may represent industrial furnace waste and was recorded at a height of 8.14m OD.

Sealing this were levelling layers of sand, sandy silt and crushed brick and concrete rubble for the 0.10m thick tarmac surface of the present yard surface, recorded with a surface height of 9.09m OD.

3.2.2 Trial pit 102

Location	537288 185064
Dimensions	4.80m N/S by 0.80m E/W
Modern ground level/top of slab	10.27m OD
Base of modern fill/slab	10.07m OD
Depth of archaeological deposits seen	3.90m
Level of base of deposits observed	6.17m OD (not bottomed)
Natural observed	N/A

Table 2 Details of trial pit 102

Trial pit 102 was located in the north of the site and was excavated to a depth of 4.10m below the present surface.

A layer of soft to firm, light grey re-deposited clay containing occasional gravels mixed with dark brown to black industrial fire waste [3], recorded at a height of 6.57m OD was excavated to a depth of 0.40m but not bottomed.

Overlying this was a 3.50m thick, dumped deposit of probable 20th century industrial waste [2] consisting of loose, dark brown to black, ash, iron slag and silty, sandy clay. The deposit included frequent 19th-20th century brick rubble, small to medium

pebbles and fragments of wood and possible stable sweepings. This deposit, which had a strong odour of sulphur and contained pockets of white gypsum may represent industrial furnace waste and was recorded at a height of 8.14m OD.

Sealing this, and recorded with a surface height of 10.27m OD, was the 0.20m thick crushed brick and brick rubble surface of the present site.

3.2.3 Trial pit 103

Location	537351 185060
Dimensions	3m N/S by 0.80m E/W
Modern ground level/top of slab	10.75m OD
Base of modern fill/slab	8.85m OD
Depth of archaeological deposits seen	2.60m
Level of base of deposits observed	6.25m OD (not bottomed)
Natural observed	N/A

Table 3 Details of trial pit 103

Trial pit 103 was located in the north area of the now demolished stadium and was excavated to a depth of 4.50m below the present surface.

A layer of loose, brown to black sandy clay, gravel and contaminated 19th-20th century industrial fire waste [4] was recorded at a height of 8.85m OD and excavated to a depth of 2.60m, but not bottomed. This deposit contained possible spent oxide, ash, iron slag and occasional fragments of leather.

Sealing this was two levelling layers of sand then brick rubble then manufactured gravel, recorded at a height of 10.75m OD, that forms part of the now demolished Hackney Stadium.

3.2.4 Trial pit 104

Location	537297 185058
Dimensions	3.50m N/S by 0.80m E/W
Modern ground level/top of slab	10.53m OD
Base of modern fill/slab	9.73m OD
Depth of archaeological deposits seen	1.20m
Level of base of deposits observed	8.53m OD (not bottomed)
Natural observed	N/A

Table 4 Details of Trial Pit 104

Trial pit 104 was located in the north area of the now demolished stadium and was excavated to a depth of 2m below the present surface. The excavation was abandoned at this depth due to asbestos contamination.

A deposit of loose, brown to black sandy, clay and 20th century contaminated industrial waste including brick rubble [5] was recorded at a height of 9.73m OD and excavated to a depth of 1.20m, but not bottomed.

Overlying this were plastic services in a loose gravel fill and sealed by a 0.50m thick layer of manufactured gravel, recorded at a height of 10.53m OD, that are associated with the sites previous use as a Stadium.

3.2.5 Trial pit 105

Location	537292 185047
Dimensions	5m N/S by 0.70m E/W
Modern ground level/top of slab	10.46m OD
Base of modern fill/slab	9.56m OD
Depth of archaeological deposits seen	3.10m
Level of base of deposits observed	6.46m OD (not bottomed)
Natural observed	N/A

Table 5 Details of trial pit 105

Trial pit 105 was located in the north area of the former stadium and was excavated to a depth of 4m below the present surface.

A deposit of loose, brown to black sandy clay and contaminated industrial waste [6] was recorded at a height of 9.56m OD and excavated to a depth of 3.10m but not bottomed. This deposit contained frequent large pink fire bricks and may represent 19th–20th century industrial furnace/fire waste. Frequent large boulders of re-deposited light brown clay were present at the base of the trench.

Overlying this was a series of light electric cables beneath a concrete paving surface recorded at a height of 10.16m OD that is associated with the Stadium. Sealing this was a 0.30m thick layer of manufactured gravel recorded at a height of 10.46m OD.

3.2.6 Trial pit 106

Location	537323 185046
Dimensions	3m N/S by 0.70m E/W
Modern ground level/top of slab	10.58m OD
Base of modern fill/slab	9.58m OD
Depth of archaeological deposits seen	1.80m
Level of base of deposits observed	7.78m OD (not bottomed)
Natural observed	N/A

Table 6 Details of trial pit 106

Trial pit 106 was located in the north east corner of the former stadium and was excavated to a depth of 2.80m below the present surface. The excavation was abandoned at this depth due to unstable sections.

A deposit of loose, light brown to black sandy clay and 19th-20th century industrial waste [8] was recorded at a height of 9.38m OD and excavated to a depth of 1.60m, but not bottomed. This deposit contained frequent boulders of re-deposited light brown clay and iron slag and coal and probably represents more mixed dumping of industrial fire or gas works waste. A complete small green coloured glass bottle, dating to between the late 19th into the first quarter of the 20th century, was recovered from this context.

Overlying this was a 0.20m thick layer of loose brown iron slag and coal [7] that represents the continuation of dumping of industrial waste.

Above this was a 0.80m thick, 20th century levelling layer of dark brown sandy crushed brick and concrete sealed by a 0.20m thick levelling layer of manufactured gravel, recorded at a height of 10.58m OD, for the Stadium.

3.2.7 Trial pit 107

Location	357299 185032
Dimensions	3m N/S by 0.80m E/W
Modern ground level/top of slab	10.54m OD
Base of modern fill/slab	9.94m OD
Depth of archaeological deposits seen	3.50m
Level of base of deposits observed	6.44m OD (not bottomed)
Natural observed	N/A

Table 7 Details of trial pit 107

Trial pit 107 was located in the north west corner of the former stadium and excavated to a depth of 4.10m below the present surface.

A loose, dark brown to black deposit of gritty, sandy clay and 19th-20th century industrial fire waste [9] was recorded at a height of 9.94m OD and excavated to a depth of 3.50m, but not bottomed. This deposit, which was heavily contaminated with sulphur, contained frequent small to medium pebbles, burnt leather, wood, electrical wiring and fragments of fire bricks and represents 20th century mixed industrial dumping.

Sealing this was a 0.30m thick levelling layers of pink and grey ash and a 0.30m thick levelling layer of manufactured gravel for the Stadium and was recorded at a height of 10.54m OD.

3.2.8 Trial pit 108

Not excavated.

3.2.9 Trial pit 109

Location	537321 185005
Dimensions	3m N/S by 0.80m E/W
Modern ground level/top of slab	10.40m OD
Base of modern fill/slab	10.00m OD
Depth of archaeological deposits seen	1.80m
Level of base of deposits observed	8.20m OD (not bottomed)
Natural observed	N/A

Table 8 Details of trial pit 109

Trial pit 109 was located in the northern half of the centre of the former stadium and excavated to a depth of 2.20m below the present surface. The excavation was abandoned at this depth due to unstable ground.

A loose, light to dark brown mixed dump deposit of ash, iron slag, slightly clayey silt, small to medium pebbles and brick rubble [10]. This deposit which was recorded at a height of 10.00m OD, excavated to a depth of 1.80m, but not bottomed, contained frequent glass waste and may represent the dumping of 19th to early 20th century industrial waste.

Sealing this was a 0.40m thick layer of grass and topsoil recorded at a height of 10.40m OD, that represents the middle of the Stadium.

3.2.10 Trial pit 110

Location	537218 184969
Dimensions	3.50m N/S by 0.80m E/W
Modern ground level/top of slab	10.48m OD
Base of modern fill/slab	8.48m OD
Depth of archaeological deposits seen	2.30m
Level of base of deposits observed	6.18m OD (not bottomed)
Natural observed	N/A

Table 9 Details of trial pit 110

Trial pit 110 was located in the north west corner of the site and excavated to a depth of 4.30m below the present surface.

A deposit of firm light brown clay with occasional rootlets [11] and containing refuse dating from the second half of the 20th century was recorded at a height of 8.48m OD and excavated to a depth of 2.30m, but not bottomed. A complete small brown bottle with embossed lettering of 'BOVRIL LIMITED' that probably dates to the first quarter of the 20th century was recovered from this context. A complete heavy bodied whiteware espresso coffee cup dating to between 1870s and 1940s was also recovered from this context.

Above this was a 2m thick mixed dumped deposit of dark brown clayey, sandy silt and concrete and brick rubble. This deposit was recorded at a height of 10.48m OD and represents late 20th or early 21st century levelling on the site.

3.2.11 Trial pit 111

Location	537233 184948
Dimensions	0.80m N/S by 3.50m E/W
Modern ground level/top of slab	10.47m OD
Base of modern fill/slab	8.57m OD
Depth of archaeological deposits seen	1.50m
Level of base of deposits observed	7.07m OD (not bottomed)
Natural observed	N/A

Table 10 Details of trial pit 111

Trial pit 111 was located in the west of the site and was excavated to a depth of 3.40m below the present surface.

A deposit of firm to stiff re-deposited fine clayey sand [12] containing occasional 19th to 20th century brick fragments was recorded at a height of 8.57m OD and excavated to a depth of 1.50m, but not bottomed.

Above this was a deposit of loose, dark brown, slightly clayey, sandy silt, brick and concrete rubble. This deposit was recorded at a height of 10.47m OD and represents late 20th to 21st century levelling on the site.

3.2.12 Trial pit 112

Location	537305 184939
Dimensions	0.80m N/S by 3m E/W
Modern ground level/top of slab	10.38m OD
Base of modern fill/slab	9.38m OD (not bottomed)
Depth of archaeological deposits seen	N/A
Level of base of deposits observed	N/A
Natural observed	N/A

Table 11 Details of trial pit 112

Trial pit 112 was located in the south west corner of the Stadium and excavate to a depth of 1m below the present surface. The excavation was abandoned at this depth due to concrete obstructions that may be an in situ foundation or slab.

3.2.13 Trial pit 112A

Location	537310 184950
Dimensions	0.80m N/S by 3m E/W
Modern ground level/top of slab	10.35m OD
Base of modern fill/slab	10.15m OD
Depth of archaeological deposits seen	4.00m
Level of base of deposits observed	6.15m OD (not bottomed)
Natural observed	N/A

Table 12 Details of trial pit 112A

Trial pit 112A was located to the immediate north east of trial pit 112 and excavated to a depth of 4.20m below the present ground surface.

A deposit of loose, brown to black slightly clayey sand and industrial waste [14] was recorded at a height of 9.55m OD and excavated to a depth of 3.40m, but not bottomed. The deposit contained iron slag, frequent small to medium pebbles and fragments of CBM. Several glass vessels dating from the later 19th into the first quarter of the 20th century were recovered from this context (see Appendix 1). Several ceramic vessels dating to between the later 19th and early 20th century were also recovered from this context (see Appendix 2).

Overlying this, and recorded at a height of 10.15m OD, was a 0.60m thick layer of loose, dark brown to black, glass waste and clinker [13] containing brick and concrete rubble dating from the 20th century.

Sealing this, and recorded at a height of 10.35m OD, was a 0.20m thick layer of manufactured gravel that may represent the levelling layer of the Stadium.

3.2.14 Trial pit 113

Location	537338 184944
Dimensions	0.80m N/S by 3m E/W

Modern ground level/top of slab	10.49m OD
Base of modern fill/slab	10.24m OD
Depth of archaeological deposits seen	3.75m
Level of base of deposits observed	6.49m OD (not bottomed)
Natural observed	N/A

Table 13 Details of trial pit 113

Trial pit 113 was located in the southern half of the centre of the Stadium and excavated to a depth of 4m below the present ground surface.

A deposit of loose, brown to black industrial waste [15] was recorded at a height of 10.24m OD and excavated to a depth of 3.75m, but not bottomed. The deposit contained re-deposited clay with frequent rootlets, small to medium flint pebbles, brick rubble, fragments of CBM, coal tar, fragments of leather shoes.

A complete clear coloured glass bottle dating from the later 19th century into the first quarter of the 20th century was recovered from this context. A Porcelain figurine and a stoneware bottle, dating to between 1860 and 1930 were also recovered from context [15] (see Appendix 2).

Sealing this, and recorded at a height of 10.49m OD, was a 0.25m thick layer of manufactured gravel that may represent the levelling layer of the Stadium.

3.2.15 Trial pit 114

Location	537360 184929
Dimensions	0.80m N/S by 3.20m E/W
Modern ground level/top of slab	10.61m OD
Base of modern fill/slab	9.61m OD (not bottomed)
Depth of archaeological deposits seen	N/A
Level of base of deposits observed	N/A
Natural observed	N/A

Table 14 Details of trial pit 114

Trial Pit 114 was located in the south of the centre of the former stadium and excavated to a depth of 1m below the present ground surface. The excavation was abandoned at a depth of 1m due to concrete obstructions.

3.2.16 Trial pit 114A

Location	537350 184954
Dimensions	0.80m N/S by 3.20m E/W
Modern ground level/top of slab	10.62m OD
Base of modern fill/slab	10.42m OD
Depth of archaeological deposits seen	3.80m
Level of base of deposits observed	6.62m OD (not bottomed)
Natural observed	N/A

Table 15 Details of trial pit 114A

Trial pit 114A was located to the north of 114 towards the middle of the former stadium and excavated to a depth of 4m below the present ground surface.

A deposit of loose, brown to black, 19th to 20th century industrial waste [16] was recorded at a height of 10.42m OD and excavated to a depth of 3.80m, but not bottomed.

This deposit contained frequent small to medium flint gravel, re-deposited slightly sandy, silt and clay with occasional rootlets, weathering and iron staining, furnace waste, iron slag and occasional fragments of wood.

A complete white glass bottle dating from the 20th century was recovered from this context. Also, a porcelain figurine and several ceramic vessels dating to between 1860s and 1930s were recovered from this context which represents 19th to 20th century dumping of industrial waste.

Sealing this, and recorded at a height of 10.62m OD, was a 0.20m thick levelling layer of crushed concrete and manufactured gravel associated with the surface of the Stadium.

3.2.17 Trial pit 115

Location	537258 184916
Dimensions	0.80m N/W-S/E by 3.40m N/E-S/W
Modern ground level/top of slab	10.36m OD
Base of modern fill/slab	7.86m OD
Depth of archaeological deposits seen	1.40m
Level of base of deposits observed	6.46m OD (not bottomed)
Natural observed	N/A

Table 16 Details of trial pit 115

Trial pit 115 was located in the west of the site and excavated to a depth of 3.90m below the present ground surface.

A deposit of loose, dark brown re-deposited fine clay [17] containing occasional rootlets and rare small to medium sub-rounded flint pebbles and occasional fragments of 20th century CBM, was recorded at a height of 7.86m OD and excavated to a depth of 1.40m, but not bottomed.

Overlying this, and recorded at a height of 10.36m OD, was a 2.50m thick, loose, mixed, dark brown slightly clayey, sandy silt and brick and concrete rubble. This deposit, with contained frequent small to medium pebbles, fragments of wood and plastic, represents late 20th to 21st century levelling on the site.

3.2.18 Window sample 101

Location	537402 185084
Depth	5.10m
Modern ground level/top of slab	9.96m OD
Base of modern fill/slab	8.96m OD
Depth of archaeological deposits seen	4.10m
Level of base of deposits observed	4.86m OD (not bottomed)
Natural observed	N/A

Table 17 Details of window sample 101

Window sample 101 was located in the north east corner of the site and completed to a depth of 5.10m below the present ground surface.

A deposit of loose, dark brown to black coarse sandy, clayey, industrial waste [20] was recorded at a height of 6.96m OD and excavated to a depth of 2.10m, but not bottomed. The deposit contained ash and iron slag and probably represents 19th to 20th century furnace waste.

Above this, and recorded at a height of 7.96m OD, was a deposit of loose, brown, gritty coarse sandy clay and industrial waste [19]. The deposit contained copper, iron slag, occasional brick fragments and probably dates to between the 19th and 20th century.

Overlying this and recorded at a height of 8.96m OD was a deposit of loose, brown gritty industrial waste [18]. This deposit contained frequent ash deposits, and included fragments of glass, CBM and pottery probably dating to the 20th century.

Above this, and recorded at a height of 9.76m OD, was a probable 20th century levelling layer of pale brown, coarse sandy, clayey gravel.

Sealing this, and recorded at a height of 9.96m OD, was a 0.20m thick layer of clayey silt topsoil, part of a garden bed associate with the present site.

3.2.19 Window sample 102

Location	537372 185056
Depth	5m
Modern ground level/top of slab	10.06m OD
Base of modern fill/slab	9.36m OD
Depth of archaeological deposits seen	4.30m
Level of base of deposits observed	5.06m OD (not bottomed)
Natural observed	N/A

Table 18 Details of window sample 102

Window sample 102 was located in the north east area of the site and completed to a depth of 5m below the present ground surface.

Deposits of brown to black industrial waste were recorded at a height of 9.36m OD and excavated to a depth of 4.30m. These deposits consisted of coarse sandy, slightly clayey industrial fire/furnace waste that represents 19th to 20th century mixed dumping on the site.

Sealing this was a 0.70m thick layer of concrete rubble, recorded at a height of 10.06m OD and represents the present surface of the site.

3.2.20 Window sample 103

Location	537391 185011
Depth	5m
Modern ground level/top of slab	10.38m OD
Base of modern fill/slab	9.68m OD
Depth of archaeological deposits seen	4.30m
Level of base of deposits observed	5.38m OD (not bottomed)

Natural observed	N/A
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Table 19 Details of window sample 103

Window sample 103 was located in east of the site in the present car parking area and completed to a depth of 5m below the present ground surface.

Deposits of brown to black industrial waste were recorded at a height of 9.68m OD and excavated to a depth of 4.70m. The deposit contained fine to coarse sand clay with gravel, ash and glass clinker that represents mixed dumping of 19th to 20th century industrial waste.

Sealing this was a 0.70m thick levelling layer of concrete rubble, recorded at a height of 10.38m OD that represents the present surface of the site.

3.2.21 Window sample 116A

Location	537386 184897
Depth	5m
Modern ground level/top of slab	10.69m OD
Base of modern fill/slab	10.39m OD
Depth of archaeological deposits seen	4.70m
Level of base of deposits observed	5.69m OD (not bottomed)
Natural observed	N/A

3.2.22 Window sample 116A

Window sample 116A was located in the south of the site and completed to a depth of 5m below the present ground surface. Window sample 116A was abandoned at a depth of 1.6m due to an obstruction.

In window sample 116A deposits of brown to black industrial waste were recorded at a height of 10.39m OD and excavated to a depth of 4.70m. The deposits consisted of gritty, coarse sandy clay and industrial fire waste including ash, iron slag, fragments of CBM, glass and wood and represents mixed dumping of 19th to 20th century industrial waste.

Sealing this was a 0.30m thick layer of brick and concrete rubble, recorded at a height of 10.69m OD that represents the present surface of the site.

3.2.23 Window Sample 117A

Location	537323 184887
Depth	5m
Modern ground level/top of slab	10.53m OD
Base of modern fill/slab	10.23m OD
Depth of archaeological deposits seen	4.70m
Level of base of deposits observed	5.53m OD (not bottomed)
Natural observed	N/A

Table 20 Details of window sample 117A

Window sample 117A was located in the south west of the site and excavated to a depth of 5m below the present ground surface. It replaced window sample 117, abandoned at a depth of 2.50m due to an obstruction.

In window sample 117A deposits of brown to black sandy clay and industrial waste were recorded at a height of 8.53m OD and excavated to a depth of 3m, but not bottomed. This deposit contained frequent ash and represents 19th to 20th century industrial fire/furnace waste.

Overlying this, and recorded at a height of 10.23m OD, was a 1.70m thick layer of brown, firm, clay and sandy clay containing fine rootlets, moderate small to medium sub-angular pebbles and fragments of brick. This deposit may represent 20th century levelling on the site.

Sealing this was a 0.30m thick levelling layer of brick and concrete crush and rubble, recorded at a height of 10.53m OD that represents the present surface of the site.

3.2.24 Window Sample 118

Location	537297 184869
Depth	5m
Modern ground level/top of slab	10.64m OD
Base of modern fill/slab	10.34m OD
Depth of archaeological deposits seen	4.70m
Level of base of deposits observed	5.64m OD (not bottomed)
Natural observed	N/A

Table 21 Details of window sample 118

Window sample 118 was located in the south west corner of the site and excavated to a depth of 5m below the present ground surface.

A deposit of light brown re-deposited clay containing frequent small pebbles, fragments of CBM, coal and ash was recorded at a height of 6.64m OD and excavated to a depth of 2m, but not bottomed.

Above this, and recorded at a height of 10.34m OD, was a mixed dump layer of brown to black, sandy clay and industrial fire waste consisting of coal, coke and ash including pockets of clay and flecks of red brick. This deposit represents dumping of 19th to 20th century industrial waste.

Sealing this, and recorded at a height of 10.64m OD, was a 0.30m thick levelling layer of crushed brick and concrete, sandy, clay silt with small to medium pebbles that represents the present surface of the site.

3.2.25 Borehole 101

Ground surface 10.53m OD

Deposit No.	Depth below surface (m)	Characteristics	Interpretation
1.1	0.0-7.0	Mid to dark grey gritty silty clay, with occasional coarse sand.	Made ground, consisting of

		Contains frequent inclusions of brick/tile, bone, clinker, pot and occasional coarse gravel.	dumped material and landfill.
3.53m OD			
1.2	7.0-7.3	Crumbly Mid to dark slightly bluish grey silty clay	Overbank flood deposit with possible accretionary soils forming within the sediment.
3.23m OD			
1.3	7.3-8.10	Firm mottled dark to mid bluish grey/greenish grey clay. Contains frequent small manganese nodules, and occasional small flecks of brick.	Overbank flood deposit probably forming mudflat environment at channel margins, with seasonal pools of standing water.
2.43m OD			
1.4	8.10-8.3	Firm mid bluish grey clayey gravel with occasional coarse sand within the matrix. Contains moderate to abundant amounts of coarse angular/sub-angular gravel.	Bioturbated gravels, with some fluvial influence. May represent formation of vegetated channel or point bar.
2.23m OD			
1.5	8.3-12.5	Loose mid greenish grey coarse sandy gravel, comprising coarse sand and angular, sub-angular, rounded and sub-rounded gravel.	Pleistocene gravels, deposited in a cold climate braided river environment.
-1.97m OD			
1.6	12.5-15	Firm mid to light grey very fine sandy clay. Displays very fine laminations and contains occasional shell fragments	Tertiary deposit. Woolwich and Reading Beds.

Table 22: Summary of deposits encountered in BH101

3.2.26 Borehole 102

Ground surface 8.71m OD

Deposit No.	Depth below surface (m)	Characteristics	Interpretation
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2.1	0-10	Mid to dark grey gritty silty clay. Contains frequent coarse angular/sub-angular gravel clasts, and occasional brick/tile, clinker and pot fragments.	Made ground, consisting of dumped material and landfill.
-1.29m OD			
2.2	10-10.5	Mid grey firm clay with occasional angular and sub-angular gravel inclusions in upper 0.1m	Tertiary deposits consisting of Woolwich and Reading Beds. Upper gravely part of unit 2.2 may represent the base of the truncated Pleistocene gravels.
2.3	10.5-14	Mid to light grey firm sandy clay. Displays very fine laminations and contains occasional shell fragments	

Table 23: Summary of deposits encountered in BH102

3.2.27 Borehole 103

Ground surface 10.44m OD

Deposit No.	Depth below surface (m)	Characteristics	Interpretation
3.1	0.0-7.0	Dark to mid grey gritty silty clay, containing occasional brick/tile, glass, clinker and pot fragments.	Made ground, consisting of dumped material and landfill.
3.44m OD			
3.2	7.0-8.0	A firm mottled mid bluish grey/greenish grey clay	Overbank flood deposit probably forming mudflat environment at channel margins, with seasonal pools of standing water.
2.44m OD			
3.3	8.0-8.5	Firm mid greenish blue moderately coarse sandy clay.	Fining up sequence from the flood plain

3.4	8.5-9.3	Loose mid greenish blue very coarse sandy clay. Contains very fine hair roots at around 9.3m bgl	gravels to coarse to fine sands. Represents probable formation of channel or point bar, possibly becoming seasonally dry allowing vegetation to colonise exposed surface.
1.14m OD			
3.5	9.3-12.5	Mid greenish grey coarse sub-angular, sub –rounded and rounded gravel in a coarse grey sandy matrix	Pleistocene floodplain gravels, deposited in a cold climate braided river environment.
-2.06m OD			
3.6	12.5-14	Mid grey very fine sandy clay, with slight greenish mottling.	Tertiary deposit. Woolwich and Reading Beds.

Table 24: Summary of deposits encountered in BH103

3.2.28 Borehole 104

Ground surface 13.13m OD

Deposit No.	Depth below surface (m)	Characteristics	Interpretation
4.1	0-7.4	Mixed mid reddish brown/mid grey gritty silty clay with frequent coarse gravel and brick/tile inclusions	Made ground, consisting of dumped material and landfill.
5.73m OD			
4.2	7.4-10.5	Firm mid bluish grey clay with light greyish green mottling, stained with manganese flecks, contains occasional brick/tile fragment and occasional organic flecks.	Overbank flood deposit representing mudflat environment. Possibly seasonally dry allowing

4.3	10.5-11.5	Firm mid greenish grey clay with occasional small clasts of yellowish white calcareous concretions, and occasional small rootlets	accretionary soils to develop in upper part of the sediment.
4.4	11.5-12	Soft mid to dark slightly greenish grey clay.	
1.13m OD			
4.5	12-12.9	Soft mid to light greyish brown slightly sandy clay.	Fining up sequence from the flood plain gravels to fine sands and sandy clays. Represents probable formation of channel or point bar, possibly becoming seasonally dry allowing vegetation to colonise exposed surface.
4.6	12.9-13	Loose mid to light greyish brown fine sand with moderate amounts of small angular and sub-angular gravel inclusions. Contains frequent small hair roots.	
0.13m OD			
4.7	13-15.2	Mid greenish grey coarse sub-angular, sub –rounded and rounded gravel in a coarse grey sandy matrix	Pleistocene floodplain gravels, deposited in a cold climate braided river environment.
-2.07m OD			
4.8	15.2-17	Mid grey very fine sandy clay, with slight greenish mottling.	Tertiary deposit. Woolwich and Reading Beds.

Table 25: Summary of deposits encountered in BH104

3.3 Assessment of the monitoring

GLAAS guidelines (1998) require an assessment of the success of any evaluation ‘in order to illustrate what level of confidence can be placed on the information which will provide the basis of the mitigation strategy’.

In the case of this site, the trial pits and window samples and boreholes were located to provide information on the nature and depth of deposits across the site from a geotechnical perspective. Nonetheless, archaeological characterisation has been possible.

The deposits observed within the trial pits and window samples indicate the presence of 19th to 20th century dumping of industrial waste across the whole site. Pottery

dated this to the first quarter of the 20th century (TP110, TP112A, TP113, TP114A) although this does not necessarily indicate the date of deposition, more the date of the original accumulation of the soil before deposition at the site. This deposit was not bottomed at depths of up to 5m below the current ground surface (window samples 101, 102, 103, 117A, 118 – in trial pits it was not bottomed at levels of up to 4.50m below the current ground surface [TP103]). The expectation must be that it extends to depths of at least between 4.50m and 5m across the whole of the area examined.

The four boreholes at the site confirmed this expectation and provided base levels for the depositions dated to the early 20th century. In BH101, BH103, and BH104 depths of 7 to just over 7m were recorded. TP 102 had a greater depth of this deposition and it extended to *c* 10m below modern ground level. These observations suggest that any deposits underlying the 20th century made ground have truncated upper surfaces at around 7m below the current ground level.

A total of eight boreholes (four from this exercise and four from data contained in: *London Stadium, Hackney: Site Investigation Report, Contamination and Geotechnical Assessment 2003* provided by Symonds Group Ltd) were used to construct a geoarchaeological deposit model for the site. The boreholes were fairly well placed across the site, apart from the central area. However, enough borehole data was available in the adjacent areas to suggest the nature of the deposits that may be encountered.

4 Geoarchaeological deposit model

4.1 Methodology

In order to understand the context of the deposits existing on the site, information has been examined from:

- Past archaeological and palaeoenvironmental work undertaken in the area;
- British Geological Survey maps and other sources describing the characteristics of the bedrock, soils and substrate in the area;
- Ordnance Survey and other mapping illustrating the modern landscape characteristics and topography of the area;
- Historic maps and other sources suggesting the past landscape characteristics of the area.

4.2 Data collection for the site itself

Borehole data was assessed from the *London Stadium, Hackney: Site Investigation Report, Contamination and Geotechnical Assessment 2003* provided by Symonds Group Ltd. This data was combined with the four boreholes monitored on site by the MoLAS Geoarchaeologist.

The borehole logs were examined and only those that extended down to floodplain gravel were selected for inclusion in the deposit model. The distribution of the geotechnical data used is illustrated in Fig 6.

4.3 Deposit model construction

The geotechnical logs were entered into a digital (TerraStation II) database. Each deposit component (gravel, sand silt etc) was given a colour and a pattern and, as a result, the two major variables of any deposit were stored in the TSII database and used to construct the deposit model.

A series of working cross-sections (transects: vertical slices through the sub-surface stratigraphy) were drawn through the boreholes and correlations were made between key deposits. Interpretation of the data is based to a large extent on examining these transects. Individual lithostratigraphic units with related characteristics within a borehole were grouped together and then linked with similar deposits, which may be made up of a number of individual contexts (lithostratigraphic units) in adjacent boreholes. Linking deposits between boreholes produced a series of site-wide deposits (facies), which are representative of certain environments. Thus a sequence of environments both laterally and through time has been reconstructed for the site.

The transects drawn through the borehole profiles form a major means of illustrating the buried stratigraphy in this report and two transects were selected to illustrate the stratigraphic sequence and distribution of deposits across the site. A key to the lithostratigraphy and its interpretation is provided with the illustrated transects (Fig 7, Fig 8).

Where possible landscape features (such as palaeochannels, cliff-lines and ‘islands’) have been identified and the changing morphology, or influence on the pattern of deposit accumulation, inferred.

The surface of the Pleistocene gravels is an approximation of the topography of the site at the start of the Holocene (i.e.: in the early Mesolithic, about 10,000 years ago). This surface is likely to have influenced the changing environments of the site for much of the prehistoric and even historic period. It also acts as the bottom line for archaeological potential in this area.

The surface of the tertiary deposits has been taken as the bottom line for archaeological potential, as these deposits pre-date human evolution. Its surface was truncated during the cold stages of the Pleistocene and all deposits above it accumulated within the period that human activity might have taken place in southeast Britain.

4.4 Discussion of the site stratigraphy

The deposits that are of archaeological or palaeoenvironmental interest on the site are discussed in this section in stratigraphic order, from the oldest to the most recent. The stratigraphic sequence is illustrated in the cross-sections drawn across the site between boreholes 101 and borehole 104, which forms a roughly north to south transect (Fig 7), and boreholes 16 and 4, which forms a east to west transect (Fig 8).

4.4.1 Tertiary deposits: facies 1

The earliest deposits consist of a very fine mid to light grey sandy clay with slight light green mottling. Within the structure of the deposit very faint laminations are present along with occasional shelly fragments. Across the site the deposit occurred at between -2.69m OD (within BH4) and -1.29m OD (within BH102). The characteristics of the deposit are consistent with the Woolwich and Reading Beds, which the BGS map no. 257 records in this part of the Lea Valley. These beds formed sometime during the Eocene (50 to 30 Million years ago) and therefore the surface of this facies marks the limit of deposits of archaeology interest.

4.4.2 Pleistocene deposits: facies 2

The tertiary deposits are overlain by a loose mid greenish grey coarse sandy gravel, comprising of coarse sand and angular, sub-angular, rounded and sub-rounded gravel clasts. The depth at which these gravels occur is fairly consistent across the site, and they can be expected to occur between 1.14m OD (within BH103) and 0.13m OD (within BH104). Generally, where the bases of the gravels are encountered they tend to be 3 to 4m in thickness.

The coarse nature of these gravels suggests they are probably Pleistocene in date and were deposited sometime during the last cold stages of the Devensian Glaciation between 18,000 to 15,000 BP. However the previous geoarchaeological assessment suggested that the site lies in the lowest part of the floodplain. Therefore such gravels are likely to have undergone significant amounts of reworking and redeposition during the Late Glacial period. Such reworking of these gravels may have taken place up until 11,000 BP towards the end of the Loch Lomond Stadial period, when the

rapidly warming climate lead to a rising influx of melt water into the fluvial system. Such high-energy fluvial systems would have lead to significant redeposition of earlier floodplain gravels in this lowest point of the floodplain. Evidence of such reworking was found in the Stratford Marsh area (Corcoran & Swift, 2004) where a ^{14}C date of 12240 +/- 80 BP was obtained from within organic deposits sandwiched between the gravels. This places the deposition of the gravels firmly within the Loch Lomond Stadial, which occurred between 13,000 and 11,000 BP.

For the site the boreholes give the impression that the gravels are relatively flat across the central parts of the site with no major hollows or dips occurring. However three of the boreholes do indicate undulations in the gravel surface, which may point to possible site wide variations, rather than localised features. Within BH101 the gravel surface occurred at 2.23m OD. This borehole is situated towards the north-eastern corner of the site and suggests that a higher area of gravel may exist in this area. No other borehole data was available within this part of the site to ascertain the extent of this higher ridge of ground.

A slight rise in the gravel surface was also noticeable towards the western periphery of the site. The gravel surface occurred at 1.33m OD within BH16. As with the ridge on the north-eastern side, the full extent of this high ground cannot be ascertained for certain as little geotechnical data was available. However BH13, a short distance to the south of BH16, does indicate that the gravels may dip gradually towards the south. The top of the gravel surface in this borehole occurred at 0.72m OD.

The most noticeable dip to occur in the gravel surface appears in BH24. The gravel in this borehole was found at -1.64m OD (Fig 9). This is significantly lower than the surrounding gravel and points to a major feature within this area. The surfer plot suggests that the dip is localised and may form part of a lake feature. Such an interpretation should be treated with caution, as there are no nearby boreholes with which to confirm this hypothesis. The overlying deposits (facies 4) within this borehole suggest the low point may be the route of a former channel rather than forming a standing body of water. Virtually no borehole data was available for the central part of the site, but such hollows can be expected to occur between BH16 and BH103. These hollows and dips, which may be infilled with peats, silts and fine sands, could represent former courses of a Holocene river, which has either become abandoned or migrated. Such a pattern could be expected to occur within the lowest part of the floodplain.

4.4.3 Sandy clays, point or channel bar formation and in-channel sediments; facies 3

Above the coarse Pleistocene gravels a number of boreholes recorded sandy clays. In BH103 a coarse mid greenish blue sandy clay occurred at 2.44m OD and measured 1.3m in thickness (units 3.3 and 3.4). In BH104 a similar sandy clay occurred at 1.13m OD and measured 1m in thickness (units 4.5 and 4.6). Sandy clays were also recorded within BH19A and 4, although these sediments were grey in colour with a lower sand content within the matrix. In BH19A the unit was 1m thick and occurred at 1.41m OD. In BH4 the unit occurred at 1.51m OD (although the upper part was truncated by modern deposits) and measured 0.4m in thickness.

The sandy clays within BH103 and 104 displayed a clear fining up sequence with the sands becoming less coarse up through the profile. Fine hair roots were also visible

within the matrix. Such fining up sequences are characteristic of channel or point bar formation, and features such as these often form dry land surfaces once channel migration or abandonment has occurred. Evidence of such a dry land surface is indicated by the presence of the hair roots within the sandy clays. However the roots may be the result of aquatic plants colonising the tranquil margins of a channel once the main route of the channel has migrated, rather than a fully established dry soil horizon. Never the less, point bars at the edge of channels, which may have become seasonally dry and exposed would provide attractive locations at the waters edge for hunter-gatherer occupation.

A ¹⁴C date was obtained from the organic hair roots within the sandy clay unit 4.6 from BH104. This produced a date of 5230 +/- 50 BP (Cal BC 4220 to 3960). This date suggests that an active flowing channel flowed through the area up until the Late Mesolithic/Early Neolithic periods .

The sandy clay units within BH19A and 4 do seem to differ in characteristics, although this may be a result of the record being taken by non-geoarchaeological specialists. It is likely that these deposits may also represent such channel or point bar formation. However no mention is made in the logs of any underlying coarser sandy clays, and therefore these deposits may represent in channel sediments rather than point bar formation at the edges of an active channel. The sandy clays within all these boreholes occur at different heights across the site. This would suggest that they are unlikely to all be contemporary, but have been deposited at different times as a channel migrated across the landscape.

4.4.4 Peaty clays infilling abandoned channels; facies 4

A peaty clay was recorded only within BH24. The sediment was dark grey/light brown in colour with occasional small rounded gravel inclusions. The unit occurred at -1.24m OD and measured 0.4m in thickness, although modern deposits truncated the upper part.

The deposit infilled the anomaly in the gravel surface identified from the surface plot. It is probably that this deposit represents the water filled hollow of an abandoned channel. As discussed earlier in section 4.4.2 the dip that the peat infills appears as a localised feature which is indicative of a possible lake. However the deposits are not recorded as containing any laminations, which often occurs within sediments deposited in a still, standing water environment. Only the very base of this deposit survived, but the inclusion of some gravel clasts suggests some fluvial activity must have taken place prior to the formation of the peat. It is likely that other features similar to this exist on other parts of the site, especially in the central part between BH16 and 103, which occupy the most likely place for infilled channel sediments.

Peat filled hollows such as this probably began to develop as a result of channel migration across the flood plain. Such migration was probably influenced by the formation of the point or channel bars identified within facies 3. Sandy bars may well have resulted in loops of a meandering river eventually becoming isolated and cut-off from the main flow of the channel, leading to the formation of ox-bow lakes and peat filled hollows.

4.4.5 Bioturbated gravel surface; facies 5

This deposit was only identified within BH101. The sediment was characterised by a mid bluish grey clayey gravel with occasional coarse sand within the matrix. The unit occurred at 2.43m OD and measured 0.2m in thickness. The unit was recorded above the Pleistocene gravels (facies 2) where the gravels were found to occur at the highest point.

The clayey nature of these gravels suggests that a possible dry soil horizon may have formed within the surface of the Pleistocene gravels. The effects of rooting and colonising vegetation would have resulted in a disturbed gravel surface with a finer clayey sediment forming around rootlets and decaying plant matter. No surviving roots were visible within the sediment, although this may be a result of later oxidising processes.

4.4.6 Overbank flood/Mudflat deposits; facies 6

Locations such as this can provide suitable points in the landscape for prehistoric occupation and such activity has been found in similar deposits. Most recently a number of artefact scatters dating to the Mesolithic period have been found within similar bioturbated gravels within the Colne Valley (Halsey, in prep). Such sediments do not always display obvious ancient soil horizons. This is usually a result of the soil formation being fairly ephemeral and immature, or as a result of subsequent waterlogging and gleying masking the soil horizon.

The overlying deposit consisted of alluvial overbank flood sediments (facies 6). It is therefore unlikely that in this area of the site high-energy fluvial activity abruptly ceased to be replaced by episodes of standing water. The clayey gravels are more likely to represent a dry soil horizon where no sedimentation occurred for a prolonged period of time.

The uppermost deposit encountered in the boreholes consists of a mottled dark to mid bluish grey/greenish grey clay. The deposit occurs at a depth between 5.73m OD (within BH104) and 1.72m OD (BH13) depending on the level of truncation by the overlying modern deposits. The thickness of the deposits varies between approximately 1m to 4m across the site. The greatest surviving thickness was encountered in BH104 where the deposit measured 4.6m in thickness. The deposit also contained occasional flecks of organic material and small manganese nodules.

The characteristics of the deposit were fairly consistent across the site, although slight differences were noticed in some of the boreholes. In BH104 the middle part of the sediment (unit 4.3), which occurred at between 2.63 to 1.63m OD contained occasional small clasts of yellowish white calcareous concretions with occasional small rootlets. The upper part in BH101, which occurred at between 3.53 to 3.23m OD displayed a matrix, which was more characteristic of a silty clay.

The clays would indicate deposition in a fairly tranquil environment, probably as a result of seasonal overbank flooding, or tidal inundation. It is likely that prior to the canalising and alterations made to the Lea from the Medieval period onwards, the river itself may have existed as a broader, wider channel, susceptible to regular tidal flooding. The lower part of the alluvial sequence may represent a mudflat environment formed by fluctuating tidal levels. With increased sedimentation the alluvial layers would have gradually built up, protecting the marginal areas from

regular tidal inundation and leading to drier land surfaces developing within the alluvium. This part of the landscape would still have been susceptible to overbank flooding occurring on a seasonal basis, possibly with accretionary soils developing within the upper part of the sediment. Evidence of this is displayed by the manganese flecking, which precipitates out from waterlogged soils if they become dry enough on a seasonal basis. The calcareous nodules are also an indication of this, forming around root fragments by the same processes. Eventually, oxidised clays, representing grass meadows would have formed in the upper most part of the alluvial. The formation of which would have been aided and protected by the major alterations and re-cutting of the channel that took place during the 18th and 19th centuries.

A similar sequence as this was also noted during the recent evaluation at Carpenters Road (Corcoran, 2005). The upper most part of this sequence consisted of mid brown oxidised clays indicating the drier hay or grass meadow environments. At the Hackney Stadium site this upper part of sequence is missing, but this is probably due to truncation by the overlying modern deposits. Historic maps demonstrate that this part of the Lea Valley was open land until the early 20th Century (Fig 2, Fig 3).

4.4.7 Modern deposits: facies 7

The upper most deposits in the boreholes consisted of a mid to dark grey gritty silty clay. The deposits contained occasional sand and gravel with frequent fragments of brick/tile, clinker and ceramics. This material generally appears to represent the dumping of industrial and some possible domestic waste during the 20th century. The top of this deposit is generally level across the site occurring at around 10.5m OD, apart from in the vicinity of BH104 where a bank raised the ground level to around 13m OD. The thickness of the deposit varies between 7 to 11m.

Towards the northern part of the site the made ground appears to lie directly on top of the Tertiary deposits (within BH1, 21, 26, 27 and 102). Here the made ground is up to 10m thick. The Pleistocene gravels and overlying Holocene deposits have all been removed. It is likely that extensive quarrying has taken place on this part of the site to remove the gravel material.

4.5 Past landscape characteristics of the site

In order to discuss the landscape evolution and archaeological potential, the site has been divided into areas (zones) where similar sequences of deposits exist and thus are likely to have a comparable potential for archaeological and archaeo-environmental remains.

The characteristics and distribution of these landscape zones (LZs), illustrated in Fig 10 are summarised below.

4.5.1 Landscape zone 1

This zone covers two areas of the site; one towards the north-eastern corner (LZ1a), and the other towards the south-western edge (LZ1b). Slightly higher ridges of gravel than elsewhere on the site define the area.

The deposits that define LZ1a where only encountered within BH101. In general the surface of the Pleistocene gravels (facies 1) can be expected to occur at around 2.20m

OD. They are likely to be overlain by a thin band of clayey gravel that may represent a dry bioturbated gravel surface formed by colonising vegetation (facies 5). These deposits may be encountered at around 2.40m OD and may measure no more than 0.2m in thickness.

The upper most deposit consists of the mottled mudflat clays formed by overbank flooding or tidal inundation (facies 6). The level at which these clays occurs is likely to be variable depending on the level of modern truncation across the site. In BH101 the deposit occurred at roughly 7m below ground level (3.5m OD).

The same sequence of deposits can be expected to occur within LZ1b although the levels at which they occur may differ. The Pleistocene gravel surface in this zone is likely to occur at around 1.33m OD (BH16) in the central part dipping to 0.72m OD (BH13) towards the south.

Although no bioturbated gravel interfaces (facies 5) were identified within this area, it is possible that they may be present where the gravels are at their highest, although they are likely to exist at isolated locations. As with LZ1a the upper part of the sequence consists of the alluvial clays (facies 6), which may be encountered at around 1.8m OD, depending on the level of modern truncation.

It must be stressed that the true nature and extent of these higher areas of gravel cannot be known for certain. It may be that they form fairly continuous ridges of higher ground that defined the limits of migrating Holocene channels, or they formed isolated spots around which the Holocene channels negotiated. In either scenario they are likely to have been high and dry during the early part of the Holocene (i.e. Mesolithic period) when water levels would have been at the lowest. However, with rising sea levels during the Neolithic to Bronze Age periods, and the probable increased tidal influence of the Thames these areas would have developed into a mudflat environment.

4.5.2 Landscape zone 2

The sandy units that exist between the underlying Pleistocene gravels and the alluvial clays define this landscape zone. As with LZ1 the zone occurs in two areas, one towards the east and one towards the west, although the characteristics and depths of the deposits in both areas do not differ greatly.

On the western part of the zone the Pleistocene gravels are likely to occur at around 0.4m OD and at around 1m OD towards the east. Overlying the gravels, sandy clays and sands occur. These deposits suggest point and channel bar formation, or active in-channel sediments. The ¹⁴C date (5230+/- 50BP) obtained from BH104 demonstrates that the sandy clays were deposited sometime during the Late Mesolithic/Early Neolithic period. However, these deposits are likely to be time transgressive, being deposited at different times across the landscape. Significant redeposition and erosion of these deposits may also have taken place as the channel migrated across the landscape. The sandy clays (facies 3) are likely to occur at around 1.5 to 1m OD.

The alluvial clays burying these deposits may be up to 5m thick (BH104), depending on the level of modern truncation. The thickness of the made ground in this zone varies between 6 to 7m.

4.5.3 Landscape zone 3

This landscape zone stands as the least defined area due to the fact it is only characterised by deposits within one borehole (BH24). However the position it occupies in the landscape enables some speculation as to the type of deposits and geomorphological features, which may be encountered within this part of the floodplain.

The surface of the Pleistocene gravels were encountered at a depth of –1.64m OD, and where overlain by a peaty clay at –1.24m OD. The gravel surface although lower than the surrounding areas, is likely to have formed a fairly undulating and irregular surface. This part of the valley floor may have formed the main route of channel flow for a Late Pleistocene braided river. This often leads to the irregular Pleistocene gravel surfaces that occur at the base of river valleys

During the Early Holocene, when the channel is likely to have adopted a meandering form, channel flow and avulsion would have lead to the deposition of in-channel sediments such as silts and sands, and the formation of peat pockets when channels were abandoned creating waterlogged hollows. If this model is true then significant reworking of the deposits may have occurred. Abandoned peat filled channels, may have been re-cut by avulsing processes and then infilled by in-channel silts and sands.

4.5.4 Landscape zone 4

This landscape zone falls into the far northern edge of the site between BH1 and 21. Modern truncation, probably as a result of quarrying, has removed the Pleistocene gravels, with only the Tertiary deposits surviving at the base of the sequence. The made ground measures up to 11m in thickness.

5 Archaeological and geoarchaeological potential

The results of the trial pit and borehole monitoring has shown that between 7 to 11m of 19th to 20th century industrial waste have been deposited across the site, as recorded in BH101 and 103.

The results of the monitoring of the trial pits have shown that the industrial waste dumped on the site dates to between the 19th and 20th centuries and contains mixed deposits showing evidence of waste from varied industrial activities such as furnace works, glass works and also possible gas works waste.

These dumped deposits consisted of a mid to dark grey gritty silty clay and industrial fire waste. The deposits contained occasional sand and gravel with frequent fragments of brick/tile, clinker and ceramics. This material generally appears to represent the dumping of industrial waste, also containing small amounts of domestic waste dating to the early 20th century.

The top of this deposit is generally level across the site occurring at around 10.5m OD, apart from in the vicinity of BH104 where a bank raised the ground level to around 13m OD. The thickness of the deposits varies to between 7 and 11m.

As there is little evidence of residential waste in the results of the watching brief so it seems the site has been used almost solely for the purpose of industrial waste management.

Within the footprint of the former stadium the majority of the made ground appears to date to no later than the 1930s.

The results of the trial pits have also shown that there are at least 4.30m of modern, late 20th to early 21st century, levelling along the western edge of the site, outside of the footprint of the former stadium (TP 110, 111 and 115).

The geoarchaeological deposit model for the site has identified a number of areas that do have palaeoenvironmental or archaeological potential. The deposits identified within LZ1 and 2 demonstrate that an active flowing channel flowed through this area at least until the Late Mesolithic/Early Neolithic periods. It is likely that the channel may still have been active in the later prehistoric and even into the historic period, and that significant reworking and erosion of deposits may have taken place as the channel migrated across the landscape.

The length of time that the channel was active in this part of the floodplain and the subsequent development of the alluvial clays has implications for the survival and occurrence of human occupation. The overlying alluvial clays suggest that a mudflat environment developed once channel migration had occurred. However, it is unclear whether this occurred across the entire landscape at the same time, or gradually, with parts of the landscape still providing host to an active channel. If sudden abandonment of the channel occurred rather than gradual migration, then exposed gravel bars and ridges may have been quickly buried by the alluvial clays leading to greater preservation of occupation surfaces. If however the channel was still active for sometime, such occupation surfaces are likely to have been disturbed by later fluvial action.

In addition to this, a large expanse of mudflats would not have been an attractive location for later prehistoric occupation. If the mudflats formed at various locations across the landscape, while a channel still occupied the site, then areas of higher ground may still have existed into the later prehistoric periods. Later prehistoric people may still have exploited such locations.

The most likely location for relatively undisturbed prehistoric activity falls within LZ1, where higher bioturbated gravel surfaces were recorded. These areas on the edge of active channels would be an ideal location for early hunter-gatherers due to the proximity to wetland resources and the channel itself, which would provide a route of transport across the landscape. LZ1 unlike the other zones, displayed no evidence of fluvial sands suggesting that these areas may have been exposed and dry from the Late Glacial period until the development of the overlying alluvial clays. If such areas were exposed for prolonged periods of time ephemeral scatters of flint and bone may have been subjected to some disturbance.

In terms of the palaeoenvironmental potential of the site, only one borehole (BH24) displayed an organic peaty deposit that may preserve plant macro and micro fossils for environmental reconstruction. The extent and date of this deposit is unknown, but other such deposits may exist elsewhere within LZ1. As channels became abandoned, and peat filled hollows developed, long sequences of organic deposits could have built up over a considerable length of time. Where such long undisturbed sequences can be identified, they may provide useful information on environmental change..

Whilst the archaeological remains are of local significance in characterising the nature of the depositional sequence at the site, there is nothing to suggest that the deposits are of regional or national importance.

6 Proposed development impact and recommendations

While the geoarchaeological deposit model has identified areas of archaeological or palaeoenvironmental potential, any further work should aim to clarify a number of points. The boreholes have confirmed that this part of the Lea Valley was once crossed by an ancient course of the river Lea, but the true nature of this now-lost river needs to be clarified.

Virtually no geotechnical information was available for the area, which covers the main route of the channel, so a full assessment of the deposits in this zone (LZ2) cannot be made. If the river was active for a long period of time significant reworking of the deposits may have occurred. The ^{14}C date demonstrates that a river was active in this part of the landscape at least until the Early Neolithic period. If the river became abandoned after this period then sand bars and gravel banks may survive where early prehistoric activity (i.e. Mesolithic) occurred. In addition to this, areas may exist where peat filled abandoned channels can provide long sequences with good palaeoenvironmental potential. If the proposed development impinges upon these deposits then any further work should aim to date any organics within the sand and gravel bars to understand the development of the river over time, and seek to identify areas that may contain palaeoenvironmental evidence.

The overlying alluvial clays may provide an opportunity to understand the tidal influence of the Thames on the River Lea, and the impact of canalisation from the Medieval period onwards. The lower part of the alluvial sequence is thought to derive from mudflats deposited by tidal inundation. To clarify this samples should be taken from the alluvial clays for diatom analysis. Diatoms would indicate under what condition these lower clays were deposited in, and whether the water conditions were freshwater, saltwater or brackish.

Where ground works in any proposed scheme may impinge on the higher areas of gravel (LZ1a and b) an evaluation should be made as to whether these zones contain any *in situ* flint scatters.

In general, the deposits of archaeological and environmental potential are buried below significant deposits of made ground – up to 11m thick across the site. Such a depth of overlying material, if retained undisturbed, will protect the archaeological resource.

7 Acknowledgements

The authors would like to thank Jackson Drilling Ltd, and White Young Green Environmental Ltd for assistance during the monitoring.

8 Bibliography

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9 NMR OASIS archaeological report form

OASIS ID: molas1-10375

Project details

Project name Lower Lea Valley Regeneration and Olympics Construction Zone 5, Hackney Stadium

Short description of the project A monitoring exercise was carried out by the Museum of London Archaeology Service on geotechnical trial pits, window samples and boreholes at the site of the Hackney Stadium, Hackney Wick, London, E15. The report summarises the archaeological potential of the site, and the likely impact on this of the proposed redevelopment, the main component of which is the construction of multi-sport arenas for the 2012 Olympics.

Project dates Start: 15-08-2005 End: 25-08-2005

Previous/future work None / Not known

Any associated project reference codes OL-00205 - Sitecode

Type of project Field evaluation

Site status Local Authority Designated Archaeological Area

Current Land use Vacant Land 1 - Vacant land previously developed

Monument type INDUSTRIAL WASTE Post Medieval

Monument type INDUSTRIAL WASTE Modern

Significant Finds POTTERY Post Medieval

Significant Finds POTTERY Modern

Methods techniques & 'Augering','Test Pits'

Development type Extensive green field commercial development (e.g. shopping centre, business park, science park, etc.)

Prompt Direction from Local Planning Authority - PPG16

Position in the planning process Not known / Not recorded

Project location

Country England
Site location GREATER LONDON HACKNEY HACKNEY Hackney Stadium

Postcode E13

Study area 5200.00 Square metres

National reference grid TQ 53733 18498 Point

Height OD Min: 7.30m Max: 10.50m

Project creators

Name of Organisation MoLAS

Project originator brief MoLAS project manager

Project originator design MoLAS/PCA

Project director/manager Kieron Tyler

Project supervisor Paul Thrle

Sponsor or funding body Capita Symonds Ltd

Project archives

Physical recipient Archive LAARC

Digital recipient Archive LAARC

Paper recipient Archive LAARC

**Project
bibliography 1**

Publication type	Grey literature (unpublished document/manuscript)
Title	Lower Lea Valley Regeneration and Olympics construction Zone 5 Hackney Stadium
Author(s)/Editor(s)	Halsey, C.
Author(s)/Editor(s)	Thrale, P.
Date	2005
Issuer or publisher	MoLAS
Place of issue or publication	London
Description	A report on archaeological and geoarchaeological monitoring of geotechnical pits and boreholes

Entered by	Paul Thrale (molas.archive@museumoflondon.org.uk)
Entered on	23 September 2005

10 Appendix 1: Glass assessment

Nigel Jeffries

The glass from this site was recovered from contexts [8], [11], [14], [15] and [16]. Much of this material is complete and would appear to date from the later 19th into the first quarter of the 20th century.

- [8] (Trial Pit 106) complete small green coloured glass bottle.
- [11] (Trial Pit 110) complete small brown coloured glass bottle with embossed lettering of 'BOVRIL LIMITED' on either face and the number '12' on the underside of the base. Bovril Limited came into being in 1896, with this example probably dating to the first quarter of the 20th century. Used as meat extract container.
- [14] (Trial Pit 112) lower portion from a clear glass flat-bottomed Codd bottle with embossed letters of 'A.A BAILEY' (retailer), 'STEPNEY' and '71 MAROONS' (address). Used as mineral water container. Late 19th century to early 20th century
- [14] (Trial Pit 112) complete clear small cylindrical glass jar. Used as ointment/cream container.
- [14] (Trial Pit 112) near complete aqua coloured chemist bottle.
- [14] (Trial Pit 112) complete small clear glass sauce/food bottle dating to the late 19th/early 20th century.
- [14] (Trial Pit 112) complete clear glass coloured perfume or scent bottle (?)
- [15] (Trial Pit 113) complete clear coloured glass bottle.
- [16] (Trial Pit 106) complete milk coloured glass bottle. Medicine or scent bottle.
- [16] (Trial Pit 114A) complete white glass bottle embossed on three sides with 'Coffee Essence', 'Symingtons' and 'Edinburgh'. 20th century in date. Symington Ltd is still producing glassware to the present day in Perth, Scotland.

11 Appendix 2: Pottery assessment

Nigel Jeffries

The pottery and ceramic figurines found from this site were recovered from contexts ([+]), [11], [14], [15] and [16]. It should be noted that some of deposits were only sampled for this material, with more frequent plain whiteware jars and lids also present not collected. Generally the assemblage can be dated between 1860s and 1930s and therefore broadly complements the chronology given to the accompanying glass.

The post-Roman assemblage from this site has been identified using the MoLSS medieval and later type-series and has been recorded on paper and computer, using standard Museum of London medieval and later codes for fabrics, forms and decoration. The numerical data comprises sherd count, estimated number of vessels and weight (see Orton, Tyers and Vince, 1993, 167-181, with regard to these specific methods of quantification).

- [+] London stoneware upright bottle (Green 1999, type 404, 170) complete accept handle. This vessel is likely to be a product of either the Fulham or the Doulton pothouses, both of which stopped firing stoneware in 1928 and 1926 respectively. Examples of this type have been found during excavations on the Fulham stoneware pothouse from 1865 and presented in a contemporary Doulton trade catalogue dated to 1873.
- [11] (Trial pit 110) Complete heavy bodied whiteware espresso coffee cup. Dating difficult to ascertain but is likely to be between 1870s and 1940s.
- [14] (Trial pit 112) Base from a polychrome glazed and overglaze painted vase with the gold painted makers mark of *Strasburg ware* with the number 16 additionally on the underside. This example of decorative arts/studio ware type of pottery can be attributed to the town of Strasburg in Virginia, USA, and could be the product of J Eberly & Co who produced such wares between the 1890s and the first decade of the 20th century.
- [14] (Trial pit 112) Near complete black-glazed teapot lid. Source could be from any one of the numerous factories producing such wares during the 19th century and early 20th centuries.
- [14] (Trial pit 112) Blue transfer printed ware plate with scalloped edge decoration. The style of print is common to the third quarter of the 19th century.
- [15] (Trial pit 113) London stoneware ginger beer bottle with right hand half of circular impressed stamp presenting ‘...gland Road’ and ‘unrivalled’. This bottle was made as a container for Bateys ginger beer, a manufactory that operated on Kingsland Road in Hackney from the 1870s.
- [15] (Trial pit 113) Porcelain figurine <2> of a male subject wearing a heavy coat with trailed fur sleeves and a fur hat. Possibly depicting an eastern European or Russian figure.
- [16] (Trial pit 114A) Complete heavy bodied whiteware conical shaped small jar.
- [16] (Trial pit 114A) Complete heavy bodied small cylindrical jar with impressed stamp of ‘*Newcastle Maling*’ on the underneath of the base. This

refers to the Newcastle marmalade factory that was operating from the mid 1850s.

- [16] (Trial pit 114A) Complete London made small stoneware jar with a green slip glaze. Function is unclear but could represent use as an industrial ware.
- [16] (Trial pit 114A) Complete base and lower portion of smear-glazed Parian figurine <1> with added over glaze liquid gilt decoration. Subject matter uncertain but shows a figure wearing a heavy cloak. Parian figurines were popular during the last half of the 19th century often depicting classical subjects or well-known contemporary figures.
- [16] (Trial pit 114A) Near complete English porcelain condiment dish with dark blue-glazed decoration and over glaze painted liquid gilt. Also present is the small part of a delicate looped handle over the middle portion of the vessel.

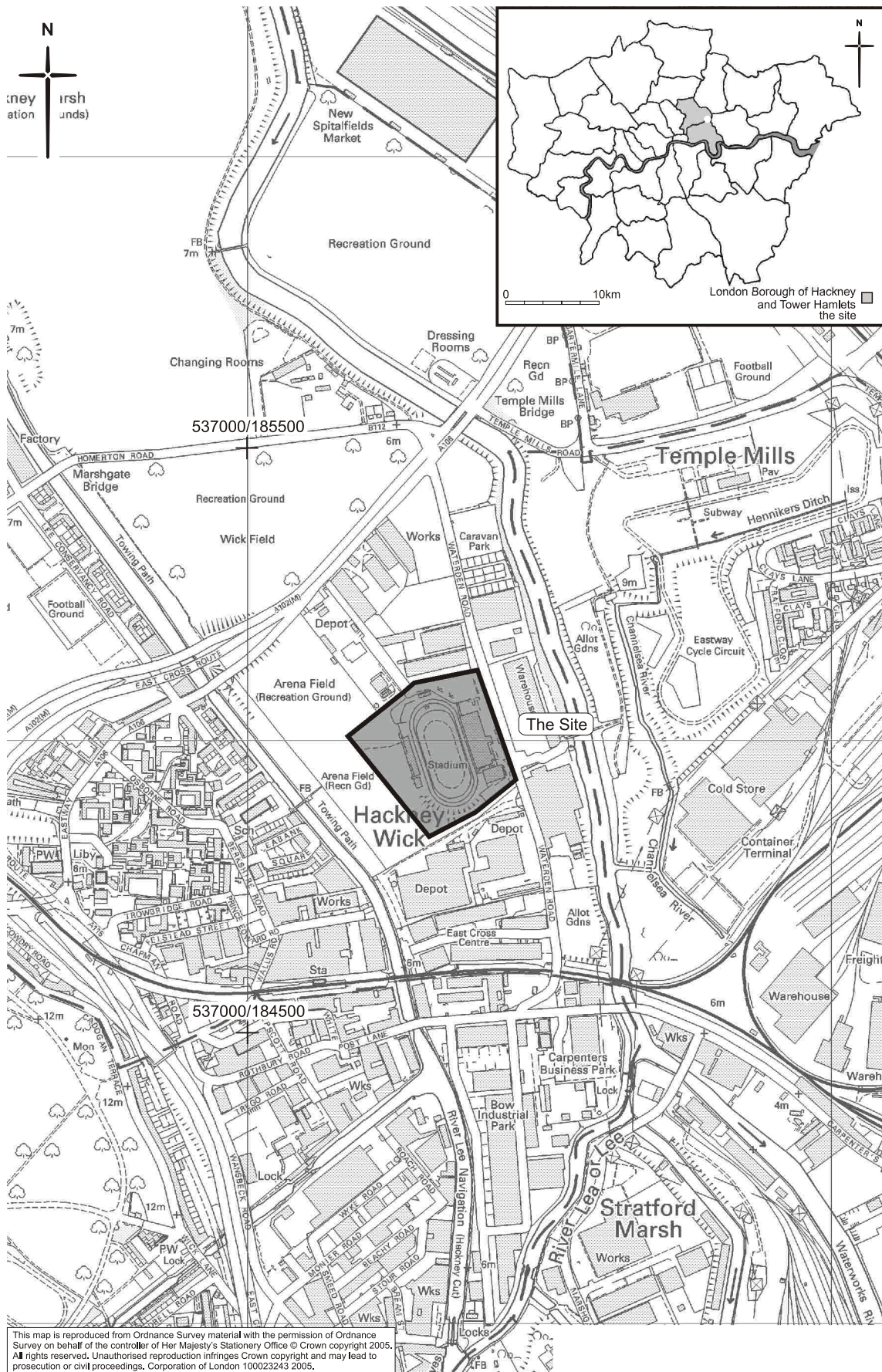


Fig 1 Site location

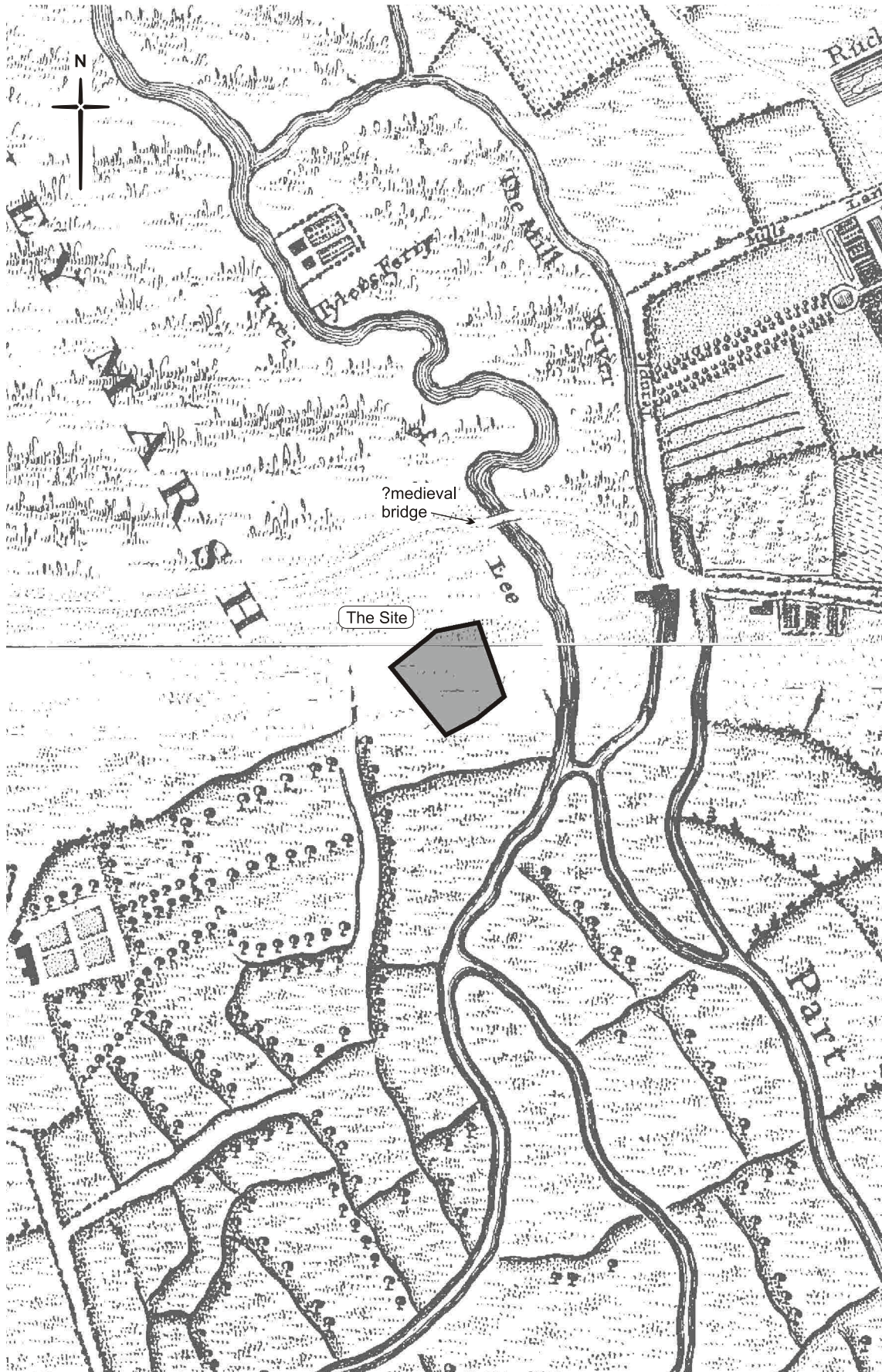


Fig 2 Extract from the Rocque map of 1745



Fig 3 Extract from the Ordnance Survey map of 1952

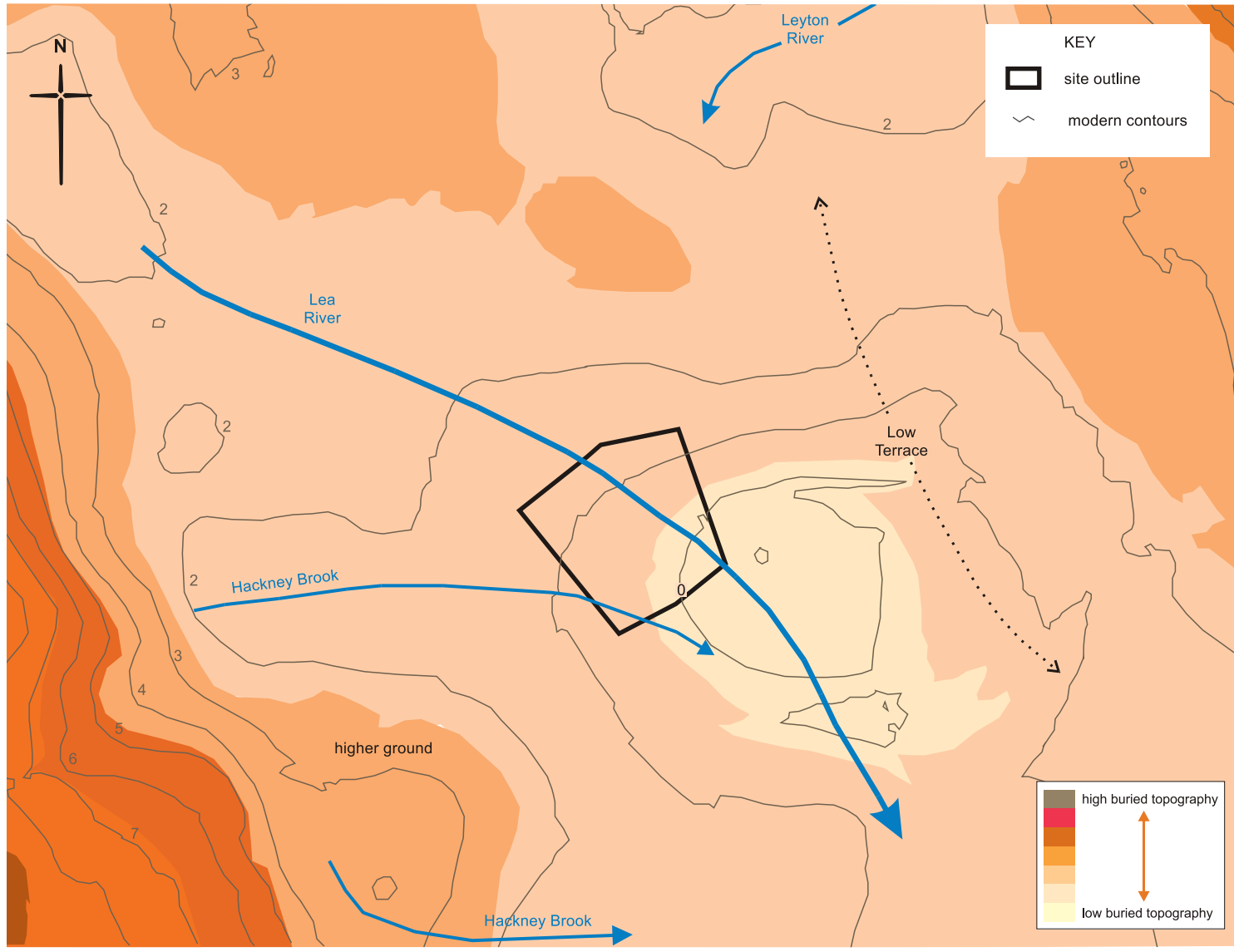


Fig 4 The early Holocene topography of the area (from Lea Valley Mapping Project)

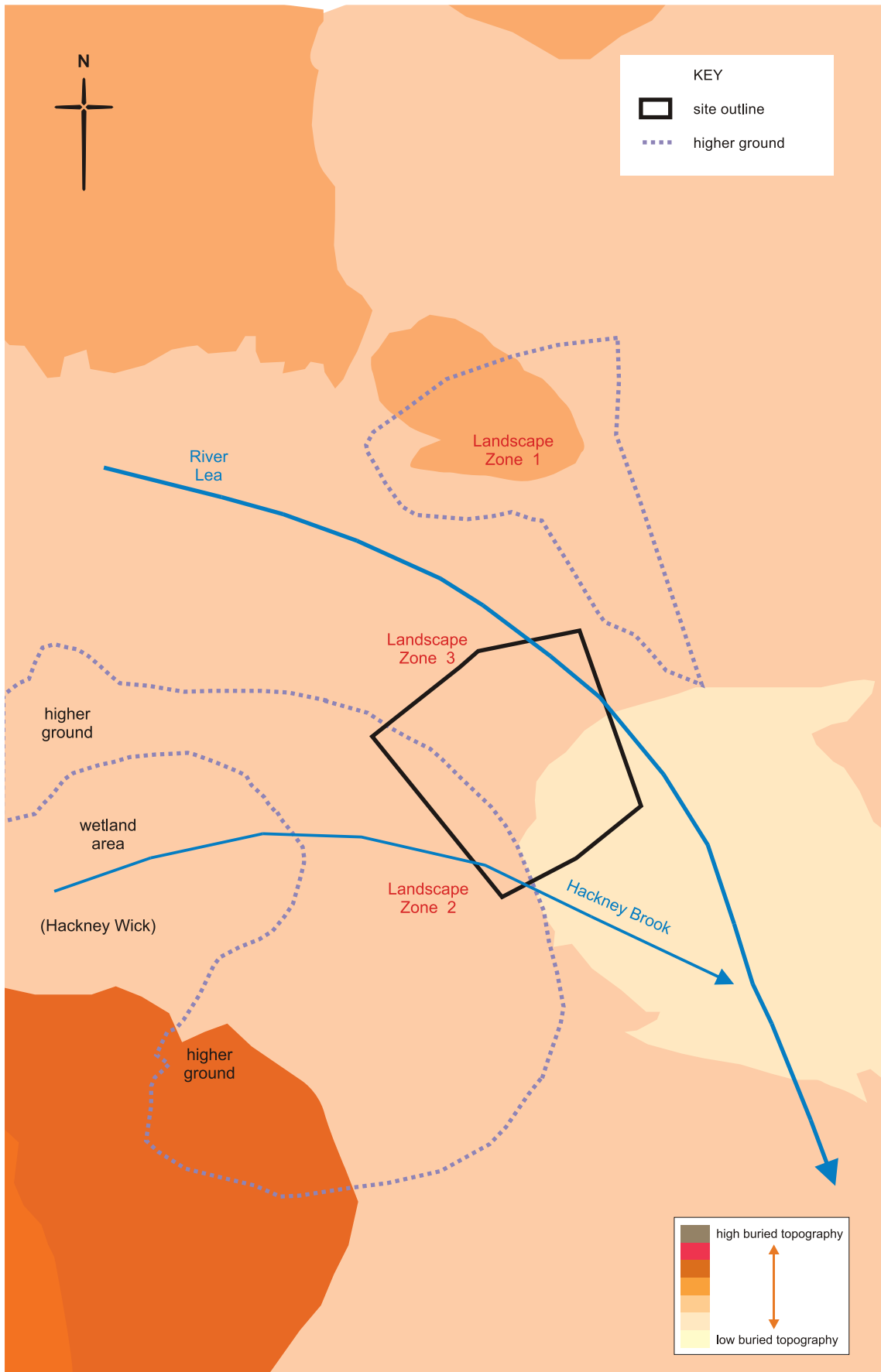


Fig 5 Landscape zones identified from previous desk-based assessment

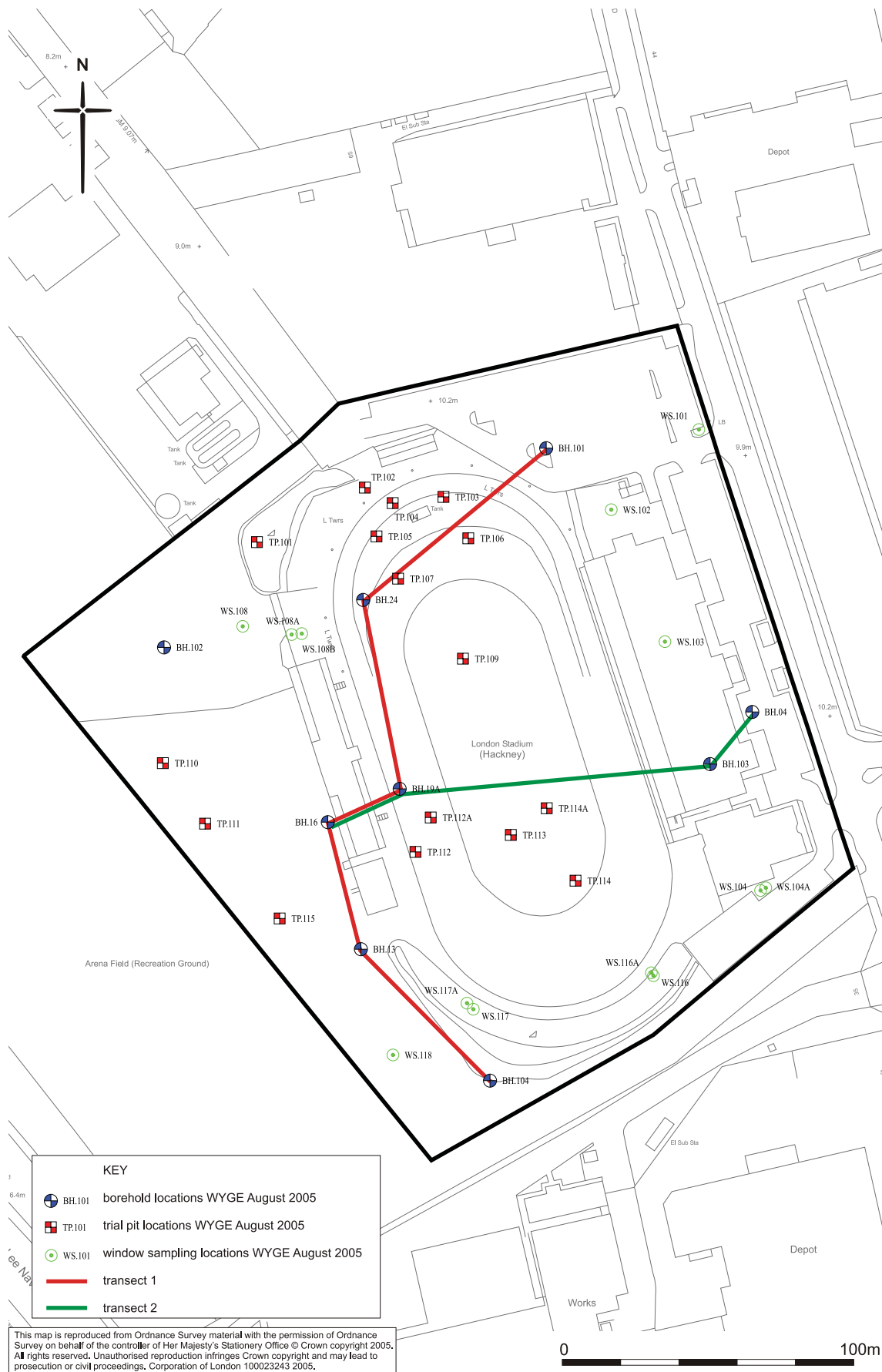


Fig 6 Location of boreholes, trial pits, window samples and transects

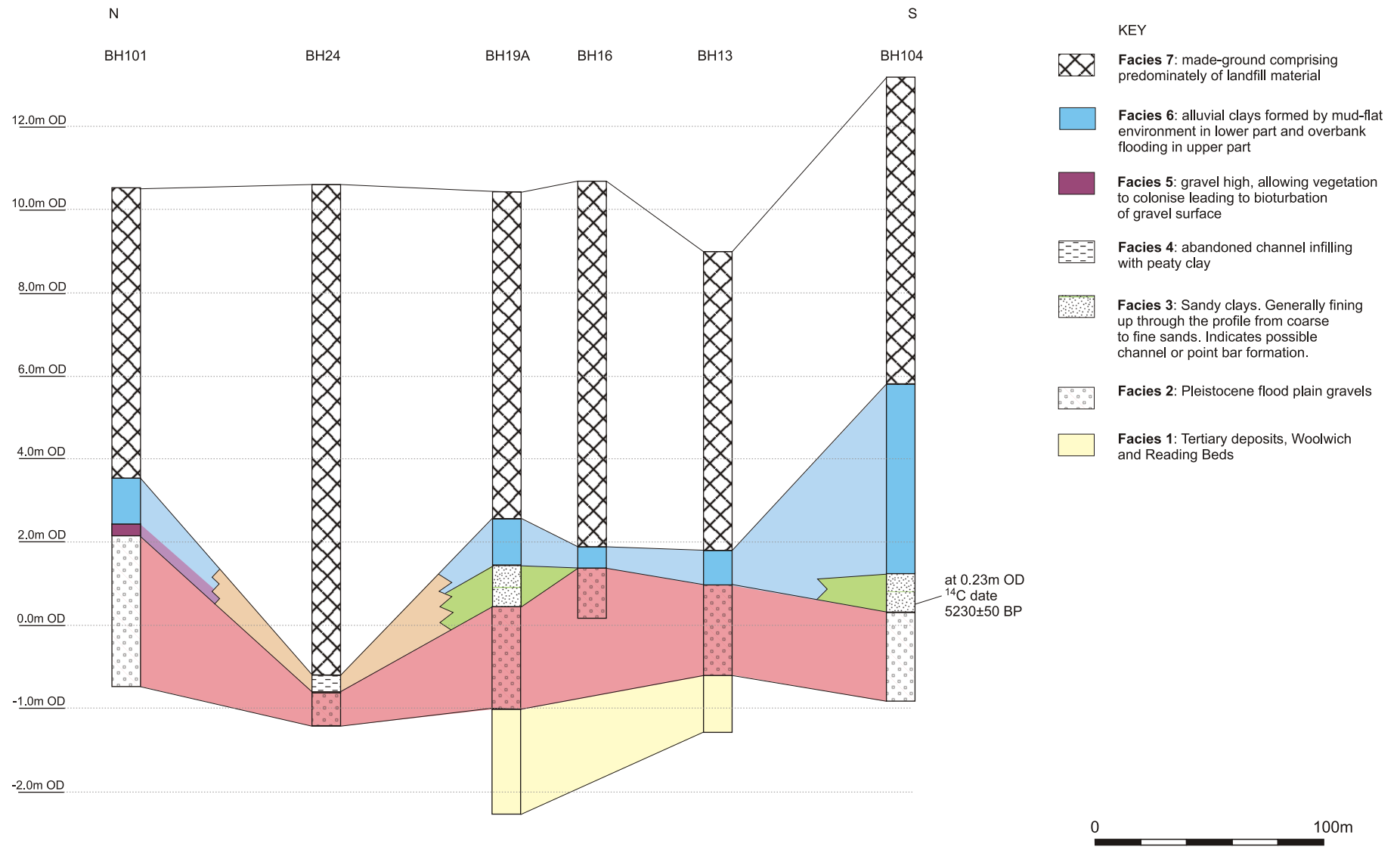


Fig 7 Transect 1, north to south across the site

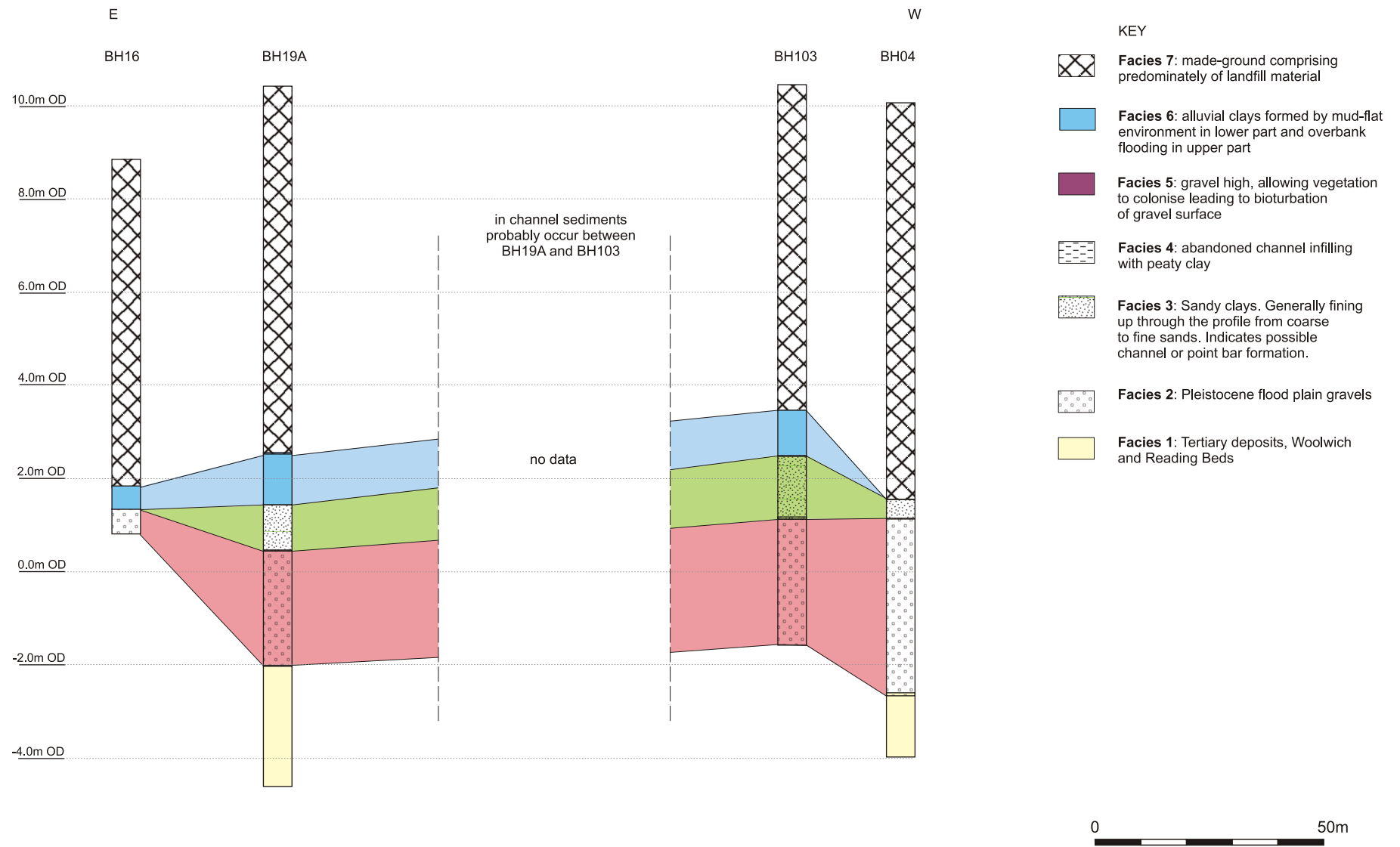


Fig 8 Transect 2, west to east across the site

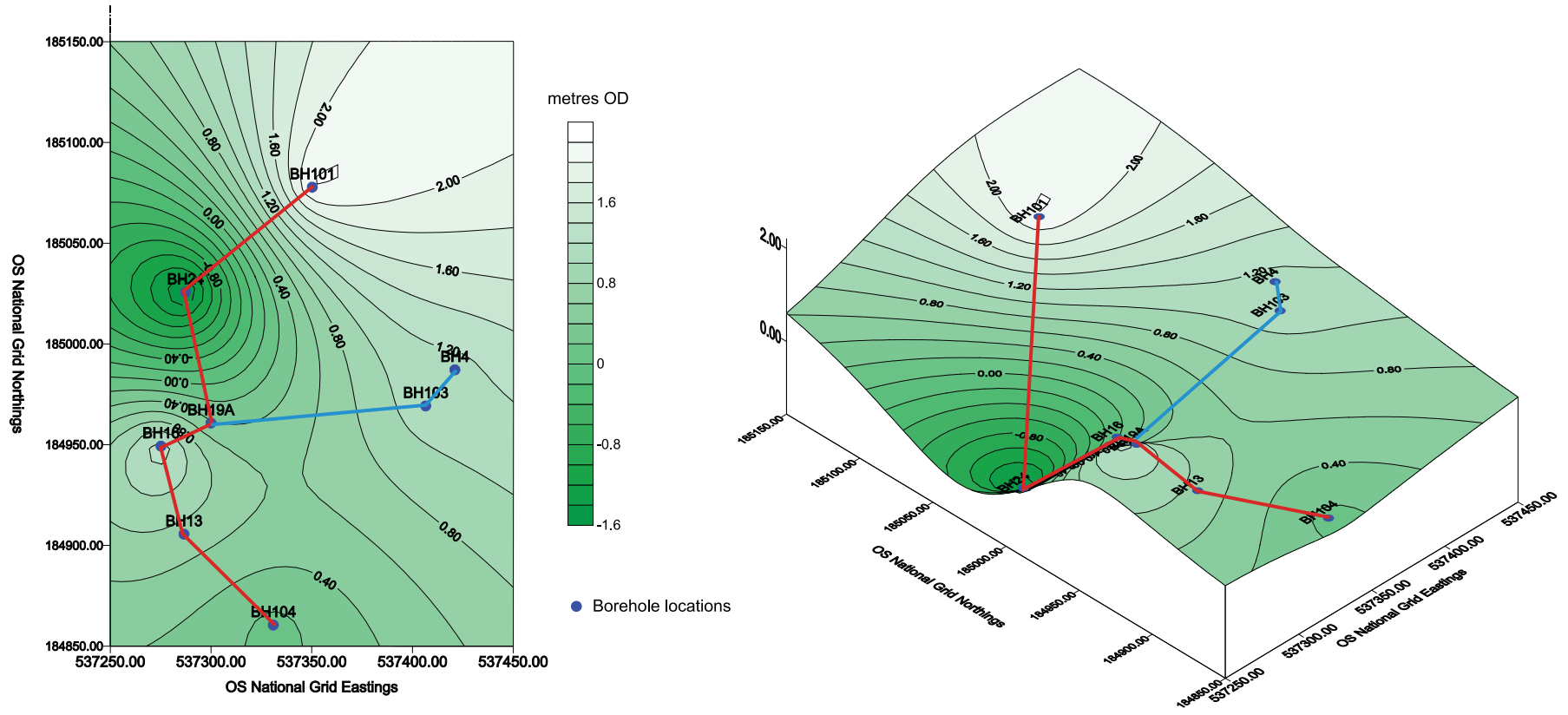


Fig 9 Plot of pre-holocene template (surface of Pleistocene gravels)

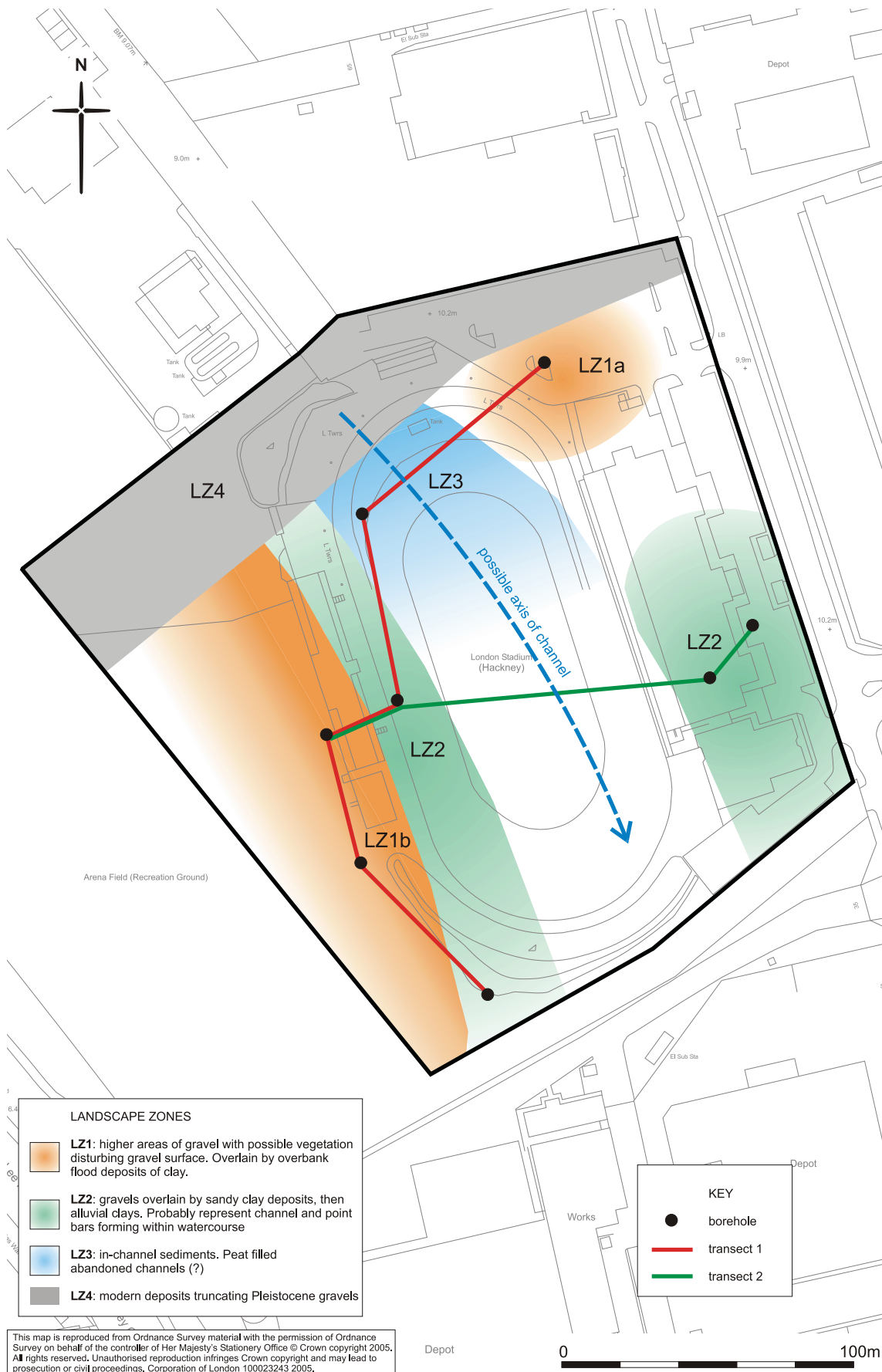


Fig 10 Landscape zones