



DESIGN CONSULTANT FRAMEWORK CONTRACT C122 BORED TUNNELS

NORTH WOOLWICH PORTAL ARCHAEOLOGICAL WRITTEN SCHEME OF INVESTIGATION

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1 Executive Summary

- 1.1.1 The proposed Crossrail railway portal works at North Woolwich consist principally of the tunnel ramp and headhouse. There would also be temporary construction compounds (worksites), sewer and utility diversions.
- 1.1.2 The North Woolwich Portal site lies within an Archaeological Priority Area. There are no scheduled monuments or listed buildings within the site. The site has high potential for palaeo-environmental and topographic evidence within the alluvium. There is moderate potential for prehistoric activity and for industrial and railway archaeology; there is a low potential for Roman, medieval, and other post-medieval remains. Any well-preserved prehistoric structures, such as timber trackways, could be of high importance. Other remains are likely to be of low or moderate importance.
- 1.1.3 The overall mitigation strategy for the site is preservation by record. Non-Listed Built Heritage recording has been conducted for a late 19th-century footbridge prior to its dismantling and reconstruction at Whitwell and Reepham Railway Station.
- 1.1.4 A geoarchaeological borehole evaluation has been conducted to allow for refining of the existing geoarchaeological deposit model. The refined model and borehole evaluation results have been used to target sample excavation trenches on a selection of the different areas and horizons within the archaeological sequence. General Watching Briefs will be carried out during the excavation for the guide walls for the diaphragm walling. Because of constraints on the site, the sample excavation trenches will be excavated during the ground reduction for the portal, within the diaphragm walls. Ground reduction in areas of the portal outside the sample excavation trenches will be subject to a Targeted Watching Brief. Localised works within the worksites and utility diversions will also require General Watching Briefs.
- 1.1.5 Watching briefs on utility diversions are ongoing for C233, and those on establishment of the worksites for the Portal will begin in February 2012. The General Watching Briefs on the guide walls will take place in March 2012.
- 1.1.6 The sample excavation trenches, and the Targeted Watching Brief on other areas of the portal, will take place during ground reduction for the portal between June 2012 and June 2013.

2 Project Background

2.1 Project Background and Site Location

- 2.1.1 Crossrail is a new cross-London rail link project which will provide transport routes in the south-east and across London. The line will provide a range of both new and improved rail journeys across London and its immediate surroundings. The proposed development will include the construction of seven stations within central London which will have interchange with other public transport modes including London Underground, National Rail and the London Bus service; the development will also include the renewal and/or upgrade of existing stations outside central London. The route itself will link Maidenhead and Heathrow in the west with Shenfield in the north-east and Abbey Wood in the south-east. East and west of central London, Crossrail will include alternating surface and tunnelled sections. Each tunnel will have portals and ramps linking it to the adjacent surface sections. As part of these works a portal at North Woolwich will be required.
- 2.1.2 The North Woolwich portal will be located within the existing railway corridor of the former North London Line (NLL), between Factory Road and Albert Road, in the London Borough of Newham, National Grid Reference 542700 180000. The narrow site extremely constricted between these two roads. The portal itself will be located between approximately the junction of Tate Street with Albert Road and Henley Street with Factory Road. In summary the permanent works comprise the construction of the tunnel approach ramp and associated utility diversions, see Section 3.1.
- 2.1.3 The temporary works comprise the portal construction worksite, the main worksite, south of the portal, and an eastern worksite, to the east of the portal. In order to construct the works it will be necessary to lower the ground water levels by dewatering. The main worksite will be used to service the construction of the portal, and the eastern worksite has been allocated for site offices.

2.2 Summary of Previous Assessment Work

- 2.2.1 The Crossrail Generic WSI (doc no. 14022008-44ES-P2Z1) outlines how the arrangements and controls for managing archaeology will be met in designing and constructing Crossrail. It also provides a common framework for archaeology which will ensure that the works conform to a common project standard.
- 2.2.2 The ES and supporting Specialist Technical Report (STR): Assessment of Archaeology Impacts presents the outcomes of the archaeological studies undertaken as part of the Environmental Impact Assessment. The archaeological assessment has included an evaluation of the likelihood of archaeological resources being present in land affected by the project, their importance and the extent to which they will be physically affected by the construction and operation of Crossrail.
- 2.2.3 A Detailed Desk Based Assessment (DDBA) has also been carried out for the North Woolwich portal site. DDBAs were undertaken on sites that require additional information to inform decisions regarding an appropriate mitigation strategy 'Detailed Desk Based Assessment (DDBA) for North Woolwich Portal' (doc no. CR-SD-PRW-X-IS-00002, Crossrail 2008a).
- 2.2.4 A digital deposit model was produced in 2008 from borehole data (see 2.4), but has now been updated with the results of archaeological monitoring of GI Package 19, Package 31 and additional geoarchaeological borehole evaluations carried out in 2011.

2.3 Summary of Previous Crossrail Studies

- 2.3.1 Previous Crossrail studies, relevant to the North Woolwich portal Site include:
- Crossrail, Environmental Statement. February 2005 (Crossrail 2005)
 - Crossrail, Assessment of Archaeology Impacts, Technical Report. Part 4 of 6, South-East Route Section, 1E0318-E2E00-00001, February 2005 [Specialist Technical Report (STR)]
 - Crossrail, Supplementary Environmental Statement 2 (SES2). January 2006
 - Crossrail, Archaeology Programming Assessment. November 2006
 - Crossrail, MDC4 Archaeology Updated Baseline Assessment. January 2008
 - Crossrail, MDC4 Archaeology Overview of ground Levels and Land Raising around the Docks in the MDC4 area. January 2008
 - Crossrail, MDC4 Archaeology — Geoarchaeological Deposit Model: North Woolwich Portal. January 2008 (Crossrail 2008a)
 - Crossrail, MDC4 Archaeology Planning and Environment, Package Specific WSI Deliverable, DDBA North Woolwich Portal, Doc no. CR-SD-PRW-X-IS-00002, (Crossrail 2008b)
 - Crossrail, 2008, Archaeological Monitoring of Ground Investigations, Borehole Package 11, Limehouse to North Woolwich (Crossrail 2008e)
 - Crossrail (MOLA), C156 – Central Project, Archaeological Monitoring of Ground Investigations, Borehole Package 19, Document Number: C156-CSY-T1-RGN-CR146_PT004-00004. May 2010, (Crossrail 2010a).

- Crossrail (MOLA), Central Project, North Woolwich Portal & Plumstead Portal, Scope of Geoarchaeological Evaluations, Document Number: C156-CSY-T1-RSW-CR146_PT004-00001, Rev. 2, (Crossrail 2010b).

2.4 Fieldwork completed to date

Non Listed Built Heritage

- 2.4.1 A non-listed built heritage assessment was conducted on 10 November 2010, which included making a Photographic record (EH 2006) of the majority of the above-ground features on the site (see 5.2).
- 2.4.2 Non Listed Built Heritage Recording (NLBH) of the footbridge was undertaken in August 2011 prior to its dismantling and relocation to Whitwell & Reepham Railway Station. Further information can be found in document reference: C263-MLA-X-RGN-CRG07-50024.


Geoarchaeological



- 2.4.3 The monitoring of GI borehole Packages 11 and 19 was completed in 2006 and 2009 (see 2.5). Geoarchaeological borehole assessment was also carried out in August 2011. The results of the fieldwork are located in document reference C263-MLA-X-RGN-CRG07-50038 and discussed in this document (see 2.9).


Utility Diversions


- 2.4.4 Archaeological general watching brief of enabling works (C233) has been carried out on Utility Diversion locations. Utility diversions which were likely to have an impact on potential archaeological remains, included water, gas, sewers and electric in Albert and Factory Road, as these were open cut, to a depth of between 1.0–1.5 and 4.5m.
- 2.4.5 The trenches for these utility diversions removed the upper horizons of the alluvial sequence. Also the sections of railway track within both Albert and Factory Road were removed during the utility diversions.
- 2.4.6 No other fieldwork within the scope of this WSI has been carried out to date (April 2012).



Table 1 Non-listed Built Heritage (NLBH) at North Woolwich Portal worksites


Name	Image	Description	Significance	Impact	Mitigation/Further Investigation
<p>Railway track crossing Factory Road, approx at CH 88570 No. 1 on Figure 7</p>		<p>Rails with inner guide rails visible at N side of road. Granite setts, light grey, worn, laid between and along outer edge of rails. Track curves round from E to SE. Image, looking SE, shows curving wall at E edge of Tate and Lyle factory, on S side of road, which follows the line of this railway track.</p>	<p>Branch siding into Tate and Lyle factory, on 1893 OS map. Low significance</p>	<p>To be removed by utility diversions</p>	<p>EH (2006) Photographic survey – fieldwork completed during assessment visit – reporting to be incorporated with NLBH recording of footbridge by archaeological contractor</p>



Name	Image	Description	Significance	Impact	Mitigation/Further Investigation
<p>Railway track crossing Factory Road, approx at CH 88620 No. 2 on Figure 7</p>		<p>Railway track with inner guide rails, crossing Factory Road more obliquely than track to W. Only the N end of the track is exposed, but its line can be traced to the S in the broken tarmac of the road surface. Image looks NW.</p>	<p>Branch siding to factory on S side of road, on 1893 OS map. Low to medium significance in association with gate (see no. 3 below).</p>	<p>To be removed by utility diversions</p>	<p>1) Investigate construction and possible use of iron ties underground between rails during the GWB on utilities diversions 2) EH (2006) Photographic survey – fieldwork completed during assessment visit – reporting to be incorporated with NLBH recording of footbridge by archaeological contractor</p>
<p>Railway track No. 2 (continued)</p>		<p>Possible iron tie underground between rails. Image looks N.</p>			



Name	Image	Description	Significance	Impact	Mitigation/Further Investigation
<p>Railway track across Factory Road, approx at CH 88700</p> <p>No. 3 on Figure 7</p>		<p>Railway track with inner guide rails, running very obliquely from NW to SE across full width of Factory Road. Image looks NW.</p> <p>Unlike nos. 1 and 2, no. 3 is marked on modern OS maps.</p>	<p>Branch line to factory on S side of Factory Road, on 1893 OS map. Low significance.</p>	<p>To be removed by utility diversions</p>	<p>EH (2006) Photographic survey – fieldwork completed during assessment visit – reporting to be incorporated with NLBH recording of footbridge by archaeological contractor</p>



Name	Image	Description	Significance	Impact	Mitigation/Further Investigation
<p>Gates from Railway track to Factory Road</p> <p>No. 4 on Figure 7</p>		<p>Posts at W and E side of railway track (above), on N side of Factory Road, closing off branch line across the road, with remains of two suspended gate leaves. Each post comprises two bullhead rails bolted together, and closed at the top. Each gate leaf consists of upper and lower timber rails, with picket fence splats, each rail hinged to the gate post. A metal strut would have run to the free end of the (long) gate leaf from a third hinge near the top of the gate post, the latter being braced by a metal rod (see image). The W gate post is further to the S than the E post. Image looks NW.</p>	<p>Associated with branch line across Factory Road, closing off the main railway line from the road and closing off the branch line from the main line. [On 1893 OS map?] Low to medium significance in association with adjacent railway track (see no. 2 above).</p>	<p>To be removed in clearance of main portal worksite</p>	<p>EH (2006) Photographic survey – fieldwork completed during assessment visit – reporting to be incorporated with NLBH recording of footbridge by archaeological contractor</p>


Name	Image	Description	Significance	Impact	Mitigation/Further Investigation
<p>Opening on N side of Factory Road, into railway line</p> <p>No. 5 on Figure 7</p>		<p>Granite setts forming road surface opening into Factory Road from railway line to N. Image looks SW.</p>	<p>Uncertain. Does not correspond to railway line crossing the road. Appears on 1893 OS map. Low significance.</p>	<p>To be removed in clearance of main portal worksite</p>	<p>EH (2006) Photographic survey – fieldwork completed during assessment visit – reporting to be incorporated with NLBH recording of footbridge by archaeological contractor</p>
<p>Footbridge across main line, connecting Factory Road (to S) with Albert Road (to N)</p> <p>No. 6 on Figure 7</p>		<p>Wrought and cast-iron footbridge, with steps to E: two long flights of steps on each side lead up to a half-landing and short flights of steps up to main span. Half-landing and intermediate landing between flights are supported by cast-iron columns. The sides of footway are formed by wrought-iron lattices, supported by angled plates at their edges. Curving wrought-iron braces on outer faces of the span. Original handrails survive on N steps and half-landings. Probably main components were</p>	<p>Standardised railway public footbridge, of a type possibly as early as 1860s. Not on 1863–7 OS map. Probably the 'FB' on OS map of 1893, though that shows N steps running down to W. These may have been re-positioned since. Medium significance.</p>	<p>To be dismantled/demolished.</p>	<p>EH (2006) 'Level 3' investigation and record by archaeological contractor.</p> <p>Possible re-erection elsewhere to be considered, eg for a heritage railway or other heritage environment, although structural repair would be required.</p> <p>If re-erection is not possible, removal for spare parts for similar structures should be considered in</p>


Name	Image	Description	Significance	Impact	Mitigation/Further Investigation
		<p>riveted, and when assembled on site these were then bolted together. Repairs, eg replacement bolts for rivets, and reinforcement, eg small column replaced on S side; S half of span supported by steel frame. Still in public use. Image looks NE from Factory Road.</p>			<p>preference to removal for scrap.</p>
<p>Footbridge (continued)</p>		<p>Image shows N half of footbridge, looking NW.</p>			

Name	Image	Description	Significance	Impact	Mitigation/Further Investigation
Footbridge (continued)		<p>Image, looking NW, shows inner face of footbridge on W side of steps up to span on S side. Note original handrail, riveted wrought-iron lattice bars continuous between vertical struts, and timber steps (with non-slip material stuck on them).</p>			
Railway track, running from W to E.		<p>Single track running towards former N Woolwich station to E. Surviving track is N half of former double track (S track has been taken up). Track appears to be relatively unworn, though rusty, with recent shoes on timber sleepers. Track removed or disturbed in places. Image looks NW from Factory Road.</p>	<p>Late 20th-century railway line (southern track already removed), along route originally opened in 1847 as the North Woolwich Railway.</p> <p>Surviving modern infrastructure is of no historic significance.</p>	<p>To be removed in clearance of main portal worksite</p>	<p>None Required</p>

Name	Image	Description	Significance	Impact	Mitigation/Further Investigation
<p>Standard Industrial Estate, Factory Road</p>		<p>Two rows of five sheds, orientated N–S, on S side of Factory Road. Sheds are steel frame, pressed metal sidings and roofs, on concrete slabs. Shed entrances face each other across concrete area, entered from Factory Road.</p>	<p>Industrial estate of 1980s or later. No features of historic significance survive</p>	<p>To be adapted and reused or demolished as main worksite</p>	<p>None required</p>
<p>Walls on E side of Store Road and N side of Pier Road No. 7 on Figure 7</p>		<p>Mid pink-red brick wall in Flemish bond, capped with course of sandstone blocks, facing W on to Store Road. The stones form a horizontal plinth course at ground level to S, on Pier Road, and the brickwork progressively increases up to 28 courses as ground level drops to the N along Store Road. Traces of brick superstructure near the S, which is continuous with a yellow brick wall at ground level facing S on to Pier Road. The latter wall contains a doorway and four windows, later blocked with brick. Image looking E from</p>	<p>W and S walls of former Victoria Ale Stores, probably at lower ground level (basement level in relation to Pier Road). These Ale Stores (after which Store Road was named?) appear on 1893 OS map. Low significance.</p>	<p>A section may be removed to create a site entrance. Otherwise, to remain in-situ.</p>	<p>Should be retained if possible: to be determined by C310 Main Works contractor EH (2006) Photographic survey – fieldwork completed during assessment visit – reporting to be incorporated with NLBH recording of footbridge by archaeological contractor</p>

Name	Image	Description	Significance	Impact	Mitigation/Further Investigation
<p>Walls on E side of Store Road and N side of Pier Road (continued)</p> <p>No. 8 on Figure 7</p>		<p>Store Road.</p> <p>Image, looking NE from Pier Road, shows S wall of Victoria Ale Stores.</p>		<p>To remain in-situ</p>	<p>Should be retained if possible: to be determined by C310 Main Works contractor</p> <p>EH (2006) Photographic survey – fieldwork completed during assessment visit – reporting to be incorporated with NLBH recording of footbridge by archaeological contractor</p>
<p>Panelled wall, etc, on N side of Pier Road [to E of work site?]</p> <p>No. 9 on Figure 7</p>		<p>Panelled wall in purple brick, including gate piers with moulded cap-stones, on N side of Pier Road. To the E of the gate piers is a red brick single-storey building with central doorway and stripped-down stone and brick decoration, and a date-stone, '1937'. To the W is a single-storey flat-roofed electricity substation, in blue engineering brick. Image looks NE.</p>	<p>Low significance.</p>	<p>To remain in-situ</p>	<p>Should be retained if possible (in particular the '1937' building): to be determined by C310 Main Works contractor</p> <p>EH (2006) Photographic survey – fieldwork completed during assessment visit – reporting to be incorporated with NLBH recording of footbridge by archaeological contractor</p>

Name	Image	Description	Significance	Impact	Mitigation/Further Investigation
<p>Former railway goods yard (North Woolwich Portal eastern worksite) No. 10 on Figure 7</p>		<p>Flat area of ground on N and E with traces of tarmac and possible granite kerb stones running from SE to NW. Cut into higher ground to S to form a level surface. Markedly higher rough ground to W and SW, on the site of and at the level of the basement or lower ground floor of Victoria Ale Stores. Low brick wall runs for about 3m N of W side of red brick '1937' building. Ground to SW has also been dumped with recent domestic rubbish and building debris. Lower ground to S is overgrown with buddleia, hazel and brambles. Rough sleepers' benders and camp fires to N. Concrete tank c 2m diameter to NW (immediately S of Thames Water pumping station). Area contains to SE remains of signal box (see below) and earth ramp up to lay-by on Pier Road. Image looks W.</p>	<p>Site of N Woolwich railway goods yard to N and E (hence level and flat, and tracks running from SE to NW); site of Victoria Ale Stores to SW. Low significance.</p>	<p>W and SW part to be levelled in preparation for eastern (Store Road) Worksite, No change to the low brick wall, and perimeter walls/structures – Later use as construction compound No works planned to central and eastern parts – outside eastern (Store Road) Worksite, but within Limits of Deviation</p>	<p>W and SW part: EH (2006) Photographic survey – fieldwork completed during assessment visit – reporting to be incorporated with NLBH recording of footbridge by archaeological contractor Central and eastern parts: none required</p>

Name	Image	Description	Significance	Impact	Mitigation/Further Investigation
<p>Remains of former signal box [near SE corner of former goods yard]</p> <p>No.11 on Figure 7</p>		<p>Base of timber-framed and iron-reinforced building, aligned NW–SE and c 3 x 6m in plan, containing iron lever mechanisms and pulley-wheels. Remains of timber external stairs to W. Image, looking SW, shows entrance to Thames Tunnel in Pier Road behind.</p>	<p>Former railway signal box at corner of goods yard. Not obvious on 1893 OS map, so probably later, but late 19th or early 20th-century in date. Medium to high significance.</p>	<p>None in current scheme</p> <p>Outside eastern (Store Road) Worksite</p>	<p><i>Only if landtake and clearance for the worksite were extended to this area: EH (2006) 'Level 3' investigation and record by archaeological contractor.</i></p>

2.5 Consultation and monitoring

Consultation to date

- 2.5.1 The external consultees for this WSI are the GLAAS (Greater London Archaeology Advisory Service) Archaeology Advisor for the LB of Newham, and the English Heritage Regional Science Advisor. They were consulted over the content of this WSI on 22 October 2010. They were also consulted in January 2012 over the trench location and layout and were satisfied with the mitigation.
- 2.5.2 In addition, the GLAAS Archaeology Advisor was consulted over the mitigation determined from the NLBH Assessment visit, on 25 November 2010, and requested the retention of structures and walls around the Store Road (eastern) worksite if possible.

Future consultation

- 2.5.3 The external consultees shall be informed in writing at least one week in advance of commencement of fieldwork.
- 2.5.4 The Project Archaeologist shall arrange and convene monitoring site visits by the external consultees, as appropriate. There shall be no unauthorised access to the works in any other circumstances. Any visits to the works shall be in accordance with the Principal Contractor's health and safety, site access and security requirements. Arrangements for GLAAS monitoring of the archaeological works will be made following the above consultation.
- 2.5.5 Periodic updates on the progress of the Crossrail archaeology programme shall be submitted to the external consultees by the Project Archaeologist. The Archaeology Contractor shall provide information to the Project Archaeologist as requested to inform this reporting.

2.6 Geology and Topography

- 2.6.1 The North Woolwich portal site lies within the alluvial floodplain of the River Thames. Overlying the chalk bedrock are the floodplain sands and gravels deposited during the Pleistocene, c 2,000,000 to 10,000 BP, during which the Thames was a fast flowing braided river, formed of interconnected channels interspersed with higher sand and gravel bars. These floodplain gravels form the 'Holocene Template' on which Mesolithic activity would have taken place, the areas around channels and lakes providing resources attracting a hunter-gatherer population.
- 2.6.2 During the early Holocene sea levels rose and lower lying areas were inundated. By the time of the Mesolithic/Neolithic transition at approximately 4000 BC the level of the Thames is likely to have risen to approximately 97m ATD. From the Later Neolithic the braided channels gradually silted up, and combined with the rising sea levels the conditions were conducive to peat formation. The landscape became predominantly marshland, which was crossed by the Thames as a single meandering channel.
- 2.6.3 Geoarchaeological deposit modelling based on borehole data was been carried out for the North Woolwich portal site in 2008 (DDBA Appendix 2, Crossrail 2008b), and has identified four landscape zones (LZs) to enable analysis of underlying geology and the archaeological and palaeoenvironmental potential (see figure 1).
- 2.6.4 In the western portion of the tunnel portal, approximately to the east of Tate Road, gravel has been recorded at levels between 94 and 96m ATD. It is likely that in this area deeper channels existed which were active during the early Mesolithic (LZ1). The areas LZ1, LZ2 and LZ3 are shown on figure 1. River levels continued to rise and as the channels gradually silted up, probably from the later Neolithic onwards, peat formed and the area became marshland. The peat is overlain by later Holocene alluvial deposits to a height of approximately 100 to 101m ATD. Some of these later Holocene deposits may relate to a former small tributary of the Thames known as Ham Creek, which is shown on maps of Eighteenth to Nineteenth Century date. Further to the east, between just west of Fernhill Street and the eastern end of the portal, a higher 'island' of gravel has been recorded at between 96 and 98m ATD (LZ2). Following production of the deposit model, GI Package 19 was monitored archaeologically in 2009. Preliminary assessment of the results concluded that the western side of the eyot (LZ2) probably lies at least c 50m further west than as shown in figure 1 (Crossrail 2010a, 7.3.1).
- 2.6.5 A similar island was located at the eastern end of the eastern worksite. Much of this area would have been inundated by the end of the Mesolithic, but LZ2 may have remained an island of higher, drier ground within the low-lying marsh into the Neolithic. The TBM reception chamber itself may lie in a marginal zone between deeper channels located to the east of the portal and the higher island to the west (LZ3). In this area well-developed peat deposits suggest an area of dense moisture-tolerant vegetation at the margins of the main channel network.
- 2.6.6 Average modern ground levels in the area surrounding the North Woolwich portal site lie between approximately 101.5 and approximately 102.5m ATD. Levels rise to a height of approximately 105 to 105.5m ATD at the very southern edge of the eastern worksite, probably as a result of the construction of embankments and consolidation of the banks of the river. The existing railway lies between approximately 0.4 and 0.9m higher than the surrounding land.

2.7 Archaeological and Historical Development of the Site

2.7.1 This section provides a summary of information contained within the DDBA carried out for the site (Crossrail 2008b), which should be referred to for further information and detail. This is referenced in Section 11.

Prehistoric Period (c. 500,000 BP to AD 50)

2.7.2 The Thames floodplain would have been targeted during earlier prehistoric periods by hunter-gatherer-fisher groups as an important resource. Occupation such as makeshift camps may have existed on the higher sand and gravel islands (LZ2), with fishing and other activities being carried out adjacent to the surrounding river channels (LZ1). Remains such as fish traps, weirs and boats may survive within the deposits in relict river channels of LZ1.

2.7.3 By or during the Neolithic, the area became marshland (including the islands of LZ2 at the portal and eastern worksite), and preserved timber trackways linking areas of drier ground have been recorded on sites located 1.5 to 2km from the North Woolwich portal site.

Roman Period (AD 50 to 450)

2.7.4 During the Roman period much of this area would still have been marshy open land, although occupation evidence suggests that sea levels were much lower than they are today, and that the marshes were drier, and were probably drained and extensively used. Potential Roman roads and trackways lie outside the site, highlighting Roman activity in proximity; these routes include a possible Roman road leading from the higher ground to the north down towards the ferry crossing at North Woolwich. At Milk Street, approximately 0.7km to the north-east of the site, postholes, dumped layers and a flood deposit of Roman date were recorded.

Medieval Period (AD 450 to 1540)

2.7.5 By the Early Medieval period much of the floodplain of East London was once again marshland due to the rising levels of the Thames. The medieval settlement of North Woolwich is located by the Site and Monument Records (SMR) immediately to the west of North Woolwich station, in the vicinity of the eastern worksite. Most of Woolwich lay on the south bank of the Thames, but a small outpost existed on the other side of the river, probably located to control the strategically important river crossing. The settlement is mentioned in documentary sources from 1086, but was destroyed by flooding, probably during the Fourteenth and Fifteenth Centuries.

2.7.6 The location of the medieval manor of Hammarsh and its manor house may have been located in the vicinity of the North Woolwich portal site. The manor is known from documentary sources from 1086, and the SMR locates the manor approximately 0.5km to the east of the site.

Post-medieval (AD 1540 to 1900)

- 2.7.7 Areas of marshland known as Trinity Marsh and New Marsh, located by the SMR in the area immediately to the north of the portal, were reclaimed for pasture during the Sixteenth Century, and by the early Seventeenth Century much of the marsh had been drained and reclaimed, although in 1612 to 1613 severe flooding occurred in the area. The ditches that were dug to drain the levels developed into major drainage dykes, becoming open sewers feeding into the tributaries of the Thames. This process of land reclamation continued into the Nineteenth Century.
- 2.7.8 By the middle of the Nineteenth Century the area had changed significantly, as London became an increasingly important international port and the associated area of docks, warehouses and industry expanded eastwards. The North Woolwich Railway line, opened in 1847, was constructed across what was previously undeveloped marshland, leading to the construction of large warehouses alongside the railway. The Ordnance Survey 25" map of 1867 shows the railway with part of the eastern worksite occupied by the Victoria Ale Stores, and the main worksite partially developed, occupied by buildings associated with the Electric Telegraph Works. Railway sidings are present at the northern end of the eastern construction compound. By the time of the Ordnance Survey 2nd edition 25" map of 1894 to 1896 the stores and works on both sites had expanded. The remnants of Ham Creek can be seen on these maps, and comparison with modern mapping indicates that the western edge of the creek and its floodplain (marked by dykes on those maps) lay on the approximate line of Tate Road, and its full width may have lain beneath the western c 40m of the portal. A late 19th-century footbridge crosses the railway in the vicinity of the main worksite (see 5.2, no. 6). Railway sidings serving the factories cross Factory Road, and a few sections of track survive within Factory Road, some of which can be seen on modern Ordnance Survey mapping.

2.8 Past Impacts

- 2.8.1 The main worksite is currently occupied by Twentieth Century industrial buildings and a warehouse, which are to be demolished under the current proposals. The eastern worksite is currently open ground. Nineteenth and Twentieth Century buildings may have truncated earlier deposits on both the main worksite and the eastern worksite. It is possible, although unlikely given the proximity of the river and the low ground level, that some of these buildings may have had basements which will have further truncated earlier deposits. However, remains of the Nineteenth Century buildings themselves form industrial archaeological resources.
- 2.8.2 The former NLL, which closed in 2006, lies within the portal footprint, and follows the line of the North Woolwich Line/North Woolwich Railway, constructed across undeveloped land and opening in 1847. It is likely that there has been little or no impact on earlier deposits from the construction of the railway.
- 2.8.3 The Royal Docks Sewer crosses the site in the vicinity of the tunnel approach ramp. The sewer has a diameter of 1.6m. It was constructed by tunnelling methods so had no impact on archaeological deposits. The construction of the associated pumping station adjacent to Store Road would have completely destroyed archaeological deposits.

2.9 Deposit Survival

- 2.9.1 The base of the archaeological deposits, the surface of the Floodplain gravels, lies at approximately 94 to 96m ATD in LZ1 and LZ3, and approximately 96 to 98m ATD in LZ2.
- 2.9.2 The sequence of superficial geology recorded during the C233 Utility Diversion watching brief demonstrated a fairly uniform pattern across the various diversion locations with some areas showing greater areas of truncation than others. Sleepers from old rail tracks crossing Albert Road were noted and recorded. Modern made ground to approximately 0.7 and 1.7m bgl coming onto Minerogenic mid-dark grey alluvial clay and silt sequence of approximately 1.7 to 4.5m bgl. This was underlain by peat deposits containing fragments of alder carr. In the Factory Road Utility Diversion works Peat deposits were observed at between 2.0 to 2.3m bgl. These observations indicate the gravel interface lies between 96 to 98m ATD.
- 2.9.3 The following table presents results from previous archaeological excavations in the area.

Table 2 Deposit Survival from previous archaeological investigations

Data ID	Data Location	Natural surface	Description	Ground Level	Notes
NWH01	ETAP Hotel (Former Silvertown Goods Yard), North Woolwich Road	-1.5	Shepperton Gravels	5.0	Top of gravel, at -1.5 to -1.0mOD sloping up to 0.0m OD to the east. Overlain by sandy deposit and peat/silty peat deposits up to 0.5 to 1.0m OD (Radiocarbon dates 4370 to 3960 BC and 4320 to 3770 BC Cal). Overlain by peat up to 2.2m OD (Radiocarbon dated 1520 to 1200 BC Cal). Overlain by silty clay up to 2.0 to 3.5m OD, and then 1.0m to 1.5m of made ground. Unusual height of levels might mean an island, which shows potential for appearance of these formations in the area.
ORI05	Shurgard Site, Oriental Road	-2.8	Shepperton Gravels	1.5	Gravels, overlain by 2m depth of peat up to -0.6m OD. Overlain by in-situ alluvium up to 0.6m OD. Made ground 0.9m thick.
DLR05	Launch Chamber, DLR Woolwich Arsenal Extension	-5.1	Shepperton Gravels	5.4	Sandy gravel (radiocarbon dated 5220 to 4790 cal BC) at -5.1m OD. Peat at -4.7m OD. Organic clay at -4.6m OD. Peat at -4.6m OD. Silty clay at -4.4m OD. Peat at -4.2m OD. Silty clay at -3.6m OD. Peat at -3.2m OD. Silty clay (radiocarbon dated 1100 to 830 cal BC) at -2.6m OD. Disturbed sediments down to -2.6m OD, from where alluvium is undisturbed.
PIE07	Land adjacent to 1 Pier Road	Not seen	Not seen	2.4	Natural geology not found at limit of excavation, -3.8m OD. Peat with occasional peaty clay lenses (wooded Thames backswamp, occasionally flooded) at -2.8m OD. Clay-silt with lenses of organic clay (flood event or local stream channel fill) at -2.3m OD. Top of peat (wooded Thames backswamp) between -1.1 and -1.8m OD. Organic clay (onset of flooding by the Thames as a result of

					rising sea levels) at -0.9m OD. Alluvium (estuarine clay) at 0.2m OD. Top of silt (post-medieval reworked alluvium) between 0.4 and 1.6m OD.
AET01	145-155 Albert Road	-4.5	Shepperton Gravels	1.3	Organic silty clays (Radiocarbon dated 5050 to 4760 cal BC) at -3.8m OD. Slightly clayey peat at -2.2m OD. Organic silty clays at -1.8m OD. Peat (Radiocarbon dated 1410 to 1040 cal BC) at -0.7m OD. Silty clay at 0.6m OD. Made ground at 0.7m OD.
BAJ00	Bargehouse Road	-4.8	Shepperton Gravels	3.1	Boreholes. Natural geology slopes down N-S from -4.8 to -6.2m OD. Sand at -4.6m OD. Humic silty sand at -4.5m OD. Wood peat/organic silt at -4.1m OD. Silty clay at -3.5m OD. Peat at -0.9m OD. Organic silty clay at 0.0m OD.
DLA03, BH142	Newland Street	-2.6	Shepperton Gravels	4.2	Borehole. Alluvial silty clay (very late prehistoric/historic) at c 0.9m OD.
DLA03, ARC8/405	DLR King George V Station	-6.1	Shepperton Gravels	4.1	Borehole. Top of Palaeochannel (early Holocene/Mesolithic sand) at c -4.8m OD. Silty and sandy channel fill (Neolithic to Bronze Age) at c -2.9m OD. Peat (Neolithic to Bronze Age) at c -1.5m OD. Alluvial silty clay (very late prehistoric/historic) at c -0.9m OD.
NW7	North Woolwich Road	-4.0	Shepperton Gravels	1.5	Borehole (Crossrail Package 4). Mesolithic sandy alluvium at -3.4m OD. Neolithic to Bronze Age peat at -1.0m OD. Bronze Age to post-medieval alluvium at 0.7m OD.

- 2.9.4 Boreholes and the results in Table 2 indicate that the depth of modern overburden is generally c 1.0–1.6m, (up to 2.2–3.5m in some locations, which are assumed to be localised truncation/intrusions), and occasionally as little as 0.5m).
- 2.9.5 There is at least c 0.5m of modern disturbance overlying remains of archaeological interest in areas where the below ground remains of Nineteenth Century structures (such as railway sleepers) are anticipated, and elsewhere that there is generally c 1m of modern disturbance and land-raising overlying any earlier archaeological remains.
- 2.9.6 Modern ground levels over the majority of the site are c 101.5 to 102.5m ATD. The deposit model resulting from the latest geoarchaeological borehole research is modelled below.

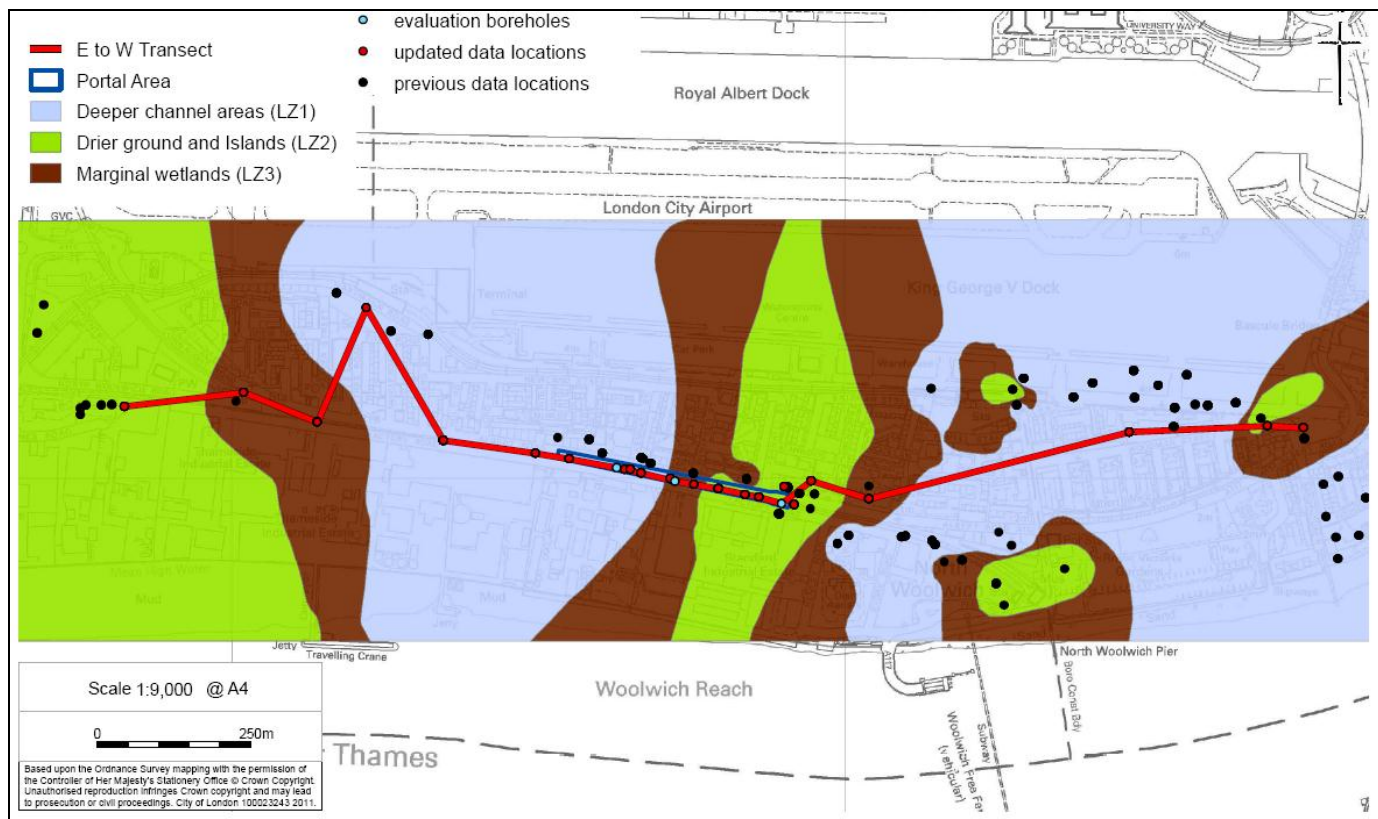


Figure 1. Geoarchaeological deposit model (and see Figure 4 in Annex 1 for more detail)

2.10 Archaeological Potential

- 2.10.1 There is high potential for palaeo-environmental and topographic evidence within the alluvium.
- 2.10.2 There is moderate potential for evidence of Mesolithic dry land and riverside activity.
- 2.10.3 There is moderate potential for evidence of Neolithic to Bronze Age wetland activities, including preserved timber trackways.
- 2.10.4 There is low potential for Roman finds, increasing to moderate potential in the vicinity of known Roman roads and occupation sites.
- 2.10.5 There is moderate potential for evidence of Roman and later flooding, river management and land reclamation.
- 2.10.6 There is moderate potential for post-medieval industrial and railway archaeology.

2.11 Importance

- 2.11.1 The majority of the potential archaeological remains within the site are likely to be of moderate importance if extensive well-preserved remains are present.
- 2.11.2 Any well-preserved prehistoric structures, such as timber trackways or jetties, could be of high importance, but preservation by record is considered appropriate mitigation (Crossrail consultation meeting with EH and GLAAS, 28 July 2004).
- 2.11.3 Less well-preserved or less extensive remains are likely to be of low importance.

3 Construction Impact Summary and Outline Mitigation Design

3.1 Construction Impact Summary

3.1.1 The proposed portal works consist principally of the tunnel entrance (eye), approached by a length of cut-and-cover tunnel ramp and retained cutting. There will also be a construction compound (worksite), comprising three main areas. The proposed works and their likely impacts are considered below.

Portal

3.1.2 The main potential impact of these works is the excavation for portal, which consists of a c 390m-long, c 15m-wide portal ramp sloping down for ground level at the western end to c 14m below ground level at the east.

3.1.3 At the eastern end, the tunnel headhouse will include a TBM reception chamber, sump chamber, and emergency escape facilities. The portal ramp consists of a floodwall at the western end, a sheet pile retained cut at the western end, and a diaphragm walled cut at the deeper eastern end. The western 275m of the ramp will be an open cut, to the east of this it will be covered, with an emergency assembly area above it at ground level. A separate M&E equipment compound would have a 0.8m deep slab, unlikely to affect below-ground archaeological remains.

3.1.4 The works likely to have an impact on possible archaeological remains comprise:

- Guide wall trenches for the diaphragm walls
- Excavation for the diaphragm walls, conducted beneath Bentonite slurry
- Tension piles along the length of the Portal, in single, double, or treble rows (see dwgs. C156-CSY-S-DDL-CR146_PT0004-00051, C156-CSY-R5-DDB-CR146_PT0004-01502 Rev. P01, C156-CSY-R5-DDB-CR146_PT0004-01504 Rev. P01, C156-CSY-R5-DDB-CR146_PT0004-01505 Rev. P01, in Annex 2). There will be 182 piles in total, 1200, 900 and 600mm in diameter. They will be 18–21m deep.
- Excavations for the tunnel ramp/headhouse (at the extreme western c 50m, these will be too shallow to affect archaeology)
- Additional bored piles over the western c 60m of the portal (see dwg. no. C156-CSY-S-DDL-CR146_PT0004-00051 in Annex 2)
- Ground treatment for a distance of approximately 15m east of the portal, which will involve rotary coring with mixing grouting into the soils
- Demolition/removal of a late 19th-century footbridge

3.1.5 The impact of the excavations for the portal (including walls and tension piles) and grouting would be to completely remove all surviving archaeological remains, except in the western end where remains would be less truncated as the ramp rises above the level of existing disturbance/overburden, assumed to be c 1m below ground level (in this

area there will also be the impacts of the tension piles). This would potentially include any historic railway infrastructure present within the former railway corridor. As the existing railway was constructed on previously undeveloped land, it is not thought that any post-medieval industrial remains will be present beneath the railway, but earlier in situ geoarchaeological deposits should be relatively undisturbed.

3.2 Outline Mitigation Design

3.2.1 The overall mitigation strategy for the site is preservation by record.

3.2.2 The following works will be undertaken by the Archaeology Contractor:

- **Archaeological excavation** of sample areas, based on the results of the geoarchaeological evaluation and the revised deposit model, will take place within the portal footprint.
- The areas of the portal outside the sample excavation areas will require a **Targeted Watching Brief**.

4 Aims and Objectives

4.1 Aims of Proposed Investigation

- 4.1.1 The overall aims of the sample excavation will be to investigate, record, and take environmental and geoarchaeological samples from a proportion of the 390m long portal. These sample areas will be targeted on a selection of the different horizons within the deep alluvial sequence, see Section 5.3.10.
- 4.1.2 Results of the geoarchaeological borehole analysis and deposit model update have been used to inform the site specific research aims. In particular the focus of the archaeological sample excavation areas will be on recording and analysing the geoarchaeological and environmental conditions located on the site to inform how humans interacted with the local environment in the past.
- 4.1.3 The aims of the watching briefs will be to investigate, record, and where appropriate sample, any archaeological remains encountered by works where the extent of the impact is limited, and/or there is only a low potential for the works to encounter archaeological remains. Watching briefs will also be used for areas of the portal not included in the sample excavations. The watching briefs may include geoarchaeological recording and sampling.

4.2 Site-Specific Research Aims

- 4.2.1 The following site-specific research aims are outlined for the proposed investigations at North Woolwich portal. Specific questions arising from the geoarchaeological borehole analysis and updated deposit model are included. The research aims set out to understand:
- the peat and alluvial deposits will preserve a range of palaeoenvironmental proxy indicators, such as pollen, ostracods, diatoms, foraminifera, molluscs and plant macro fossils. What can be inferred about the mode of deposition based on these proxy indicators? Is there evidence for stream channels, lakes, etc in the flood plain gravel surface? What date can be attributed to these landscape changes?
 - can the evidence for localised changes in the environment, hydrology and geomorphology be used to revise and update currently accepted models for the Holocene evolution of the Thames floodplain?
 - does the palaeoenvironmental evidence preserved within the deposit sequence provide new information which can be used to investigate the relationship between human activity and landscape change?
 - is there any evidence for prehistoric activity? If prehistoric remains are present, what is their character and what can be learned about the exploitation of the floodplain by prehistoric groups? In particular, is there any evidence for Mesolithic activity in at the base of the alluvium/surface of the gravel, or for occupation in the areas of higher ground, such as the eastern end of the portal? Is there evidence for timber structures, such as platforms or causeways?

- how can evidence of floodplain stabilisation and soil formation of a Roman to Medieval date within the upper minerogenic alluvium provide information on the timing of marine regressive and transgressive episodes? Is there robust evidence for earlier regressive and transgressive episodes? How does this compare with human interactions in the landscape?
- can alluvial deposits in the western c 40m of the portal be related to the tributary of the Thames known as Ham Creek? If so, what can be learned about the processes by which the channel became infilled?
- what can be learned about the processes of Roman and later land reclamation, land management and flood defence?
- what can be learned about the industrial development of the area following the construction of the railway in the Nineteenth Century?

4.3 Regional Research Aims

4.3.1 The site has potential to address several more general research aims identified in the regional research agenda: '*A Research Framework for London Archaeology*' Museum of London, 2002. The regional research themes considered relevant are (page numbers are in brackets):

- understanding the significance of geomorphology, ecology, ecosystems and climate, hydrology, and vegetation and faunal development, on human lives (79);
- understanding London's hydrology, river systems and tributaries particularly the role of the Thames (as boundary, communication route, resource, ritual focus etc) in shaping London's history, and the relationships between rivers and floodplains (79);
- understanding the relationship between landscape, river and settlement, and the influences of the Thames in particular on communications and social interaction (79);
- understanding the origins of the prehistoric metalwork sequence from the Thames, and examining the links between the metalwork hoards deposited at the headwaters of river tributaries and other activities (79);
- understanding the relationship between the Bronze Age wooden trackways and the settlements to which they presumably led, and what the trackways represent in terms of woodcraft and woodland management (81); and
- understanding the reasons for evolution of the road systems, street layouts, river crossings and ferries, and their importance as engines of development and change (82).

5 Scope of the Investigation

5.1 Introduction

5.1.1 The scope of archaeological investigation required is a series of excavation of sample areas within the portal footprint. These are summarised below.

5.1.2 In summary:

- **C263 and Principal Contractor C310: Archaeological excavation** of sample areas within the portal footprint.
- **C263 and Principal Contractor C310: Targeted Watching Brief** on ground reduction in areas/horizons of the portal outside the sample excavation areas

5.1.3 The overall mitigation strategy for the North Woolwich Portal site is preservation by record.

5.1.4 The main portal worksite has severe restrictions on archaeological field work in advance of portal construction:

- the narrowness of the site, flanked by roads, with a single entrance to east,
- the high water table (c 1.0–1.5m below ground level), therefore water extraction from archaeological trenches could lead to contraction of adjacent alluvium (especially peat) and subsidence of the public roads either side of the narrow site.
- trenches c 4–5m deep would be required to reach the level of potential prehistoric activity on the higher gravel eyot at the eastern of the portal, deeper elsewhere.

5.1.5 In addition, the alluvial sequence is predicted to commence immediately under the modern made ground, and there is a low potential for historic period remains within the portal footprint, which historic maps show was open ground until the construction of the North London Line in the early 19th century.

5.1.6 Therefore, the mitigation fieldwork will take place after construction of the diaphragm walls for the portal, and during subsequent ground reduction within them. This would take the form of sample excavation during construction, see 5.3.

5.2 Non-listed Built Heritage (NLBH) Assessment and Recording

5.2.1 Non-listed built heritage (NLBH) assessment and recording forms part of the archaeological mitigation strategy for Crossrail. The definition of non-listed built heritage adopted follows Information Paper D22 Archaeology and Crossrail Generic WSI (Document Reference 14022008-44ES-P2Z1), and includes:

- Important non-listed buildings of historic interest proposed for demolition in conservation areas (as set out in Information paper D18, Listed Buildings and Conservation Areas);
- Important non-listed historic street furniture and materials;

- Other important non-listed buildings and structures of historic interest outside conservation areas, locally listed station buildings and railway structures and any industrial and defence archaeology of significance.

5.2.2 In addition to visible, above-ground structures there may be buried industrial or railway remains within the construction compounds or the portal footprint. These will be dealt with under the procedures for buried archaeology, below.

5.3 Portal

5.3.1 Mitigation for the portal will comprise two phases of archaeological work:

- Sample excavation areas by C263 during C310 portal excavation
- Targeted Watching Brief by C263 on excavation of the remaining areas of the portal by C310

5.3.2 The areas of the watching briefs are shown in Figure 8 in Annex 1. The locations of the sample excavation trenches are shown in Figure 2 and again in Figure 3 in Annex 1.

5.3.3 This sample excavation will mitigate the potential impacts of all portal construction, including grouting and piling. This includes the 15m-long area of grout mixing immediately east of the portal, for which no mitigation is practicable, because of the methodology, and the reasons preventing excavation in advance of construction described in section 5.1. Similarly, piling (tension piles and secant pile walling) will not be monitored or otherwise mitigated separately from the overall portal construction; the arisings are unlikely to produce any useful archaeological data additional to that which will be obtained from the guide walls and main portal excavations.

Sample excavation by C263 and C310 during portal construction

5.3.4 For the reasons stated in section 5.1, the archaeological excavation will take place after the construction of the diaphragm walls, which will provide trench support and prevent dewatering of the strata outside the excavations.

5.3.5 Given the 390m length of the portal, it is not proposed to excavate its entire footprint archaeologically. Instead, the refined geoarchaeological deposit model (using the evaluation results) has been used to target excavation trenches in selected sample areas and strata within the portal footprint, that have higher archaeological potential for differing archaeological horizons. This took into account the practicalities of the site (eg the sample excavation areas may need to be restricted to one side of the portal, in order that construction traffic etc to pass along it). The areas and relevant horizons will be defined in advance of construction (from the geoarchaeological deposit model. The remainder of the portal (including any strata *below* the designated horizons within the sample areas) would be covered by Targeted Watching Brief (TWB).

5.3.6 The sample excavation comprises four areas, c 25m x 4m. The archaeological works within the portal will be undertaken with the piles in place, as with the engineering excavations. This should not significantly affect the archaeological programme. When sample areas have been excavated any piles within them can be broken down as part of the subsequent engineering excavations.

5.3.7 Location of the sample excavation areas and horizons has taken into account:

- areas of higher gravel in the eastern part of the portal, with potential for activity and occupation from the Mesolithic and early Neolithic periods. (gravel surface: c 4.6 to 5.4m below ground level)

- the Neolithic/Bronze Age peat horizons around the margins of higher ground, with potential for timber structures such as jetties or trackways. (c 2.7m (surface) to 5.1m (base) below ground level)
- potential floodplain gravels and base of the alluvium adjacent to any Mesolithic channels.
 - NB modern ground level rises west to east, from c 1m OD at the western end of the portal, 2–3m OD in the centre, and up to c 3.8m OD before falling again to c 2.5–3m OD. The embankment lies at c 3–4m OD.
 - Depth of modern overburden is generally c 0.5–1.6m (straight onto alluvium), but correspondingly greater where ground levels are greater than c 1m OD indicating ground raising.



Figure 2. Location of archaeological trenches (see figure 3 in Annex)

- 5.3.8 The modern overburden will be removed by the Principal Contractor, who will continue ground reduction in the sample excavation areas using machines with a smooth-bladed ditching bucket, under archaeological supervision until the specified horizons (or any significant archaeological remains at a higher level) are reached, as a targeted watching brief.
- 5.3.9 The machines will be used to clean to the specified archaeological horizon under close archaeological supervision. The sample archaeological excavation areas, with a suitable safe working area around them, will be separated from the remainder of the portal

worksite by robust barriers. A safe method of working in the confined circumstances of the portal will be devised by the principal contractor and archaeological contractor and previously specified in their method statements.

- 5.3.10 The archaeological contractor will then clean, record, sample, and where required excavate the specified archaeological remains, within the timescales specified in section 6. Further excavation may be required by hand, or using machines under instruction and close supervision from the supervising archaeologist(s). This will include geoarchaeological recording and sampling of the alluvial sequence(s), in conjunction with similar work during the targeted watching brief.
- 5.3.11 Except where the specified archaeological horizon is at the base of the geoarchaeological sequence (eg the gravel eyot or lower areas of the floodplain gravels), archaeological excavation/investigation will cease at the base of the specified horizon, and the principal contractor will continue ground reduction under the targeted watching brief.

Targeted Watching Brief by C263 on works by C310

- 5.3.12 The Principal Contractor's ground reduction of areas and horizons of the portal not included in the sample excavation areas will be subject to a Targeted Watching Brief.
- 5.3.13 The TWB will cease at the floodplain gravels (River Terrace Deposits). The surface of the gravels slopes down from 96–98m ATD at the eastern end of the portal /headhouse, to 94–96m ATD at the western end. It will, however, include any archaeological features cut into the surface of the gravels, including palaeochannels (alluvium-filled former stream channels).
- 5.3.14 TWB will be adopted as part of a programme of observation, investigation and recording of archaeological remains during construction, in this case utilised for areas of the portal not included in the sample excavation areas.
- 5.3.15 For North Woolwich Portal, TWB will involve initial ground reduction of modern made ground or overburden being conducted by the ground works contractors under archaeological supervision, using a flat-bladed ditching bucket (unless ground conditions prevent this). This will be followed, if necessary, by localised hand inspection, and assessment by archaeologists.
- 5.3.16 If no significant or extensive archaeological remains are revealed, the alluvial sequence will be **rapidly** recorded (and if appropriate sampled), then the next alluvial horizon will be removed by machine, using a flat-bladed ditching bucket, in spits of 0.2–0.5m depth (as advised by the supervising archaeologist). This process will be repeated for each successive alluvial horizon, until either:
- significant or extensive archaeological remains are uncovered, or:
 - a depth of 0.5m below the surface of the floodplain gravels is reached (not just any sandy deposits that may overlie them, which are form part of the alluvial sequence).
- 5.3.17 If, however, significant or extensive archaeological remains are uncovered, the archaeological contractor will notify the Principal Contractor and Project Archaeologist, and mobilise their on-call archaeological support team, and any specialists required (eg geoarchaeologists or surveyors), to rapidly excavate and record the remains. This requires a 'draw down' contingency in the construction programme for such work, to be called on if required. Note that this contingency time may not necessarily mean a delay

to construction work for the whole of that period, as archaeologists may be able to work in different areas from construction teams, depending on circumstances and safety issues.

- 5.3.18 This will include geoarchaeological recording and sampling of the alluvial sequence(s), in conjunction with similar work during the sample excavation. This will require co-ordination between the two tasks to ensure recording of complete alluvial sequences, and conversely, to avoid duplication of effort.

6 Programme for the Investigation

The programme for archaeological investigation is set out below.

6.1 Introduction

6.1.1 Site-specific targeted watching brief and general watching brief mitigation measures are presented using the following phasing:

- **CRITICAL** phase archaeological works which need to be undertaken prior to the enabling works (this may apply to very significant archaeological remains where complex mitigation is required and where early site access is required)
- **Phase 1** archaeological works to be undertaken commensurate with the programme of Enabling Works (advance works)
- **Phase 2** archaeological works to be undertaken commensurate with the Main Works
- **Phase 3** archaeological works to be undertaken after the Main Works phase (e.g. post excavation assessment, analysis, publication and dissemination).

6.2 Main Works

Sample Excavation during Portal Construction

6.2.1 Four sample excavation areas have been identified. These are located on Figure 2. The excavation of these areas will be carried out after the diaphragm wall is in place, and will be excavated in layers, retaining a longitudinal section for archaeological recording.

Targeted Watching Brief during Portal Construction

6.2.2 In addition to the sample excavations, a Targeted Watching Brief will cover ground reduction in those parts of the portal which lie outside the sample areas/horizons. This will require a further draw down contingency in the programme for the archaeological contractor to investigate and record any significant finds.

6.3 Summary Table

Table 3 Programme of archaeological fieldwork

Archaeological Task	Programme
Sample Archaeological Excavation during Portal Construction (C263 & C310)	July/August 2012
Targeted Watching Brief during Portal Construction (C263 & C310)	August- onwards

7 Specification for Evaluation & Mitigation (including Watching Brief)

7.1 Generic Standards

- 7.1.1 The archaeological evaluation and mitigation works and scope of any archaeological scientific methods shall be designed and undertaken in accordance with the Generic WSI and relevant best practise guidance (and any subsequent revisions) i.e.:
- Those listed in *Crossrail Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* section 7.A.1 (Crossrail, 2009, Doc. No. CR-PN-LWS-EN-SP-00001 Ver. 0.3)
 - *GLAAS Standards for Archaeological Work, London Region, External Consultation Draft* (English Heritage 2009)
 - English Heritage *Understanding historic buildings: a guide to good recording practice* (English Heritage 2006c)

7.2 Potentially nationally important remains

- 7.2.1 Where unexpected, potentially nationally important archaeological remains (as defined in the Crossrail Environmental Minimum Requirements and Generic WSI) are identified during the works, the Archaeology Contractor shall undertake works in accordance with the Environmental Requirements (archaeology) section of the relevant package Works Information and shall adhere to procedures as set out in the SS-WSI.
- 7.2.2 The Archaeology Contractor shall submit details of their procedure for excavating and recording potentially nationally important remains in the Archaeology Contractor's Method Statement.
- 7.2.3 Details shall be in accordance with Crossrail procedures and include how relevant parties are to be informed of such discoveries, the criteria to be utilised by the Archaeology Contractor in the assessment of the significance of such discoveries and the timescales to be adhered to.
- 7.2.4 As a result of the discovery of unexpected, potentially nationally important archaeological remains, the SS-WSI will be updated by the Design Archaeologist and reissued by the Project Archaeologist to incorporate any additional specific primary fieldwork event aims.
- 7.2.5 NB whilst any extensive and well-preserved timber structures such as trackways (if present) might potentially be considered to be of national importance, in a consultation meeting on 28.7.04, EH and GLAAS agreed that preservation by record was suitable for prehistoric timber trackways.

7.3 Human Remains

- 7.3.1 Human remains are unlikely to be present on the North Woolwich Portal site.
- 7.3.2 If any human remains were to be found, they will be treated in accordance with the procedures in section 7.A.6 to 7.A.15 of *Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* (Crossrail, 2009). Crossrail procedures for dealing with discoveries of human remains shall identify any specific individual roles or actions that are relevant to the works.
- 7.3.3 If removal of human remains were to be required, an Exhumation Licence would be required from the Coroner's Office of the Ministry of Justice, under the terms of the 1857

Burial Act. This would be obtained by the archaeological contractor, unless otherwise required by the Project Archaeologist.

7.4 Treasure Act

- 7.4.1 If any items falling within the scope of the Treasure Act 1996 were found on site, the procedures in section 7.A.16 to 7.A.22 of *Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* (Crossrail, 2009) will be enacted. This currently appears unlikely.
- 7.4.2 Crossrail procedures for dealing with Treasure finds shall identify any specific individual roles or actions that are relevant to the works. Details shall include how relevant parties are to be informed of such discoveries, the criteria to be utilised in the assessment of the significance of such discoveries and the timescales to be adhered to.

7.5 Health and Safety

- 7.5.1 Health and Safety will be addressed in accordance with section 7.B of *Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* (Crossrail, 2009).
- 7.5.2 The Archaeology Contractor shall undertake the works in accordance with the Employer's Health and Safety requirements and the Principal Contractor's Health and Safety Plan. Where specific health and safety constraints or requirements for the Archaeology Contractor's method of work are required, these are set out below and shall be addressed in the Archaeology Contractor's Method Statement (in the Health and Safety Plan).
- 7.5.3 In addition to the general issues arising from conducting watching briefs on a major construction site, the archaeological contractor, in conjunction with the Principal Contractor, will need to address:
- Conducting the sample excavations, and the TWB within the restricted areas of ground reduction within the diaphragm walls of the portal
 - Conducting GWB and TWB on deep, potentially confined, utility shafts and trenches

7.6 Location and ground elevation of interventions and survey grids

- 7.6.1 The archaeological contractor will survey the site in accordance with section 7.C of *Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* (Crossrail, 2009).

7.7 Specification for geo-archaeological investigation (coring and boreholes)

- 7.7.1 The archaeological contractor will conduct the geoarchaeological borehole evaluation in accordance with section 7.G of *Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* (Crossrail, 2009).

7.8 Specification for archaeological sample excavation (investigation)

- 7.8.1 The sample excavations will be conducted in accordance with section 7.1 of *Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* (Crossrail, 2009e).
- 7.8.2 The Archaeology Contractor shall undertake archaeological excavation of sample areas and horizons during the Principal Contractor's ground reduction within the diaphragm walls of the portal.
- 7.8.3 In particular, the Principal Contractor will facilitate the sample excavation by providing:
- In co-operation with the archaeological contractor, a safe method of working for the sample excavation areas during ground reduction within the diaphragm walls. To include safe access for the archaeological team to the working area.
 - The above to include designated safe working areas with robust barriers, and traffic management in the surrounding area, to prevent accidental machine/traffic entry.
 - Ensuring that there are no live services within the areas of excavation, and that Unexploded Ordnance (UXO) risks have been mitigated.
 - Machining (under archaeological supervision), using a mechanical excavator with a smooth-bladed ditching bucket and banksman for ground reduction to expose and initially clean the sample excavation area and horizon, and any subsequent machine excavation requested by the archaeological contractor.
 - Spoil removal, and water extraction/disposal, from the sample excavation areas.
 - Trench support, or further machine ground reduction of the surrounding area, if the sample excavation trench should need to be deeper than c 1.2m or less if the edges are unstable.
 - Providing a health and safety regime, accommodation, welfare, and other facilities to enable the archaeological team to carry out the sample excavation.
- 7.8.4 Particular responsibilities of the archaeological contractor include:
- To provide a suitably qualified and experienced team of archaeologist and appropriate specialists (in particular geoarchaeologists) to carry out the sample excavations and associated off-site works.
 - In co-operation with the Principal Contractor, to produce a safe method of working for the sample excavation areas.
 - To comply with, and contribute to, the Principal Contractor's health and safety regime, Environmental Management Plan, and other requirements, and reflect this in their Method Statement.
 - To record, excavate, and sample the archaeological remains (if present) in the specified sample areas and horizons. Sample excavation will normally cease at the base of the specified horizon or features, unless varied by the Project Archaeologist.
 - If not such remains are present, to facilitate the signing off of the area to Targeted Watching Brief by the Project Archaeologist (or whoever they designate to do so).

- Co-ordinating the geoarchaeological recording and sampling between the sample excavation areas and the TWB elsewhere in the portal (also the borehole evaluation results/cores), in order to produce a geoarchaeological record which covers the extent of the portal site.

7.9 Specification for watching brief

7.9.1 The watching briefs will be conducted in accordance with section 7.H of *Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* (Crossrail, 2009e).

7.9.2 In particular, Targeted Watching Briefs are described generically as follows:

- A targeted watching brief shall comprise observation and recording of the Principal Contractor's works with specific operations carried out under the supervision of the Archaeology Contractor. Under targeted watching brief, the Archaeology Contractor may impose constraints on, or require changes to, the Principal Contractors' or his sub-contractor's method of working to enable the archaeological investigation to take place alongside construction works (7.H.4).
- In archaeologically sensitive areas, where the need for a targeted watching brief has been identified in the SS-WSI, the Principal Contractor will strip soils (which may include modern made ground, topsoil, subsoil, alluvium and colluvium) using a 360 degree excavator and **smooth-bladed ditching bucket** under the supervision of the Archaeology Contractor. The Principal Contractor will limit their tracking of vehicles and plant within areas specified in the SS-WSI and/or as instructed by the Project Archaeologist. The Principal Contractor will facilitate mapping and sampling of deposits by the Archaeology Contractor through use of agreed plant, a site share agreement and careful liaison between the Archaeology Contractor's supervising archaeologist and the Principal Contractor's site supervisor (7.H.9).

7.9.3 The Archaeology Contractor shall undertake Targeted and General Watching Briefs at North Woolwich Portal during Enabling Works and Main Works. The scope and site-specific requirements for the watching briefs are described in sections 5.3 of this WSI.

7.9.4 In particular, the Principal Contractor will facilitate the Targeted Watching Brief by:

- Providing, in co-operation with the archaeological contractor, a safe method of working for both archaeologists supervising ground reduction, and teams conducting any excavation/recording/sampling required (for any *significant* archaeological remains). The latter will require designated safe working areas with robust barriers.
- Ensuring that there are no live services within the areas of excavation, and that Unexploded Ordnance (UXO) risks have been mitigated.
- To facilitate the Targeted Watching Brief.
- Spoil removal, and water extraction/disposal if required for any excavation/recording/sampling required.
- Providing a health and safety regime, accommodation, welfare, and other facilities to enable the archaeological team to carry out the Targeted Watching Brief.

7.9.5 Particular responsibilities of the archaeological contractor include:

- To provide a suitably qualified and experienced team of archaeologist and appropriate specialists (in particular geoarchaeologists) to carry out the watching briefs and associated off-site works.
- In co-operation with the Principal Contractor, to produce a safe method of working for the sample excavation areas.
- To comply with, and contribute to, the Principal Contractor's health and safety regime, Environmental Management Plan, and other requirements, and reflect this in their Method Statement.
- For TWB: to record, excavate, and sample any *significant* archaeological remains (if present), and to record and sample important geoarchaeological sequences. The latter to be co-ordinated with similar work in the sample excavation areas (also the borehole evaluation results/cores), in order to produce a geoarchaeological record which covers the extent of the portal site.

7.10 Archaeological science

7.10.1 Investigation and sampling of archaeological, geoarchaeological, and palaeo-environmental deposits will be conducted following the site-specific sampling strategy and in accordance with section 7.K of *Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* (Crossrail, 2009e).

7.10.2 At North Woolwich Portal such methods are potentially required for all of the below-ground archaeological fieldwork, but in particular for the sample excavations and targeted watching brief for the portal.

7.10.3 Absolute dating (eg Radiocarbon or OSL) may well be required for floodplain deposits; samples for dating should be taken where appropriate. Multiple samples may be required from each major unit within selected stratigraphic sequences. Multiple determinations from contemporary samples or stratigraphic sequences should be considered for Bayesian analysis of the results, where appropriate.

8 Deliverables

8.1.1 The Archaeology contractor shall produce method statements, reports, site archives, digital data in accordance with section 8 of *Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* (Crossrail, 2009). Additional and site-specific considerations are listed below.

8.2 Archaeological Contractors Method Statement

- 8.2.1 The Archaeology Contractor's Method Statement(s) will include details of how they will conduct the sample excavation and the targeted watching brief, agreed with the Principal Contractor.
- 8.2.2 It will also include a preliminary geoarchaeological and environmental sampling strategy for the site. This will be developed during the course of the fieldwork, in conjunction with the Project Archaeologist, and if appropriate in consultation with the English Heritage Regional Science Advisor.

8.3 Fieldwork Reporting

- 8.3.1 Each fieldwork event requires:

- An Interim Statement
- A Survey Report
- A Fieldwork Report – incorporating a SMR/HER Summary Sheet (OASIS form)
- Summary Reports (Annual summaries for *London Archaeologist*, and for period journals such as *Post-Medieval Archaeology* where appropriate) submitted to the Project Archaeologist. These should conform to the guidance on submission dates and vocabulary at:
<http://www.museumoflondonarchaeology.org.uk/English/ArchiveResearch/Fieldwork-Roundup/> .

- 8.3.2 The individual fieldwork events requiring reporting are currently defined below, and shown on the programme in Annex 3. They may be revised by the Project Archaeologist in the light of archaeological results or project requirements.

- GWB Utility Diversions (2011–2012)
- NLBH Recording (2011)
- Geoarchaeological borehole evaluation (2011)
- GWB Site-set up (if required) (2012)
- GWB Guide walls + Sample Excavation + TWB portal excavations (all 2012–2013)

- 8.3.3 Where a fieldwork event is of sufficient duration, Summary Reports will be submitted to the Project Archaeologist for each event (site code) annually at the start of January. The signed-off summaries will be sent to LAARC (for *London Archaeologist*) by the annual submission date: the end of February each year (period journals differ).

9 Site Monitoring & Progress Reports

- 9.1.1 Weekly progress reports, other reporting, and site monitoring by the statutory consultees (eg GLAAS) will be conducted in accordance with section 9 of *Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* (Crossrail, 2009).

10 Personnel requirements

- 10.1.1 The Archaeology Contractor shall provide project personnel in accordance with section 10 of *Archaeology, Specification for Evaluation & Mitigation (including Watching Brief)* (Crossrail, 2009).

11 References and glossary of terms

11.1 References

- Brown, Duncan H, 2007, Archaeological Archives: A guide to best practice in creation, compilation, transfer and curation, Archaeological Archives Forum, ISBN 0948393912
- Brunning, R., 1996, Waterlogged wood. Guidelines on the recording, sampling, conservation and curation of waterlogged wood. English Heritage, London
- Canti, M., 1996, Guidelines for carrying out assessments in Geoarchaeology. Ancient Monuments Laboratory Report 34/96, English Heritage
- Crossrail, 2005, Assessment of Archaeology Impacts, Technical Report, Part 4 of 6, South-East Route Section: Isle of Dogs to Abbey Wood. Crossrail (doc no. 1E0318-E2E00-00001)
- Crossrail, 2006, Archaeological Programming Assessment, Report Number 1E0318-G0E00-00006 (Rev B)
- Crossrail, 2007, Archaeology Generic Written Scheme of Investigation, Document Number CR-PN-LWS-EN-SY-00001
- Crossrail, 2008a, MDC4 Archaeology, Geoarchaeological Deposit Model: Victoria Dock Portal (appendix to DDBA, doc no. CR-SD-PRW-X-IS-00001)
- Crossrail, 2008b, MDC4 Archaeology Planning and Environment, Package Specific WSI Deliverable, DDBA North Woolwich Portal, (doc no. CR-SD-PRW-X-IS-00005)
- Crossrail, 2008c, MDC4 Archaeology, Updated Baseline Assessment
- Crossrail, 2008d, Procedure for non-listed built heritage recording. Document number CR-PN-PRW-EN-PD-00010
- Crossrail, 2008e, Archaeological Monitoring of Ground Investigations, Borehole Package 11, Limehouse to North Woolwich
- Crossrail, 2009, Archaeology, Specification for Evaluation & Mitigation (including Watching Brief), Doc. No. CR-PN-LWS-EN-SP-00001 Ver. 0.3
- Crossrail (MOLA), 2010a, C156 – Central Project, Archaeological Monitoring of Ground Investigations, Borehole Package 19, Document Number: C156-CSY-T1-RGN-CR146_PT004-00004.
- Crossrail (MOLA), 2010b, Central Project, North Woolwich Portal & Plumstead Portal, Scope of Geoarchaeological Evaluations, Document Number: C156-CSY-T1-RSW-CR146_PT004-00001, Rev. 2.
- Crossrail 2010, C156 North Woolwich Portal Constructability Report (B 095), Document Number: C156-CSY-C-RGN-CR146-PT004-00001, Rev. 3.0, 13 October 2010
- Department of Communities and Local Government (DCLG), 2010, *Planning Policy Statement 5: Planning for the Historic Environment (PPS5)*
- English Heritage, 2000, Metric survey specifications for English Heritage, English Heritage, London
- English Heritage, 2001, Archaeometallurgy. Centre for Archaeology Guidelines 2001/01, English Heritage, London

- English Heritage, 2002, Environmental Archaeology. A guide to the theory and practice of methods, from sampling and recovery to post-excavation, Centre for Archaeology Guidelines 2002/01, English Heritage, London
- English Heritage, 2002a, Human Bones from Archaeological sites. Guidelines for producing assessment documents and analytical reports. Centre for Archaeology Guideline, unnumbered, English Heritage, London.
- English Heritage, 2006a, Guidelines on the X-radiography of Archaeological metalwork, English Heritage, London
- English Heritage, 2006b, Our portable past, English Heritage, London
- English Heritage, 2006c Understanding historic buildings: a guide to good recording practice, English Heritage, Swindon
- English Heritage, 2008a, Investigative Conservation Guidelines on how the detailed examination of artefacts from Archaeological sites can shed light on their manufacture and use, English Heritage, London
- English Heritage, 2008b, Luminescence dating. Guidelines, English Heritage, London
- English Heritage, July 2009, Standards for Archaeological Work, London Region, External Consultation Draft (replacing earlier GLAAS guidance) <http://www.english-heritage.org.uk/content/publications/docs/glaasstandspapersexternalconsultationdraft.pdf>
- English Heritage/Archaeological Leather Group 1995. Guidelines for the care of waterlogged Archaeological leather, English Heritage, London. Goodburn-Brown D. and UKIC Archaeology Section, revised edition 2001. Excavated Artefacts and Conservation UK Sites
- GLAAS 2009 Standards for Archaeological Work, London Region, External Consultation Draft (English Heritage)
- Goodburn-Brown D, and UKIC Archaeology Section, revised edition 2001, *Excavated Artefacts and Conservation UK Sites*
- Handley M, 1999, Microfilming Archaeological archives, IFA Paper 2
- Hillam, J., 1998, Dendrochronology: Guidelines on producing and interpreting dendrochronological data, English Heritage, London
- Institute of Field Archaeologists, 2001, Standard and guidance for Archaeological excavation, Reading
- Institute of Field Archaeologists, 2008a, Standard and guidance for Archaeological desk-based assessment. Reading
- Institute of Field Archaeologists, 2008b, Standard and guidance for an Archaeological watching brief, Reading
- Institute of Field Archaeologists, 2008c, Standard and guidelines for finds work, Reading
- Institute of Field Archaeologists, 2008d, Standard and guidance for the collection, documentation, conservation and research of Archaeological materials, Reading
- Institute of Field Archaeologists, 2008e, Standards and guidance: field evaluation, Reading
- Institute of Field Archaeologists, 2008f, Draft Standard and guidance for the creation, preparation, transfer and deposition of Archaeological archives, Reading

- McKinley, J. and Roberts, C., 1993, IFA Technical Paper 13: Excavation and post-excavation treatment of cremated and inhumed human remains. Institute of Field Archaeologists
- Museum of London, 1987, Finds Procedures Manual
- Museum of London, 1994, Archaeology Site Manual, 3rd edn.
www.museumoflondon.org.uk/laarc/guidelines/ASM_3edn_1994.pdf
- Museum of London, 1998, General Standards for the Preparation of Archaeological Archives deposited with the Museum of London
<http://www.museumoflondonarchaeology.org.uk/English/ArchiveResearch/DeposResource/GuideDep.htm>
- Museum of London, 1999, General Standards for the Preparation of Archaeological Archives deposited with the Museum of London, Supplement
- Museum of London (Nixon, T, McAdam, E, Tomber, R, and Swain, H), 2002, A Research Framework for London Archaeology 2002
- Nixon, T, McAdam, E, Tomber, R, and Swain, H, 2003, A Research Framework for London Archaeology 2002, Museum of London Archaeology Service
- Richards JD and Robinson D (eds), 2001, Digital archives from excavation and fieldwork: guide to good practice. 2nd edn. Archaeology Data Service
- Sidell, E J, Wilkinson, K N, Scaife, R G, and Cameron, N, 2000 The Holocene evolution of the London Thames: archaeological excavations (1991–8) for the London Underground Limited Jubilee Line Extension Project, MoLAS Monogr Ser 5, London
- Society of Museum Archaeologists, 1993, Selection, retention and dispersal of Archaeological collections. Guidelines for use in England, Northern Ireland, Scotland and Wales. SMA: London
- Victoria County History, Essex Volume 6
- Walker, K., 1990, Guidelines for the preparation of excavation archives for long-term storage, Archaeology Section of the United Kingdom Institute for Conservation
- Watkinson, D. and Neal, V., 1998, First Aid for Finds (3rd edition), RESCUE and the Archaeology Section of the United Kingdom Institute for Conservation

11.2 Glossary

ATD	Above Tunnel Datum. Tunnel Datum = Ordnance Datum plus 100m
BP	Before Present
BP	Years before present, conventionally taken to be 1950
Bronze Age	c 2000–650 BC
CDM	Construction (Design and Management) Regulations
DDBA	Detailed desk-based assessment(s)
Devensian	Geological era from 70,000 to 10,000 BP
DLR	Docklands Light Railway
EMR	Environmental Minimum Requirements
ES	Environmental Statement
Eyot	A small island (in this work, one within the existing or former courses of the Thames or its tributaries)
GLAAS	Greater London Archaeology Advisory Service (an English Heritage department providing archaeological advice to the planning departments of the London boroughs (excepting the City and Southwark))
LB	London Borough
m OD	Metres above Ordnance Datum (Newlyn). To obtain Tunnel Datum heights (m TD) add 100m to OD heights.
m TD	Tunnel Datum (Crossrail project datum, see above)
Medieval	AD 1066–1485
NLL	North London Line (former North Woolwich Line/North Woolwich Railway, opened 1847, closed 2006)
NR	Network Rail
OHLE	Overhead Line Equipment
OLE	Overhead Line Electrification
Palaeochannel	Deposits representing a former stream channel
Post-medieval	AD 1485–present
Roman (Romano-British)	AD 43–c 410
Saxon (early-medieval)	AD 410–1066



TBM	Tunnel boring machine.
TfL	Transport for London

Annex 1 – Figures

In WSI

Figure 1 Geoarchaeological deposit model (see Figure 4)

Figure 2 Location of archaeological trenches

In Annex 1

Figure 3 Location of archaeological trenches

Figure 4 Site Location Plan

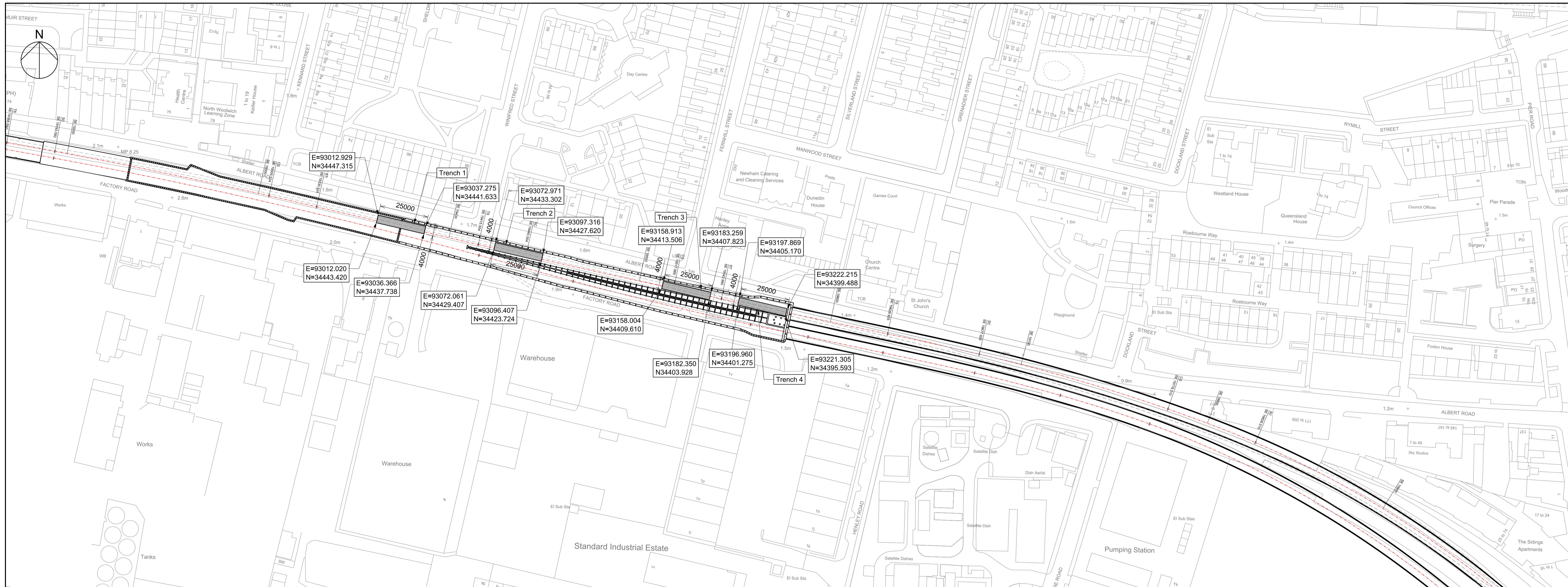
Figure 5 Landscape Zones

Figure 6 Ordnance Survey map 1869

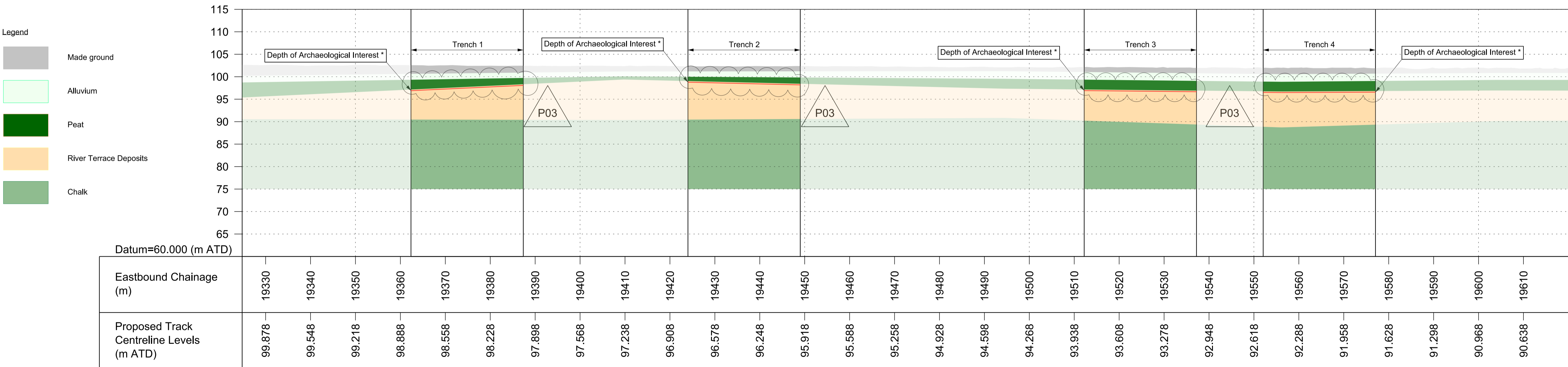
Figure 7 Ordnance Survey map 1894

Figure 8 Archaeological watching brief areas

Figure 9 Location of non-listed built heritage features



Plan
Scale 1:1000



Geological Profile
Scale 1:500 natural

Copy Approved for Design - Created: 25-APR-2012

Rev.	Date	Description	By	Chkd	App	Auth
P01	25/01/2012	First Issue	GK	MK	RM	-
P02	16/02/2012	Trench locations amended and geological profile added	GK	JR	RM	-
P03	23/04/2012	Updated to clarify depth of archaeological interest	GK	MK	PC	-

Notes

- This drawing is to be read in conjunction with Crossrail Document C156-CSY-T-RGN-CR148 PT004-50001 C156 North Woolwich Portal Site-Specific Archaeological Written Scheme of Investigation.
- Setting-out:
 - No Scaling from this drawing.
 - Coordinates to the London Survey Grid, heights to the London height datum which is 100 metres below Ordnance Datum Newlyn. See Crossrail standard CR-STD-010.
 - Any alterations to the proposed trench location are to be undertaken only through prior written agreement with Crossrail's Project Archaeologist.
 - No responsibility is taken for inaccuracies in Third-Party information provided for the purposes of producing this drawing.

3 Residual hazards:

- No risks have been identified, outside of those normal risks which should be recognised and addressed by a competent contractor.
- The residual risks to be addressed by the Principal Contractor and the Archaeological Contractor in their respective method statements should include, but not be limited to the following:
 - General site working
 - Deep excavation, falls from height (objects or people)
 - Safe access
 - Spoil location, removal and muck-away
 - Plant and machinery operation
 - Site traffic
 - Handling and lifting

VIII Power and Lighting
 IX Potential for contaminants/disease
 X Multiple Contractors (conflicts in working practices)
 XI Safe storage

* Excavate to a depth of greatest impact or archaeological sterile layer (likely top of River Terrace Deposits)

Legend
 --- Rail Centreline

20m 0 20m 40m 60m 80m 100m
 Scale: 1:1000

Contract: Bored Tunnels (Alignment and Track)
 Originator: Ove Arup & Partners Limited
 Location: Crossrail General
 Title: Archaeological Plan North Woolwich Portal
 By: G.KAVANAGH
 CHK: M.KEMP
 App: P.CHAMLEY
 Auth: ...

Crossrail
 25 Canada Square
 Canary Wharf
 London
 E14 5LQ

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 www.crossrail.co.uk

C310
 Scale: 1:1000@A1
 Drawing and CAD file No: C122-OVE-C2-DDA-CR001_Z-21703
 Rev: P03
 Suitability: S4

RESTRICTED

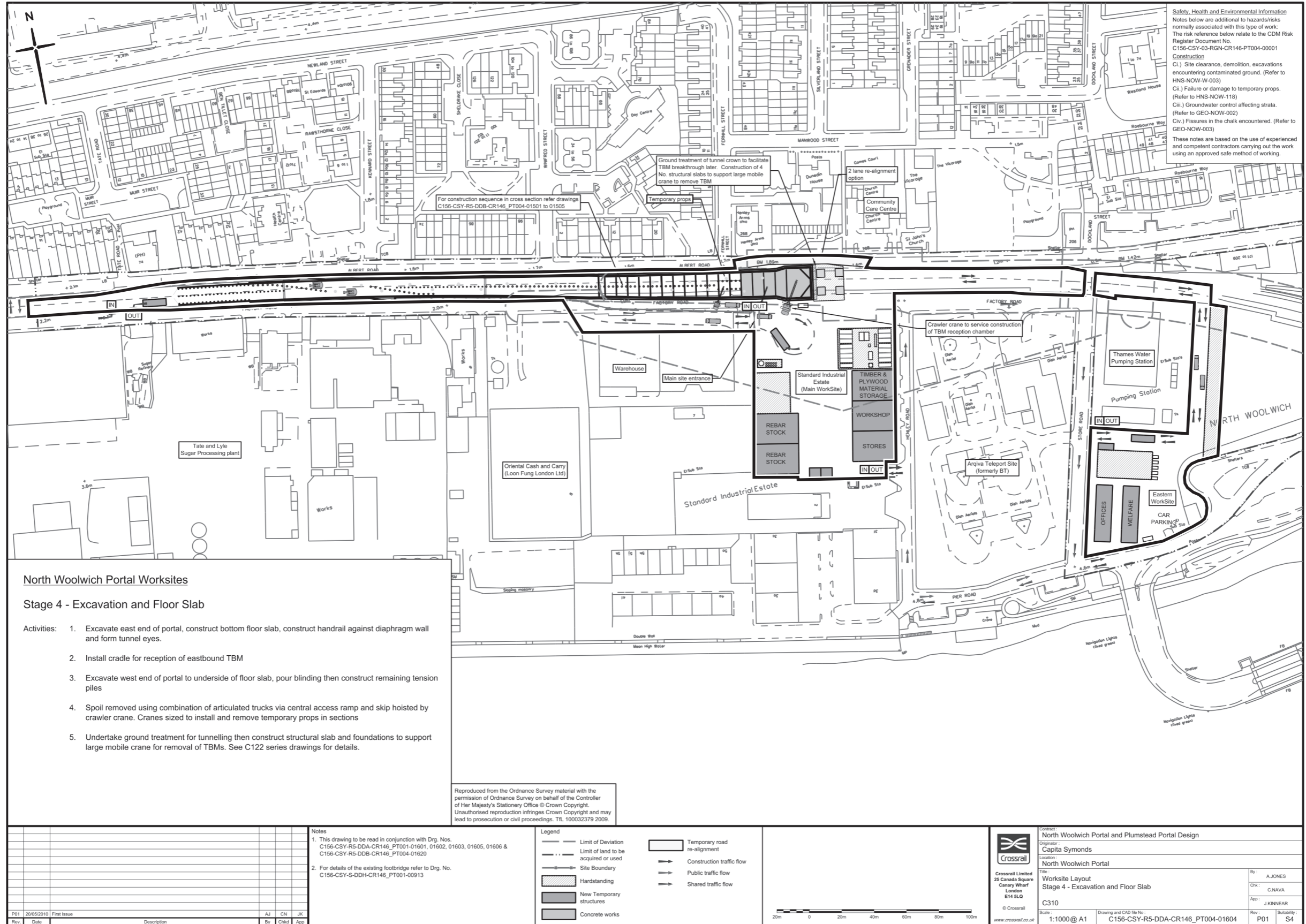


Figure 4 Site location plan

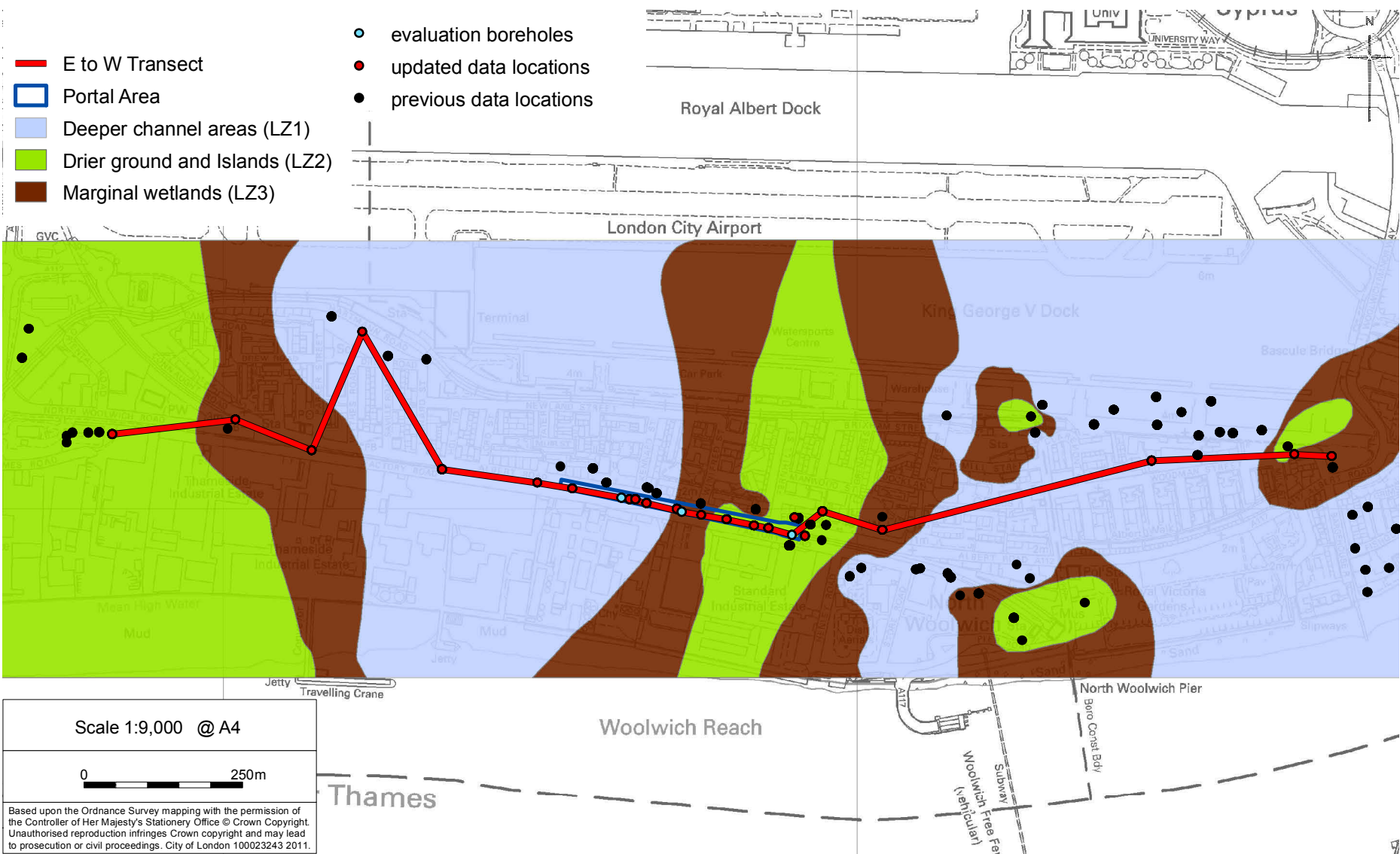


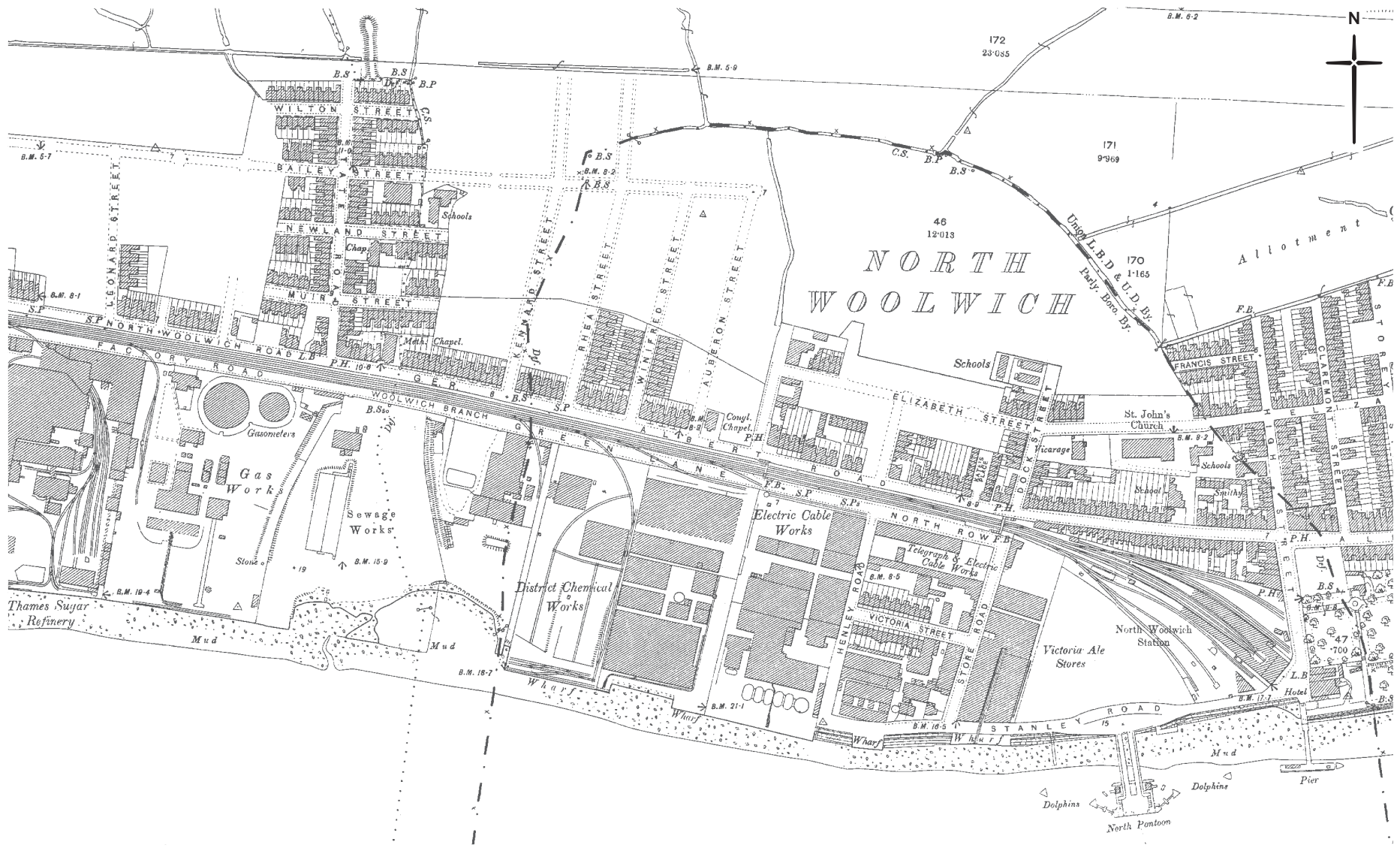
Fig 5 Landscape zones



MULTI1051WS10#03_INWP

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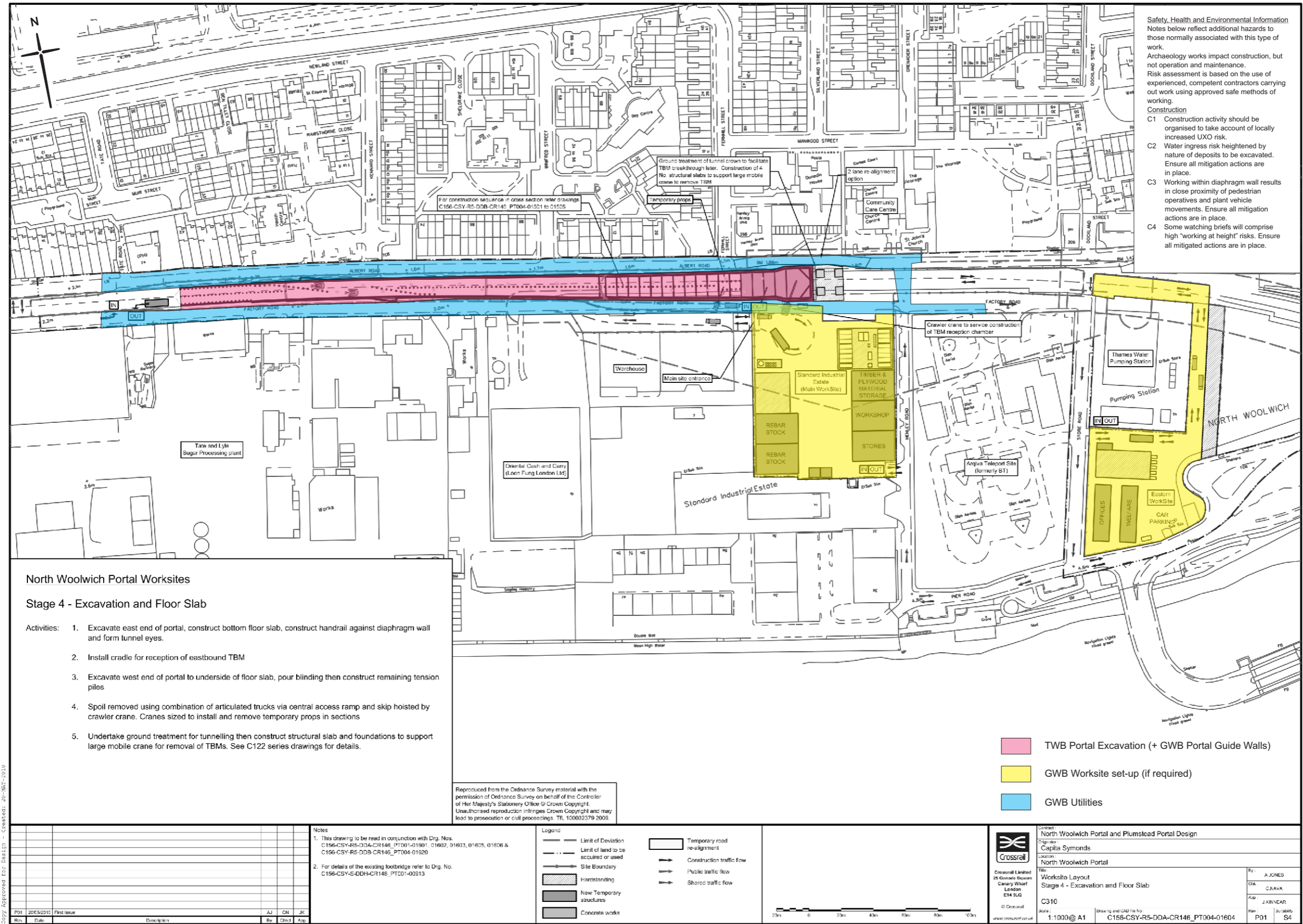
Figure 6 Ordnance Survey map 1869



MULTI1051WS10#04_INWP

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Figure 7 Ordnance Survey map 1894



Safety, Health and Environmental Information
 Notes below reflect additional hazards to those normally associated with this type of work.
 Archaeology works impact construction, but not operation and maintenance.
 Risk assessment is based on the use of experienced, competent contractors carrying out work using approved safe methods of working.
Construction
 C1 Construction activity should be organised to take account of locally increased UXO risk.
 C2 Water ingress risk heightened by nature of deposits to be excavated. Ensure all mitigation actions are in place.
 C3 Working within diaphragm wall results in close proximity of pedestrian operatives and plant vehicle movements. Ensure all mitigation actions are in place.
 C4 Some watching briefs will comprise high "working at height" risks. Ensure all mitigated actions are in place.

Figure 8 Archaeological watching brief areas

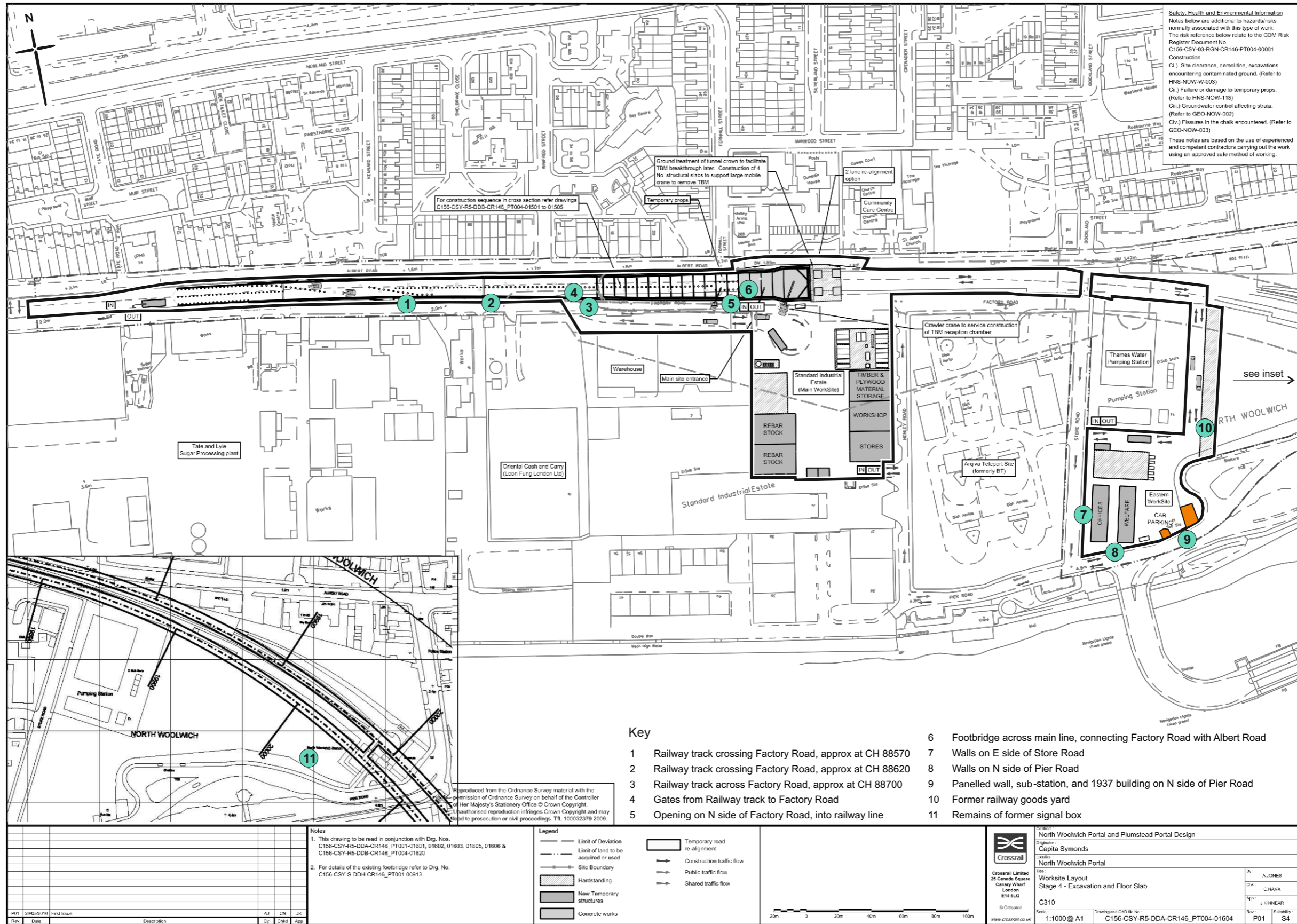


Figure 9 Location of non-listed built heritage features

Annex 2 – Engineering Plans and Drawings

- Portal Plan and Profile, sheet 1 (dwg. no. C156-CSY-S-DDL-CR146_PT0004-00051 Rev. P01)
- Portal Plan and Profile, sheet 2 (dwg. no. C156-CSY-S-DDL-CR146_PT0004-00052 Rev. P01)
- Geological Cross Section (dwg. no. C156-CSY-C2-DDH-CR146_PT0004-00051 Rev. P02)
- Demolition Worksite Clearance (dwg. no. C156-CSY-S-DDA-CR146_PT0004-00021 Rev. P01)
- Worksite Layout Stage 4 (dwg. no. C156-CSY-R5-DDA-CR146_PT0004-01604 Rev. P01)
- [Portal, typical construction sequence] Construction Sequence, Cut and Cover Tunnel, (dwg. no. C156-CSY-R5-DDB-CR146_PT0004-01502 Rev. P01)
- [Portal, typical construction sequence] Construction Sequence, Retained Cut with Secant Piled Wall, (dwg. no. C156-CSY-R5-DDB-CR146_PT0004-01504 Rev. P01)
- [Portal, shallow western end] Construction Sequence, Flood Wall (dwg. no. C156-CSY-R5-DDB-CR146_PT0004-01505 Rev. P01)
- General Arrangement Surface Structure Site Plan, Sheet 1 of 2 (dwg. no. C156-CSY-A-DDL-CR146_PT004-10100 Rev. P01)
- General Arrangement Surface Structure Site Plan, Sheet 2 of 2 (dwg. no. C156-CSY-A-DDL-CR146_PT004-10101 Rev. P01)
- General Arrangement Longitudinal Section (dwg. no. C156-CSY-A-DDB-CR146_PT004-20100 Rev. P01)
- North Woolwich - Portal Enabling Works - Utility Diversions Combined Proposals, Utility Diversions (dwg. no. CRL1-XRL-U-DDA-CR146_PT004-00006 Rev. PO5)

Annex 3 – Programme

To be confirmed by C310 during development of Method Statements – currently may/June 2012.

Annex 4 – Health & Safety Requirements

- Designer's Risk Assessment
- CDM requirements
- Archaeological Contractors risk assessments and Health and Safety Plans
- Archaeological Contractor's Safety Audits, Safety Inspections, Reporting of Accidents
- Personal Protective Equipment (PPE)
- Labelling of Hazardous Substances, Contaminated Land
- Crossrail Health and Safety Management System, Crossrail Drugs and Alcohol Policy
- Crossrail Policy for work on Network Rail Land



Designer's overall Risk Assessment

It is believed that there are no live railway utilities remaining in the disused NLL railway corridor over the length of the Portal and its worksites. However, for safety as an early activity in the construction programme, prior to any excavation or site clearance work, an intrusive survey should be undertaken, by the Contractor, to establish the status of any NR assets such as cables/cabinets and drainage in the original railway corridor.

Below is the Designers Risk Control Log Summary

Activity	Health Risk	ERIC	Possible Control Measure	Responsibility
General Site Working	All following	E	Site Specific Induction, toolbox talks etc.	<i>Main Contractor</i>
		R	Contractors' Method Statements and Risk Assessments to be approved in writing prior to working. All site staff to confirm that they have read and understood MS and RA	<i>Designer</i> <i>Main Contractor</i> <i>Archaeological Contractor</i>
		I	Zoning of site activities to prevent unnecessary overlap of working areas	<i>Designer</i> <i>Main Contractor</i> <i>Archaeological Contractor</i>
		C	Ensure all site staff are competent and aware of risks (e.g. CSCS cards)	<i>Main Contractor</i> <i>Archaeological Contractor</i>
	Contact with plant/machinery, trips, falls,	E	Zoning of site activities to prevent unnecessary overlap of working areas	<i>Designer</i> <i>Main Contractor</i> <i>Archaeological Contractor</i>
		R	Minimum PPE to be worn at all times to include Hi-Visibility clothing, Hard Hats, site safety boots, safety glasses, gloves.	<i>Main Contractor</i> <i>Archaeological Contractor</i>
		I	Zoning of site activities to prevent unnecessary overlap of working areas	<i>Designer</i> <i>Main Contractor</i> <i>Archaeological Contractor</i>

Activity	Health Risk	ERIC	Possible Control Measure	Responsibility
		C	Minimum PPE to be worn at all times to include Hi-Visibility clothing, Hard Hats, site safety boots, safety glasses, gloves.	<i>Main Contractor</i> <i>Archaeological Contractor</i>
	Contaminated land/disease etc	E	Geotechnical reports indicate risk of contamination due to previous site use as railway.	<i>Main Contractor</i>
		R	Geotechnical reports indicate risk of contamination due to previous site use as railway. Appropriate PPE to be provided by <i>Archaeological Contractor</i> as required.	<i>Archaeological Contractor</i>
		I	Any areas of contamination identified during excavation are to be reported and remedial measures put in place prior to further excavation.	<i>Main Contractor</i> <i>Archaeological Contractor</i>
		C	Staff required to wash hands before ingestion of food/drink etc.	<i>Main Contractor</i> <i>Archaeological Contractor</i>
			Welfare for hygiene etc. is to be provided by Main contractor at Archaeologist site office. To include washing facilities	<i>Main Contractor</i>
Deep	Falls from height,	E	n/a	

Activity	Health Risk	ERIC	Possible Control Measure	Responsibility
excavation Archaeological contractors will require access to deep excavations	tripping etc. Objects falling from height.	R	Dedicated Egress – ramping with edge guard is preferred option. Edge Guards/Heras fencing to be specified to provide barrier to deep excavation and prevent falls from objects into trench.	<i>Main contractor</i>
		I	n/a	
		C	Deep excavation signs	
	Burial from spoil or loose material falling into the trench	E	Working direction is to be controlled, with spoil delivered to a defined area or areas within the trench to be removed by machine directly into muck-away vehicles	<i>Designer Main Contractor Archaeological Contractor</i>
		R	Two routes are specified into trench (specific locations to be determined by <i>Main Contractor</i>)	<i>Designer Main Contractor</i>
		I	n/a	
		C	No spoil to be placed within 2m of trench edge	<i>Main Contractor Archaeological Contractor</i>
	Plant and Machinery	Proposed Archaeological contractor's working route towards proposed location of plant. Risk of contact with excavating machine arm, crushing etc.	E	n/a
R			Appropriate PPE to be provided	<i>Archaeological Contractor</i>
I			Ensure dedicated pedestrian routes away from arc of machine working	<i>Main Contractor</i>
C			Employ banksman	<i>Main Contractor</i>

Activity	Health Risk	ERIC	Possible Control Measure	Responsibility
Site Traffic	Risk of injury or death from contact with moving vehicles	E	Proposed working and storage area for <i>Archaeological Contractor</i> to be located away from site traffic routes	<i>Designer</i> <i>Main Contractor</i> <i>Archaeological Contractor</i>
		R	n/a	
		I	Controlled crossing points and separation of pedestrian/site traffic routes	<i>Main Contractor</i>
		C	n/a	
Use of hand tools	Possible injury resulting from use of hand tools, e.g. mattocks, trowels, spades	E	n/a	
		R	Appropriate training and PPE to be provided	<i>Archaeological Contractor</i>
		I	n/a	
		C	n/a	
Adverse Weather	Changeable ground conditions leading to trips and falls etc.	E	n/a	<i>Archaeological Contractor</i>
		R	Use of Youngmans boards or similar is to be specified for the transportation of spoil where appropriate	<i>Main Contractor</i>
		I	Appropriate finishing to egress ramps (e.g. compacted hardcore/rubble to provide sufficient purchase, edge guard etc.)	<i>Main Contractor</i>
		C	Appropriate PPE to be provided for adverse weather working	<i>Archaeological Contractor</i>
		Adverse weather conditions may	E	n/a

Activity	Health Risk	ERIC	Possible Control Measure	Responsibility
	require use of electrical equipment powered by generators (e.g. pumps, temporary lighting etc), with accompanying associated risks for electrocution etc.	R	Energy Supply methods and risk assessment to be detailed in Contractor's method statements	<i>Main Contractor</i>
		I	n/a	
		C	Only staff with appropriate training are to operate generators and other electrically operated equipment (for example pumps)	<i>Archaeological Contractor</i>
Buried utilities/services Existing utilities plan indicates main utilities corridors are routed primarily through road surfaces and are not present within area of proposed evaluation.	Hazardous contact with buried services e.g. electrical shock, gas leakage/explosion, contamination through contact with sewage etc.	E	This area is to be excluded from the archaeological design and identified on plan. <i>Main Contractor</i> to confirm that appropriate action has been taken to decommission services prior to archaeological investigation. <i>Main Contractor</i> to identify location of utilities/services in Method Statement and on plan.	<i>Designer</i> <i>Main Contractor</i>
		R	n/a	
		I	Surface sweep (e.g. CAT scan) to be undertaken prior to excavation by <i>Main Contractor</i> .	<i>Main Contractor</i>
		C	Banksman to be employed to watch for possible buried services/utilities	<i>Main Contractor</i>
			Appropriate PPE measures as outlined above for contamination	<i>Main Contractor</i> <i>Archaeological Contractor</i>

Activity	Health Risk	ERIC	Possible Control Measure	Responsibility
Natural Methane	May be present in areas of peat.	E	n/a	
		R	Avoid creating confined spaces where methane could accumulate	<i>Main Contractor</i>
		I	Ensure gas monitors are provided, and training for use, where appropriate	<i>Main Contractor</i> <i>Archaeological Contractor</i>
		C	Appropriate PPE measures as outlined above for contamination	<i>Main Contractor</i> <i>Archaeological Contractor</i>
Unexploded ordnances (UXO)	Records show there is a low risk	E	<i>Main Contractor</i> to employ UXO specialist to undertake site survey and probe for UXO	<i>Main Contractor</i>
		R	Briefing by UXO specialist to site staff where appropriate.	<i>Main Contractor</i>
		I	Potential UXO to be reported immediately to site manager and isolated. Any works halted.	<i>Main Contractor</i>
		C	Following identification Authorities to be informed. Procedures for remediation as set out in <i>Main Contractor's</i> method statement to be enacted	<i>Main Contractor</i>
Dewatering system doesn't draw water down effectively – increases risk of contaminated water in trench	The risk to archaeological contractors is considered to be low assuming mitigation measures are followed	E	Geotechnical reports indicate risk of contamination due to previous site use as railway.	<i>Main Contractor</i>
		R	Appropriate PPE to be provided by <i>Archaeological Contractor</i> as required.	<i>Archaeological Contractor</i>

Activity	Health Risk	ERIC	Possible Control Measure	Responsibility
		I	Remedial measures put in place prior to further excavation if water ingress becomes a risk	<i>Main Contractor</i> <i>Archaeological Contractor</i>
		C	Staff required to wash hands before ingestion of food/drink etc.	<i>Main Contractor</i> <i>Archaeological Contractor</i>

CDM requirements

The archaeological contractor for the watching briefs will be working under and reporting to the Principal Contractor and to the Crossrail Project Archaeologist and CDM Co-ordinator. The archaeological contractor will review and comply with the Principal Contractor's Construction Phase Plan under the CDM Regulations 2007.

For other requirements see the C263 Works Information forming part of the Crossrail contract for C263 Archaeology Late East.

Archaeological Contractors risk assessments and Health and Safety Plans

The archaeological contractor will prepare method statements, site-specific risk assessments and a health and safety plan to be approved by the Principal Contractor.

For other requirements see the C263 Works Information forming part of the Crossrail contract for C263 Archaeology Late East.

Archaeological Contractor's Safety Audits, Safety Inspections, Reporting of Accidents

See the C263 Works Information forming part of the Crossrail contract for C263 Archaeology Late East.

Personal Protective Equipment (PPE)

The minimum requirement is: hard hat, safety boots with toe and mid-sole protection (no rigger boots), gloves, safety goggles or glasses, and hi-visibility jacket or vest. Where necessary or required: ear defenders, flame-retardant overalls, and any other protection required for specific tasks.

For other requirements see the C263 Works Information forming part of the Crossrail contract for C263 Archaeology Late East.

Labelling of Hazardous Substances, Contaminated Land

See the C263 Works Information forming part of the Crossrail contract for C263 Archaeology Late East.

Crossrail Health and Safety Management System, Crossrail Drugs and Alcohol Policy

See the C263 Works Information forming part of the Crossrail contract for C263 Archaeology Late East.

Crossrail Policy for work on Network Rail Land

See the C263 Works Information forming part of the Crossrail contract for C263 Archaeology Late East.

Annex 5 – Environmental protection requirements

See the C263 Works Information forming part of the Crossrail contract for C263 Archaeology Late East.

Annex 6 – Enabling and temporary works design requirements, attendances and implementation

The Principal Contractor will provide Technical services and attendances to the archaeologists as set out below. This may require the installation of temporary works or other attendances such as pumping out, in order that the archaeologists may enter the works excavations safely.

The Principal Contractor will be responsible for supplying the necessary support items on site, to allow the archaeological investigations to be carried out safely. Those items in bold will be required – others may be required, depending on site conditions:

- **locating and making safe any live services or hazardous substances (above or below ground)**: preliminary services searches should be carried out by the Principal Contractor via the statutory undertakers etc, plus on-site inspection and testing where required. Where there is reason to believe from previous uses that the ground or adjacent buildings may be contaminated the Principal Contractor should make arrangements for advance inspection, sampling, testing and where necessary specialist remediation. The results of such surveys should be forwarded to the archaeological contractor *prior to commencement on site*. Any identified hazards will be addressed in the health and safety planning. Any unexpected hazards encountered during the investigations will also need to be made safe by the Principal Contractor before archaeological fieldwork may continue. In the event of the accidental disruption of a live service by archaeologists or sub-contractors under archaeological supervision the archaeological supervisor will inform both their project manager and the Principal Contractor and, when appropriate, call the relevant emergency number.
- **development of a safe method of working**: archaeologists will not be able to work within excavations whilst attendances (such as installing temporary support or removing spoil) are taking place, and when demolition, construction or heavy plant activity occurs adjacent or overhead.
- **Safety barriers** between archaeological work areas and construction work, in particular during ground reduction within the portal for sample excavation areas, and if required, Targeted Watching Brief.
- **accreditation and supervision of operatives, plant and equipment**, including supply of sufficient qualified banksmen to control plant movements
- **temporary support**: design, installation and maintenance of appropriate temporary support to excavations, where deeper than c 1.2m. Where such temporary support is not provided, archaeologists will not be able to enter the excavations, and will have to make observations and records from the surface, reducing the effectiveness and validity of that work as mitigation.
- **other safety measures in deep excavations** monitoring of air quality and provision of rescue facilities and equipment in any areas defined by the Principal Contractor as a

confined space. Where hoists are used in shored shafts less than 4m x 4m size the archaeological contractor's staff will leave the shaft before hoisting of buckets takes place. Beyond a depth of 3m within such shafts gas monitoring equipment will be required to ensure appropriate air quality for those working there. Where mechanical or electrical hoists are in use in larger excavation trenches, the area in which the hoist is in use must be clearly demarcated and no staff will enter this area while the hoist is being raised or lowered.

- **pumping-out** : a suitable method to keep the trenches dry, e.g. pumping into a previously investigated trench, to create a sump.
- **managerial services** – nominated points of contact for Principal Contractor and other key members of development team.
- *technical advice* to be available if required (e.g. via client or Principal Contractor's consulting engineer) re: protection of adjacent streets and buildings, removal of obstructions, depth of excavation, live services etc.
- **providing safe access** to the site and the specified archaeological investigation areas via separately identified pedestrian routes, signing, safety guard-rails, secure ladders etc. This includes segregating these areas from any vehicles and plant operating nearby e.g. via a robust physical barrier.
- adequate *ventilation and protection from noise, fumes and dust* where plant is in use, especially within standing buildings.
- **site accommodation** and welfare facilities with electricity and water. To include furnished main base cabin as work space; separate male/female changing areas, toilets and washing facilities; plus additional steel cabin for storing tools and finds.
- If required: *110v. site lighting* for access routes to excavations, plus individual task lighting within trenches (e.g. tripod-mounted spotlights). The need for lighting depends on the depth, season and weather conditions.
- **general site security** including hoardings, gateway, warning notices, etc; to create a secure site perimeter, sufficient to prevent unauthorised access. If the Principal Contractor has retained security guards, it is recommended that the archaeological investigation areas be added to their schedule for regular patrols, particularly out of hours.
- *specific site security*: it may be necessary to separately secure individual archaeological trenches via a physical barrier (such as Heras fencing) eg if there are public areas nearby or human remains are encountered.

Annex 7 – Security requirements

The archaeological contractor will comply with the Principal Contractor's Security Plan.

Human remains are not likely to be present on the North Woolwich Portal site. However, if they should be present, the Principal Contractor will need to provide secure storage on site for human remains, in advance of them being removed by the archaeological contractor.

See also general and specific site security in Annex 6.

Annex 8 – Need for screening or other protective works

Human remains are not likely to be present on the North Woolwich Portal site. However, if they should be present, the Principal Contractor will be required to screen them from public view, including buildings overlooking the site.

Such screening may include semi-opaque roofing if the public may see the relevant area(s) from above.

Annex 9 – Procedure for notification of the Discovery of Human Remains

In the case of unexpected discoveries the Crossrail procedures will be adhered to. The Project Archaeologist shall be informed immediately and the remains left in situ, covered and protected pending a decision on exhumation. If removal is essential, it should be undertaken under appropriate Ministry of Justice (Coroner's Division) licence and environmental health regulations. It will be necessary for the Principal Contractor to provide adequate site security, and screening (see Annex 8).

Annex 10 – Procedure for notification of the Discovery material falling under the Treasure Act 1996

All finds falling within the definitions of treasure (Treasure Act 1996) shall be reported immediately to the Project Archaeologist and all subsequent works must be undertaken in accordance with the relevant legislative requirements as set out in the Environmental Requirements (archaeology) section of the relevant package Works Information.

To protect the finds from theft, the archaeological contractor shall record the finds and remove them to a safe place. Where recording and removal is not feasible or appropriate on the day of discovery, the archaeological contractor shall ensure, in liaison with the Project Archaeologist, that adequate site security is provided by the Principal Contractor.

Annex 11 – Procedure for notification of major unexpected discoveries

In cases where unexpected discoveries cannot be preserved in situ, the response plan would revert to the normal Crossrail mitigation strategy of further archaeological investigation (preservation by record). The aim would be a rapid and commensurate response, targeted to just those remains unavoidably affected by the works. Recording and sampling methods would also be proportionate to the significance of the remains. Additional archaeological resources would be deployed to achieve this, in order to minimise any delay to the Principal Contractor's works. With flexibility and good communication it is often possible for the development works to continue in other areas while localised discoveries are recorded.