C263 LATE EAST

The Connaught Tunnel, Pumphouse and Air Vents: Non-Listed Built Heritage Recording

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1 Introduction

1.1 Summary site background and the proposed development

This report presents the results of the non-listed built heritage recording (NLBH), undertaken in advance of the refurbishment of the Connaught Tunnel and surface rail works at the following three sites:

- Connaught Tunnel West Worksite
- Connaught Tunnel Central Worksite
- Connaught Tunnel east Worksite (Silvertown)

The tunnel, which runs through all three of the above sites, is located in the London Borough of Newham, between Prince Regent Station and Victoria Dock Road to the north and Silvertown Station and Connaught Road/Factory Road to the south. (NGR 541050 180945 to 542060 180110 see Fig 1). The Connaught Tunnel passes beneath Connaught Passage, which connects Royal Victoria Dock to the west and Albert Dock to the east. The event code (sitecode) for the project is **XSY11**

The Connaught Tunnel was built in 1878 as part of the railway line between Stratford and North Woolwich. The 600m long brick lined tunnel was constructed by the cut-and-cover technique. The cutting and the brick structure were covered with concrete making the tunnel an early example of a mass-poured concrete structure. It incorporates arched buttresses at its northern and southern ends and traces of the former infrastructure are known to have survived after 2006 when the railway was closed. In 1935 the central section was lowered in order to allow the Connaught Passage to be deepened and the original central brick-lined, twin tunnel was replaced with a steel lining, again another innovation not used in Britain before. The tunnel also sustained minor bomb damaged during the Second World War.

Photo 1. The cutting and buttresses of the northern approach to the Connaught Tunnel, looking east

The surface structures comprise two air vents in the central area which appear on the surface as brick structures either side of the Connaught Passage and a single storey octagonal brick pumphouse, constructed to enable the drainage of the tunnel.

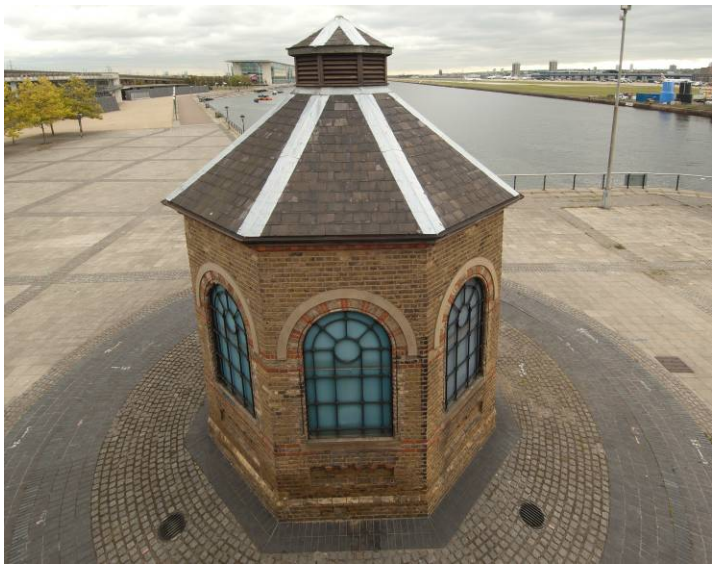

Photo 2. The pumphouse looking east from the Connaught Bridge

Photo 3. The air vent on the north side of the Connaught Passage looking east, with the pumphouse in the background.

The Connaught Tunnel site can be divided into three worksites, Worksite West, Worksite Central and Worksite East. All three of the worksites lie within an Archaeological Priority Zone as defined by the London Borough of Newham. The site does not include any scheduled monuments or listed buildings. The Connaught Tunnel lies within all three work sites and was considered to be of medium or local significance (Crossrail Document No. C122-OVE-T1-GMS-CR146_WS158-00002). The NLBH assessment (Crossrail Document No. C122-OVE-T1-GMS-CR146_WS158-00002) has identified the tunnel itself and the associated structures including a pump head house and two vent shafts as being of local significance. The immediate area around the pumphouse and the shaft vents has been subject to

comprehensive modern redevelopment and they stand out as the few clearly visible 19th century structures in the area. The pumphouse is due to be dismantled and its material components salvaged and stored, with a view to reinstatement at an alternative site in the future.

Photo 4 The pumphouse looking south.

1.2 Purpose

This document presents the results of the NLBH recording of Connaught Tunnel prior to alterations required for the reuse of the tunnel.

The existing tunnel and the adjacent section of surface railway require refurbishment and improvement in order to be incorporated into the south-east spur of the Crossrail Scheme, between Custom House Station and North Woolwich Portal. The existing tunnel will be enlarged during the refurbishment in order to enable the tunnels to be used by Crossrail trains. The area around Connaught Passage is to be used as a construction compound (central worksite) and two other worksites (west and east) are also planned.

1.3 Scope

The Non-listed Built Heritage (NLBH) recording forms part of the archaeological mitigation for Crossrail and the definition of NLBH follows Information Paper D22 Archaeology and Crossrail Generic WSI (Document Reference 14022008-44-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 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 industrial and defence archaeology of significance.

The fieldwork, conducted between 26/09/11 and 14/10/11, covered the structure of the Connaught Tunnel, its portals and cuttings, along with the Pumphouse and ventilation shafts adjacent. A further watching brief to monitor the removal of the steel rings and brickwork of the former twin tunnel in the dock passage area took place between 26/04/13 and 11/06/13, the results of which are discussed in an addendum to this report. All of the buildings and structures were recorded at Level 3 as defined by the English Heritage publication *Understanding Historic Buildings, a guide to good recording practice* (EH 2006).

As described in section 3.3.2 of the Crossrail Document *Method Statement Watching Briefs, Non Listed Building recording and trench evaluation, Connaught Tunnel* (document number: C263-MLA-X-RGN-CRG07-50023) the overall objective of the NLBH recording was to produce a Level 3 record of the tunnel before modifications were made to the structure.

2 Methodology and objectives

The NLBH recording was undertaken according to the methods and practices laid out in the Crossrail document *Connaught Tunnel and Surface Rail Non-Listed Built Heritage Assessment* (document number C122-OVE-T1-RSI-CR146_WS158-00001).

In addition the fieldwork, the off site analytical study and the reporting in this document comply with the relevant guidelines from the Institute for Archaeologists, (IFA 1996), English Heritage (EH 1991, GLAAS 1998, 2000, 2006 and 2008), the Museum of London Archaeology Health and Safety Policy (MOLA 2008), and the Museum of London Archaeology Service site manual (MoLAS1994).

The Crossrail document *Connaught Tunnel and Surface Rail Archaeological Written Scheme of Investigation* (document number C122-OVE-T1-GMS-CR146_WS158-00002) stated that the Connaught Tunnel should be subjected to a Level 3 Historic Building Record (as specified by English Heritage, 2008).

The survey subsequently by MOLA focussed on capturing a detailed record of the structures in their present state, prior to alteration. Details and surviving railway features within the tunnel were also drawn and/or photographed and their locations noted.

Photography included wide and general views along with detail of more complex or unusual features and those of architectural interest. A scale was used where appropriate.

Further to the on-site work, a programme of documentary archive research was undertaken, primarily at the Museum of London Docklands (Sainsbury's Study Centre), London Metropolitan Archives, the Guildhall Library and the National Archives.

The specific research aims for the recording were laid out in the Crossrail document *Method Statement Watching Briefs, Non Listed Building recording and trench evaluation, Connaught Tunnel* (document Number: C263-MLA-X-RGN-CRG07-50023) and are as follows:

- Are any features present that can be related to the initial construction of the North Woolwich Railway in the 1840s?
- What is the relationship of the Connaught Tunnel, its drainage and adjacent pumphouse, and the construction of the Royal Alert Dock?
- What evidence is there for modifications to the Connaught Tunnel over time?

Further to the specified aims above were the following objectives:

- To investigate the fabric of the structure before demolition/alteration/refurbishment, with the aim of elucidating its structural history, and record and analyse the resulting evidence for this history using applicable archaeological methods.
- To make a record of the existing building in its present condition, by means of photography, measured survey where necessary and annotated sketches.
- To carry out an appropriate level of documentary research in order to give a written account of the structure.
- To report the results in suitable form in accordance with Crossrail requirements, and archive the records.

3 Comprehensive historical account of the Connaught Tunnel

The Connaught Tunnel was constructed between 1876-8 by the London & St. Katharine Docks Company (L&SKDC). Its purpose was to transport trains running on the North Woolwich Line of the Great Eastern Railway Company (GERC) underneath an eastern extension to the Victoria Dock between Custom House and Silvertown. This dock extension was opened in June 1880 and was known as the Royal Albert Dock.

The Victoria Dock opened in 1855 and was specifically intended to berth steam ships, in particular those carrying grain (royaldockstrust.org.uk). The dock was the first purpose-built dock integrated into the rail network (Connor 2000, vi), a factor probably influenced by George Parker Bidder who was instrumental in the construction of both the docks and the North Woolwich line which served them (Wood 2004). By the 1870s it had become apparent that the capacity of the dock was not great enough to accommodate the increasing size of ocean-going vessels (L&SKDC 1880, 4). The General Manager of the L&SKDC voiced concerns that many of their bigger clients such as the P&O Line had threatened to remove their custom if their ships were not better accommodated (MLDSSC 5/15/221, 14-15).

A committee was formed in early 1874 to discuss the potential for extending the dock three miles to the east as far as Gallions Reach. Significant members of the Committee on Victoria Dock Extension included the L&SKDC Chairman, George Chambers; the General Manager, Colonel Martindale who had made a name for himself as a railway engineer in New South Wales, Australia (Sydney Morning Herald 1904, 12); and Colonel William Yolland. This last figure had been an influential member of the Ordnance Survey, was appointed as an inspector of railways by the Board of Trade in 1854 (later the chief inspector from 1877) and was a noted early advocate of safety on the railways and he went on to serve on the Board of Inquiry into the Tay Bridge Disaster of 1879 (Vetch 1990, 322-3). Also serving on the committee was the civil engineer Alexander Meadows Rendel whose previous experience included the construction of the Albert Dock, Leith (Hume 1976, 187-9) and as a consultant for several Indian railways (Venn 1924, 274). Rendel was nominated by the L&SKDC to design the new dock extension (MLDSSC 5/15/221, 3).

It was immediately apparent to the Dock Extension Committee, during their meeting dated 25th February 1874, that the presence of the North Woolwich railway line would cross the path of the proposed extension and their immediate concern was how to overcome this obstruction (MLDSSC 5/15/221, 3). The initial construction of the Victoria Dock in the 1850s had caused a similar problem to the one posed in 1874 as the original route of the North Woolwich Line had run across the site of the entrance to the dock at Bow Creek. The dock entrance there was spanned by a swing-bridge but this had slowed down the railway services to such an extent that the line was subsequently diverted to the north and east of the dock via Custom House and the earlier alignment was retained purely for goods traffic (Connor 2000, vi). Given that the new extension was planned to link the Victoria Dock with Gallions Reach to the east it was not be possible to further divert the railway and therefore the L&SKDC were forced to consider either a bridge or a tunnel.

Initially the Committee were in favour of constructing a tunnel beneath the extension, a preposition firmly advocated by Colonel Yolland given that a bridge would lead to greater disruption to shipping and was morally questionable on grounds of railway safety (MLDSSC 5/15/221, 6-7, 17). It was also pointed out by Rendel that the arrangements laid down for the GERC by an act of Parliament would practically close the bridge to the Docks Company for all but one hour a day and that the railway company would undoubtedly look for compensation for any disruptions to their own services (MLDSSC 5/15/221, 12). Rendel was dispatched to prepare plans and estimates of the docks and methods of carrying the railway (MLDSSC 5/15/221, 9) and reported back on 19th June 1874 that a swing-bridge would cost £30,000 whereas a tunnel would be £100,000. The Committee then discussed the implications of payments of compensation to the railway company both during the period of construction and for the potential disruption to the GERC which would be caused by shipping if a bridge was chosen. It was agreed that the total cost of constructing the dock with a tunnel would amount to £700,000.

Subsequent to the Committee meeting of 19th June 1874 it was reported that the GERC had obtained Parliamentary consent to construct a footpath across part of the proposed dock extension on land owned by the L&SKDC (MLDSSC 5/15/221, 17). This had a very negative, almost panicked, effect on the Committee and the plans to construct a tunnel were immediately shelved during the meeting of 13th July 1874. The Committee felt that as the GERC was in favourable position with Parliament the construction of a tunnel was unfeasible, whereas George Chambers stated that recent communication with the railway company indicated that they would not oppose the bridge project (MLDSSC 5/15/221, 18). When the General Meeting of the L&SKDC took place five days later it was unanimously agreed to proceed and apply to Parliament for the eastern extension with a bridge at an estimated cost of £500,000 (MLDSSC 5/15/219).

Just over a year later it was reported in the General Meeting of 29th July that permission for the extension had been granted by Parliament and that very little obstruction was given by the GERC (MLDSSC 5/15/219). The fact that the project progressed so smoothly is somewhat surprising given that George Chambers had previously stated on 10th October 1874 that "*Matters were not so favourable with the Great Eastern Ry. Co.* [sic] *and it was to be feared that they would oppose this Compy*. [sic] *in every possible way*" (MLDSSC 5/15/221, 20). It is however very significant that a new member was added to the committee during that very meeting - the marine civil engineer and Liberal MP for Tower Hamlets, Joseph d'Aguilar Samuda. Clearly the L&SKDC were lobbying Parliament to ensure that the project was received favourably. Samuda also seems to have been instrumental in reigniting the Committee's interest in constructing a tunnel as the minute-keeper recorded that: "*Mr Samuda anticipated opposition with regard to the bridge and enquired whether large ships would be likely to want to come up the Dock above the bridge. Further, whether, if offered, the Company could take the scheme without the bridge; and argue subsequently with the Ry. Coy*.[sic] *as regards tunnel or bridge, and obtain the sanction of the Board of Trade*" (MLDSSC 5/15/221, 24)

The arguments between the L&SKDC and GERC were eventually quelled and a fitting solution to the problem of the railway was found as on 29th July it was also reported that: "*an Agreement has been entered into, the result of which is not only to effect an immediate saving, but to establish direct Railway communication between the Victoria and London Docks, from which great benefits may be expected to accrue to both Railway and Dock Companies*" (MLDSSC 5/15/219). Rather surprisingly this solution involved the construction of both a swing-bridge *and* a tunnel, with the

majority of the railway traffic using the tunnel unless it was temporarily unavailable in which case they would be able to use the bridge without impediment (Connor 2000, vi-vii).

Records of the General Meetings during 1876, 1877, 1878 and 1879 refer to the swift and unimpeded progress of the dock extension until it was confirmed on 29th July 1879 that "*the Railway Tunnel between the Custom House and Silvertown has been opened for public traffic*" (MLDSSC 5/15/219). The dock extension, now known as the Royal Albert Dock, was formally opened in June 1880 by Prince Arthur, Duke of Connaught and Strathearn, the seventh son of Queen Victoria (L&SKDC 1880, 2). Fittingly. the bridge was named the Connaught Bridge and the stretch of canal linking the Victoria and Albert Docks was named the Connaught Passage, the tunnel itself was more usually called the Silvertown Tunnel in documents contemporary with its construction (MLDSSC 7/59/0001-0003), only being associated with the Connaught monika in the later 20th century.

The tunnel was constructed using the cut-and-cover method (see Section 4.3 for a technical description of the structure and building materials) and featured a relatively steep 1 in 50 gradient. Its initial build consisted of Portland cement concrete lined cuttings to north and south with 15 brick and concrete flying buttresses which entered via portals into a single-coursed brick and cement arch. The structure was enclosed below and to the sides by concrete and above by clay. The section underneath the Connaught Passage was divided into a twin-tunnel arrangement for strength with a brick central wall (Fig 2 and Fig 3). All refuges along the length of the tunnel date from this initial construction as do the air vents and the initial build of the associated pumphouse and shaft (MLDSSC 7/59/0001-0003).

The tunnel featured in two news items related in The Times. The first, in 1891, was a report on the inquest of an attempted murder and subsequent suicide. A bombardier at Woolwich Arsenal named Charles George Lucy attempted to shoot his fiancé Louisa Purchase whilst under extreme stress created by fairly substantial debts. Louisa Purchase survived, however Charles Lucy turned the gun on himself. This all occurred as the train that they were travelling on passed through the tunnel, and the jury even recommended that the GERC should in future light the tunnel (The Times 1981, 5). In 1904, two boys were charged with maliciously attempting to alter the railway signals at the tunnel which resulted in both receiving 12 strokes of the birch (The Times 1904, 14)

The Royal Victoria and Albert Docks passed into the ownership of the Port of London Authority (PLA) in 1909, and the North Woolwich Line became owned by the London & North Eastern Railway from 1923 following amalgamation of the GERC with several other companies. The PLA proposed a scheme to deepen the Connaught Passage to 31 feet (9.45m) in March 1935 in order to accommodate the exponentially increasing size of ocean-going vessels as the passage became the principal entrance to the Victoria Dock from 1930 after the Bow Creek gates were closed to all but barge traffic. These works required that the 4 foot 6 inches (1.37m) thickness of brickwork of the central section of the tunnel were to be reduced to only 1 foot 6 inches (0.45m), a structural change which was to be mitigated by strengthening the twin-tunnels with cast-steel linings (Liddell 1939, 292).

The tender for the scheme was won by Messrs. Charles Brand & Sons Ltd of Merton, Surrey and the project was begun on 7th October 1935. Brand & Sons remit consisted of:

"*(i) The strengthening by cast-steel lining, for a length of approximately 160 feet, of each of the twin tunnels*

(ii) The construction eastward of the tunnels a cast-iron subway under the passage with two cast iron shafts for the diversion of the mains.

(iii) The deepening of the passage by removel of brickwork, etc., over the twin tunnels, existing culverts, and pipe-trenches." (Liddell 1939, 292).

This was the first time that cast-steel tunnel-linings had been used in the United Kingdom however "BSS30: Castings for Marine Purposes" was used as an engineering guidance for the metalwork which gave a tensile strength of 26 to 35 tons per square inch (Liddell 1939, 293). Such was the success of this system that Brand & Sons were commissioned to bore the pilot tunnel under the Thames at Dartford in 1938 (The Times 1938, 9). Contemporary photographs show the work in progress (Fig 6) during November 1935 and also make it clear that access to the works in the tunnel was via the southern ventilation shaft (Fig 7). The scheme was completed on 28 March 1936 at a total cost of £40,200 (Robson Liddell 1939).

Photographs taken during works on the docks in July 1937 (Fig 8) demonstrate that the tunnel pumphouse was once surrounded by a complex of buildings and dock cranes. Also evident in the photograph from 1937 is the scar of a pitched roof structure which once abutted the north elevation of the pumphouse which was presumably accessed via the blocked up doorway which is visible on the extant structure. No evidence of this roof-scar survives at the present time.

The tunnel sustained damage during World War 2 as a result of the extensive campaign across the Docklands by the Luftwaffe aerial bombardment. The eastern side of the northern single tunnel section was penetrated by a bomb and later repaired with concrete reinforced with a steel mesh (Brown & Pembroke 2010, 12). There was also an accident in the tunnel during the war years when the 8.25am train from Woolwich to Stratford collided with the rear of the preceding train derailing three carriages. Fortunately no passengers were seriously injured (The Times 1945, 2).

The PLA extended the width of Connaught Passage from 80 feet (24.38m) to 100 feet (30.48m) by removing and replacing the southern canal-side wall in 1959. A cofferdam was created and where the soffit of the tunnel arch was revealed the brickwork was removed and replaced with reinforced concrete. This did not quite seal the tunnel from leaks and as a result lead plugs were inserted where necessary and grouting was carried out internally (Glover 1969, 422-5).

The whole length of the tunnel is blackened with soot from the coal-fired steam engines that utilised the North Woolwich Line (Photo 30). However, two photographs of railway traffic entering the concrete cuttings demonstrate the transition from steam to diesel. The first, dated March 25 1961 shows a Class N7/5 0-6-2T steam engine entering the tunnel (Connor 2000, Plate 72); by 1965 diesel electric locomotives such as the BTH Type 1 were utilising the tunnel (Great Eastern Railway Society 1987, Plate 32).

The tunnel and the North Woolwich Line ceased to operate on December 9 2006 due to the development of the Docklands Light Railway (disused-stations.org.uk). In 2008 the tunnel was used as a location in the Guy Ritchie film Rock'n'Rolla (imdb.com).

4 Description of the buildings

4.1 The Pumphouse

4.1.1 Exterior

The Pumphouse is octagonal in plan (Fig 12) and situated on the north side of the Connaught Passage, the waterway which links the Victoria and Albert Docks. It is also situated on the eastern side of the Connaught Tunnel which at present it continues to serve after 133 years, pumping water from the tunnel that flows into its shaft via a culvert. The water is pumped back into the Royal Albert Dock to the east. The National Grid reference for the approximate centre of the building is 541688 108657.

The building on the surface is a small, brick built, single storey, plinth built structure using yellow Gault bricks in English bond (Photo 5). Finer red stock bricks are used for decorative effect externally and form two pairs of string courses, one pair being at the level of the spring of the arched windows (of which there are five), the second pair being level with the window sills.

Photo 5. The entrance and southern façade of the pumphouse looking north

A third type of brick, a light whitish-yellow in colour is used within the space between each string course of red brick, though there is a variation in the thickness of the two string courses formed. The upper arrangement is thicker and has one course of red brick above and one below, with two courses of whitish-yellow bricks between (four bricks thick in total). The lower string course at sill level has two courses of red brick divided by a single course of whitish-yellow bricks (three bricks thick in total)

Further red bricks are used to form dentils at the tops of the recessed panels which are situated below each window (Photo 8). Red bricks also appear, again forming a line of dentils below the eaves at the top of the building. Throughout the building the standard dimensions of all of the bricks used are breadth: 105mm, length: 220mm and thickness: 60mm. The angled corners of the building are formed using King closer bricks in all three main brick types (Photo 6).

Photo 6. The south west corner of the building looking north showing the three main brick types used in the building's construction, note the King closer bricks on the corner.

The roof reflects the octagonal nature of the building, a pitch rising from each façade (Fig 12). The building is roofed with grey slate and has lead flashing along the edge of each roof segment. At its pinnacle the roof is capped with a louvered timber vent, which is also roofed in slate with lead flashing.

As mentioned above there are five windows in the building. These are in the east, south east, south west, west and north-west walls. However an original sixth window existed in the north east wall and the width of the window has been kept, along with its sill (though repaired with concrete) whilst the area of wall between the top of the former window and the eaves of the roof has been removed, maintaining the width of the window and the whole opening covered by a timber slatted grill or louvered screen to allow for ventilation (Photo 7). An identical louvered screen arrangement has been inserted above the door in the southern façade of the building (Photo 5).

The north façade appears never to have been fenestrated though the three course segmental arch of a small blocked doorway is clearly visible. When the doorway was bricked up an attempt was made to continue the decorative band at sill level in the brickwork as the two lines of red bricks continue in this later blocking (Photo 7).

The arched windows and the door are edged by bricks with a roll moulding which terminates at a level just above the sill on the windows and just above the plinth around the door (

Photo 8). In addition, around the windows down to the level of sill and around the door down to ground level, the lighter whitish/yellow bricks are used to form a bonded pattern against the yellow stock brick of the remainder of the wall.

Photo 7. The north east façade with the timber louvers and the north façade with the segmental arch visible from a blocked former doorway

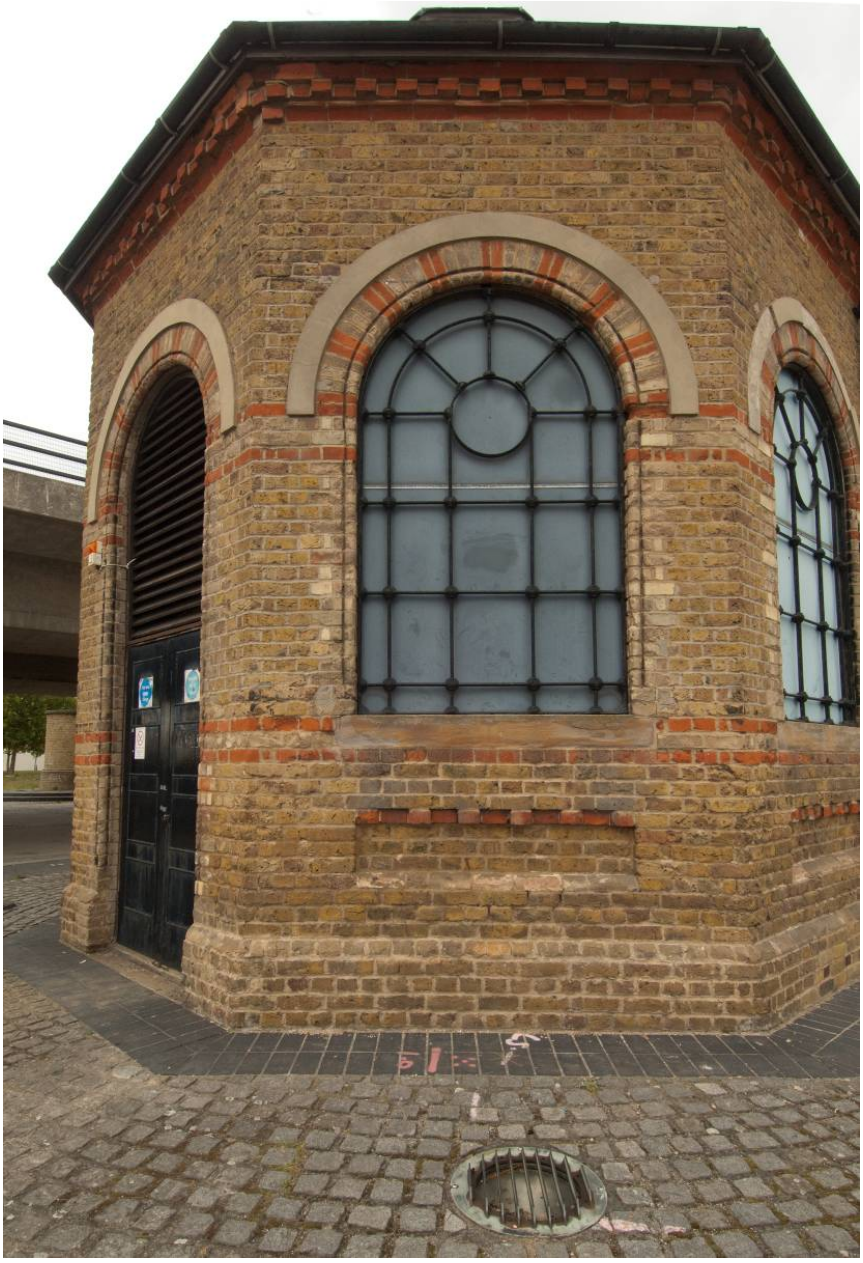

Photo 8. The south eastern façade of the building looking north west, showing decorative brickwork features.

The roll moulding continues over the arches of the windows and the entrance door where finer and narrower rubbed bricks are used. This area is also patterned as two bricks in red are followed by three in whitish/yellow, the sequence continuing over the arch, which is topped by a narrow arch of render. The render appears to be modern. The photograph of the building taken in 1935 (see Fig 8) indicates that the dentil pattern was originally repeated over the window arches.

The original window glass has been removed and an opaque plastic material put in its place. The decorative metal frames within each window are likely to be the original frames visible in the photograph from 1935 (see Fig 8), as the close examination of their form clearly indicated that they had originally held individual panes of glass in each section. The photograph from 1935 (Fig 8) shows that the circular panes of glass at the top of the window originally opened on horizontal pivots.

In the north western façade at plinth level is a single course segmental brick arch situated to the left of centre (Photo 9). It would seem likely that this was originally a low level window allowing some natural light to illuminate the upper levels of the pump shaft.

Photo 9. The single course segmental brick arch in the north western façade.

4.1.2 The changes to the exterior 1970s–1990s

A series of photographs taken in 1977 and held at the London Metropolitan Archive, show the pumphouse from various angles (Fig 9, Fig 10 and Fig 11) and illustrate the poor state of repair of the building at this time. The Crossrail document, *Connaught Tunnel Scope of Works: Pump Shaft Condition Survey* reproduces a series of drawings of the pumphouse made for the London Docklands Development Corporation by Halcrow in 1992, when various repairs and refurbishments were made to the building, possibly the first repairs since the photographs were taken in 1977. The changes include the removal and replacement of the render above the window arches (though the render removed in 1992 was probably that shown in the photos of 1977 which was not original, as the photograph from 1935 (Fig 8) shows that the dentil pattern was originally repeated over the arch), the replacement of the north east window with the louvers, the removal of an original fanlight above the

double entrance door (visible in Fig 9) and its replacement with the present timber louvered fanlight visible in Photo 5. The 1992 drawings show the earlier (but probably not original) entrance door was also replaced with the four panelled double doors visible in Photo 5. Timbers adjoining the window on the west elevation were removed as were unspecified redundant external fittings. The brickwork repaired and the surfaces were made good in which may explain why the scar of a former pitched roof of an adjoining single storey structure on the north elevation that is visible in the 1935 photograph (Fig 8), is no longer clearly visible today (Photo 7) .

4.1.3 Interior

The pumphouse interior is accessed through the double doors in the southern façade of the building. The interior is open to the roof which is covered with boarding, set at an alternate angle within each of the eight sections of the roof, which as a whole, forms a herring bone pattern (Photo 10). Two pairs of substantial timbers run west to east across the roof space, resting on the wall plate. These do not appear to give structural support to the roof and are likely to have enabled machinery and parts to be hoisted up and down the pump shaft below. Two wheel-pullies are evident, one mounted on the northernmost of the four west to east timbers (Photo 12) and a second mounted at the south east corner (Photo 13). These both appear to be too small to have enabled the lifting of all but the lightest pieces of machinery. In the central louver smaller horizontal boards are used whilst a king post resting upon two cross beams supports the structure (Photo 11).

Photo 10. The interior of the roof of the pumphouse, looking up and to the north.

Photo 11. Detail of the interior of the louver in the pumphouse roof, with the king post resting on the two small cross beams.

Photo 12 left and Photo 13 right. The two pulleys within the pumphouse. The left pulley was mounted on the northernmost cross timber, the right in the south east corner.

The interior of the building was undecorated and a simple frame had been inserted into each of the arched window spaces to support the opaque plastic glazing (Photo 14). The timber floor, supported by large timber joists ran around the opening of the shaft with a width of approximately 0.88m. A modern staircase ran down into the shaft from the north west (Photo 14). The south-western part of the shaft opening had been covered over in order to enable the instillation of a modern hoist (Photo 15). This was supported from below the floor by a joist, probably of wrought iron, which had tapered vertical flanges along its length suggesting a 19th century date (Photo 16).

Photo 14. The interior of the pumphouse looking north west, with the steps into the shaft and the blocked doorway in the north elevation.

Photo 15. The interior of the pumphouse looking north showing the modern hoist.

Photo 16. The possible 19th century wrought iron joist across the centre of the shaft opening, used to support the modern hoist.

The shaft is lined with brick and covered with a grey cement render. Access down into the shaft is provided by a modern steel step ladder which leads onto each of the six steel platform levels that reach down to the bottom of the shaft. The original ladder access, set within a recess in the brick is clearly visible (Photo 17) though it has been disturbed in some areas by the insertion of the modern steel platforms. In other areas, in particular on the northern face of the shaft the cut ends of iron joists are visible. Presumably these would have supported the original (possibly timber) platform levels, removed and replaced by the current steel arrangement.

There is an inverted brick arch that runs west to east at the base of the shaft, whilst a circular inlet is situated on the southern side of the shaft at its base. The original, hydraulic powered iron pumping mechanism also survives on the southern face of the shaft (Photo 18). Two long hydraulic powered piston pumps are fixed to the side of the shaft, the movable upper part being mounted on timber runners. At the head of each piston a short, fat pipe connects the pump to a pipe that runs the entire height of the shaft (Photo 19). This extractor pipe is narrow in its lower section where it is in contact with the water and then widens where it connects to the hydraulic pump. The increased width continues up to the top of the shaft where the pipe turns to run horizontally into the southern face of the shaft. The movement of the pistons up and down on the runners would have provided both the suction to draw water up through the narrow part of the adjacent pipe, and the pressure to pump the water up the remaining, wider section of the pipe and then out to the south, probably into the Connaught passage. The power for the original pumping mechanism is without doubt hydraulic as the distinctive oval shaped joins between pipes are visible within the shaft. The supply of water under pressure to power the pumps is likely to have come from the dock company's own hydraulic accumulator tower, though a steam engine to maintain pressure may have originally been housed in the pumphouse.

Interestingly there is a large spherical electric pump, now abandoned with its power cables cut, lying at the bottom of the shaft. This appears to have been an initial replacement for the hydraulic mechanism and it reused the easternmost of the two earlier extractor pipe, pumping water up and out to the south. However this in turn has been replaced by the new current mechanism, which is again electric. Two

electric pumps push water up wide rubber pipes up and out through a new outlet to the north west of the shaft and into the Royal Albert Dock, instead of to the south.

Photo 17. The original step ladder access into the shaft, set within a recess in the western side of the shaft wall, looking west.

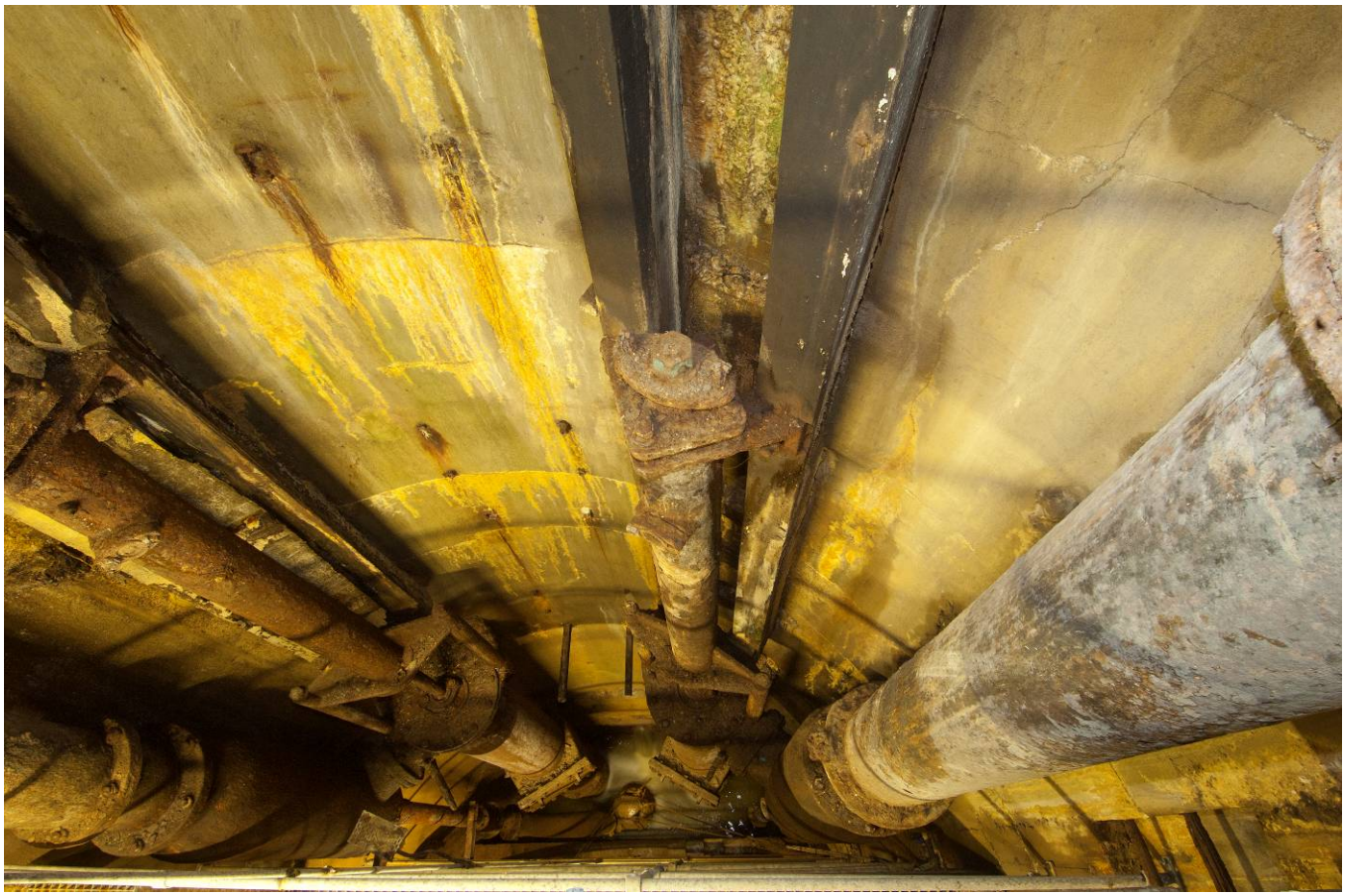

Photo 18. The original pumping mechanism of 1878 on the southern side of the shaft, looking down and to the south. The westernmost of the two hydraulic pistons is in the centre of the photo, the other is on the left.

Photo 19. The view looking up and to the south east at one of the two hydraulic pistons and its connection to the extractor pipe which continues up to the top of the shaft and out to the south.

Photo 20. The base of the shaft showing the inlet with water flowing in from the Connaught Tunnel. The earlier abandoned electrical pump is partially submerged in the centre of the photograph.

4.2 The brick air vents

The two identical ventilation shafts are situated either side of the Connaught Passage and take the form of brick built cylindrical structures. In relation to the tunnel which the vents serve, they are situated at the north and south ends of the central, twin section of tunnel (Photo 30) and would have allowed steam and smoke to exit from this lower, more confined part of the tunnel. The GER's original plans and section drawings (Fig 2) demonstrate that the air vents were part of the original design of the tunnel, dating to 1876.

The twin section of the tunnel runs for approximately 106m along the south-western elevation of the central dividing wall, with the north-west vent lying 29.04m west-north-west of the pumphouse and the south-eastern vent 86.84m SSE of the pumphouse. Above ground the vents stand 3.69m high upon a late 20th century stepped podium 0.27m high made of blue bricks and granite sets. Each vent plinth is 3.03m wide x 0.85m high and culminates in two courses of chamfered bricks 0.15m high which reduce with external diameter of the vent to 2.78m for 2.57m in height. The fabric of the vents is yellow London stock brick coursed entirely in snapped headers 65mm thick and 95-110mm in breadth. Both vents have concrete copings 0.12m high which overhang the brickwork by 0.1m; the concrete copings are a post-1935 replacement of original stone copings which are visible in (MLDSSC 23896 – Album B: 30323; (Fig 7).

Internally the open shafts are faced with coursed stretcher bond brickwork (see Photo 21) and are approximately 2.45m in diameter internally and 14.69m in height from the track bed to the top of the exterior brickwork.

The bottom of the shafts are 5.21m above the ballast surface, or track bed of the tunnel below and both have a half-round aperture through the crown of the tunnel vault formed of four courses of headers, with an additional bullnosed course around its rim.

Photo 21. The southern air vent structure with the pumphouse in the background, the northern air vent is just visible behind the Connaught Bridge in the far left of the photo.

4.3 The Connaught Tunnel

The Connaught Tunnel runs from the north west to the south east and originally carried the North Woolwich Line of the Great Eastern Railway Company (GERC) underneath the Connaught Passage, which was a short section of canal and an eastern extension to the Royal Victoria Dock linking it with its neighbour the Royal Albert Dock. The various component parts of the tunnel are (beginning from north to the centre of the tunnel) the cutting with its buttresses, through the north portal into the single tunnel, brick twin tunnel and the steel twin tunnel. This sequence is then repeated in reverse to the south from the steel twin tunnel, the southern brick twin tunnel, the southern single tunnel and its portal and finally the southern cutting and buttresses.

4.3.1 The north cutting

At the north portal the concrete retaining walls of the cutting begin approximately 280m to the west of the north portal. There is a capped buttress at the western end of the north cutting wall and here the cutting wall makes a short return to the north. (see Photo 22). The southern cutting wall terminates in an identical capped buttress though any return to the south as seen ion the north wall, has been removed.

Photo 22. The northern entrance to the cutting of the Connaught Tunnel looking east.

The cutting is 7.28m in width with walls formed from mass concrete. The concrete contains gravel which was locally dug and mixed with Portland cement in the ration of 1:7 (Halcrow 1989). The concrete appears to have been poured into long shutters without any vertical joints, resulting in continuous horizontal bands or lifts of concrete between 0.75m and 1m in thickness.

At a high level in the cutting walls at the northern end in the approach to the buttresses are eight regular square scars, in matching pairs on both north and south cutting walls, some with a surviving bolt in each corner These indicate the positions of the steel props that were installed in 1988 to prevent movement during the instillation of drainage pipes below the north cutting (Halcrow 1989).

At the first of the 15 arched buttresses that transect the cutting, the top of the cutting wall reaches a height above the adjacent ground of approximately 1.4m. This height above ground level of the top of the cutting wall is maintained until the portal. Meanwhile as the cutting drops in depth as the tunnel portal is approached the tops of the buttresses are set at gradually decreasing depths in relation to the top of the cutting wall. This gradual decrease in the height of the buttresses in relation to ground level can be seen in Photo 23, taken from ground level, but is not easily perceptible from within the cutting at track bed level.

The arched buttresses are equally spaced, just under 5m apart. They are formed from a three course brick segmental arch which spans the cutting wall, with mass concrete above. The horizontal joints between the different concrete pouring episodes are continued into the arch, indicating that the arches were part of the original construction and built at the same time, using the same technique as the cutting walls.

Photo 23. The first or westernmost of the arched buttresses in the approach to the north portal looking south east. Note the gradual increase in depth of the buttresses to the left.

Photo 24. The buttresses of the north cutting looking west.

Within the cutting walls are a series of refuges, six in the north wall and seven in the south, each spaced approximately 39m apart, though the two lines of refuges are offset from each other. This means that any person on the track would only need to

cover a maximum distance of 19.5m in order to reach a refuge. In the cuttings the refuges are formed within the concrete but the height, width and depth of the refuge, along with the regularity of their spacing does not alter in the brick built sections of the tunnel (see *Photo 25*).

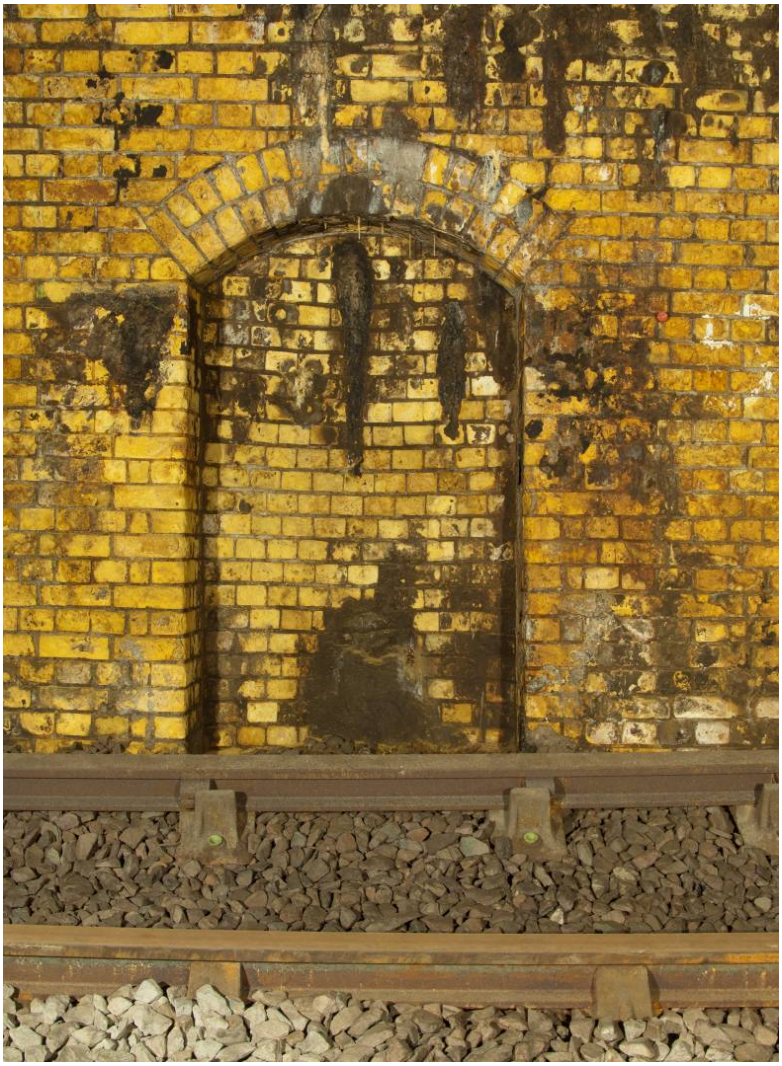

Photo 25 A typical refuge within the north wall of the northern single tunnel section.

The last two buttresses of the cutting in the approach to the north tunnel portal are covered over by the modern concrete structure that supports the road which leads from Royal Albert Way to the Festoon Way Roundabout (see *Photo 26*).

Photo 26 The view east towards the approach to the north portal of the tunnel covered by the concrete structure of the modern road.

Photo 27 The north portal of the tunnel, looking east.

4.3.2 The north single tunnel section

The north portal to the tunnel leads into the northern single tunnel section (Photo 27), approximately 6.12m in height. At the portal the arch is constructed of seven courses, the bricks on the inner course or the edge of the portal being bull-nosed. Above the brick arch of the portal the concrete continues up to ground level and a plaque simply inscribed with the year1878 is located centrally above the brick arch. The plaque has chamfered edges and may be of Portland roach bed stone rather than a cement render (or similar) as the figures of the inscribed date appear sharp. There also

appear to be shell like inclusions in the stone, particularly visible on the plaque above the south portal (Photo 43), which are a common trait of Portland stone. The bricks used in the tunnel's construction are yellow Gault bricks, which were supplied by Aylesford Pottery Company (Halcrow, 1989) with a Portland cement mortar.

Within the north single tunnel section is an area of repaired Second World War bomb damage (Photo 28). The repair was done by shuttering the interior of the tunnel with concrete poured over reinforcing bars, some of which are visible at the eastern end of the repaired area. During this repair the opportunity seems to have been taken to address drainage problems and a drain pipe was inserted. At present a plastic replacement for the original, carries water down into a central drainage culvert that runs below the track bed. This brick built culvert can be seen in the original GER section drawings (Fig 2).

Photo 28. The area of bomb damage repair in the northern single tunnel section, looking north west. Note the reinforcing bars on the right within the concrete and the inserted drain pipe.

The brickwork along the sides of the tunnel is in English bond, up to a height of approximately 2.2m above the present track bed. Though much of the brick surface is covered with soot it is clear that at this height there is a change in bond to stretcher bond (Photo 29) which forms the barrel vaulting for the top of the tunnel. Within a distance of approximately 2.6m along the length of this change in bond, a course of stretchers is gradually added or inserted, starting at first with a thinly cut slice of a brick, gradually increasing in thickness until a whole brick appears in the sequence, with a thin slice of brick beneath and the process continues again. This allows the diameter of the barrel vault to increases as the tunnel widens from 7.5mm at the entrance to the tunnel to 10m wide where the tunnel divides in two. As a consequence of the tunnel getting wider, the height of the tunnel also increases from 6.12m at the single portal to 7.5m where it enters the twin tunnel section.

Photo 29. The change in brick bonding from English to stretcher in the northern single tunnel section and the gradual insertion of an extra course of stretcher bricks from left to right.

This enlarging aspect of the tunnel is shared in both this area around the northern vent shaft, as well as the corresponding area around the southern vent shaft, and at both points the single tunnels fan out or widen and increase in height as they approach the twin tunnels. This is not easily perceptible for the observer within the tunnel itself. However the original plans for the tunnel show this slight widening and it can be seen in the recent plans of the tunnel in this report (Fig 13). The north single tunnel begins to enlarge approximately 96m from the junction with the twin tunnel, whilst the southern single tunnel fans out only 45m from the southern twin tunnels.

The north section of the single tunnel is approximately 245m in length from the portal to its south eastern end. Both the north cutting and the north single tunnel gradually turn from a west to east orientation to a south-eastern curve over a total distance of approximately 525m. At the south-eastern end of the northern single tunnel is the junction with the north twin tunnel section (Photo 30). Here the base, or bell mouth of the northern air vent is situated centrally above and between the two portals of the

brick built, northern twin tunnel section. One half of the base of the shaft forms a semi-circular recess, with a flat base, within the cross wall above the twin portals, whilst the other half of the shaft base is within arch of the single tunnel (Photo 31). This semi circular aperture has four courses of headers, with a course of bull-nosed bricks around its rim (Photo 31). The change from the single tunnel to the twin tunnel is marked by a break in the brick bond as the lines of brick courses from the single to the twin tunnel do not correspond. In addition, the twin tunnels are built with a brick plinth 0.25m in height, projecting 0.07m from the tunnel walls.

Photo 30. The junction between the north single tunnel and the north twin tunnel sections, with the base of air shaft, looking south east.

Photo 31. The view up and to the south east at the north [portals of the twin tunnels showing the base of the northern air shaft.

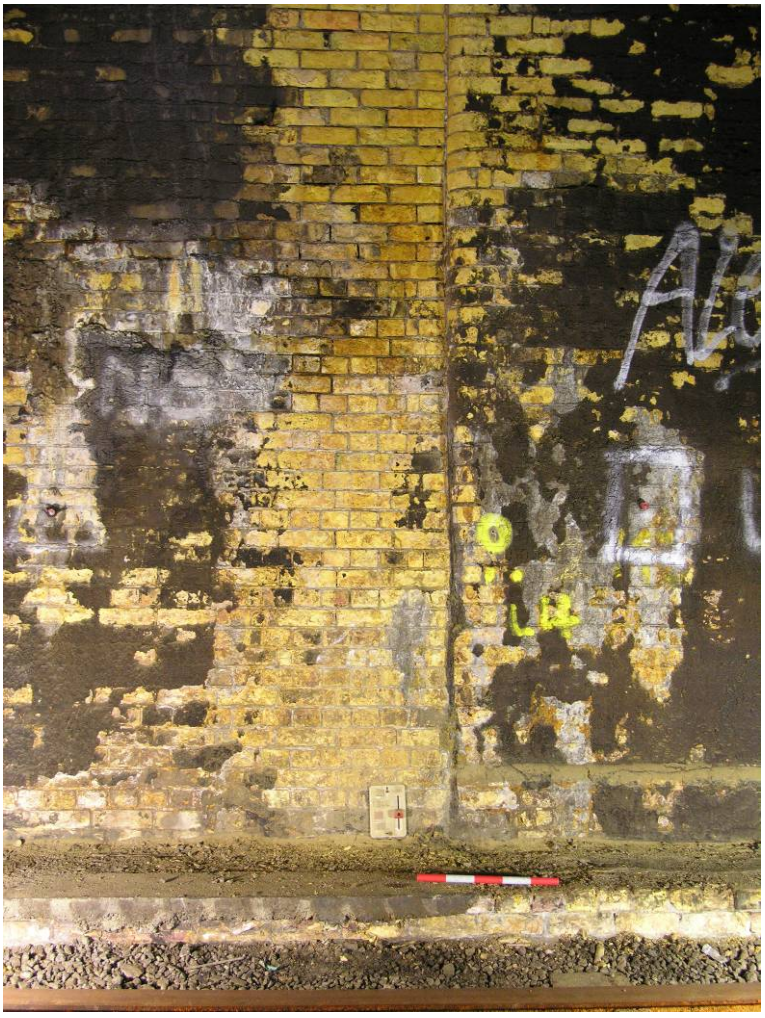

Photo 32. The junction between the north sections of the single and brick twin tunnels, looking north, showing the break in bond and the plinth of the twin tunnel in the bottom right.

Not immediately noticeable in the single tunnel are the brick built edge platforms or walkways on either side of the tunnel at the base of the tunnel walls. These are hidden in the single tunnel by ballast, but around the junction between the single and twin tunnels these become more prominent, emerging from the ballast to a height of 0.35m above the track bed and continuing throughout the length of the twin tunnels (see Photo 32 and Photo 34).

A plastic gutter and drain have been fitted to carry water from the air shaft down into the culvert below the track bed. An area of modern concrete is visible where the drain enters the track bed, which is adjacent to a square timber, 0.26m thick, with chamfered edges, rising 0.27m above the track bed. The size of the timber suggests it continued a considerable distance below the track bed. The timber may be the base of a former post which has been cut short, or alternatively it may relate to the modification works to the drainage below the track bed in order to accommodate the flow from the shaft above (Photo 33).

Photo 33. The timber in the track bed between the north portals of the twin tunnel.

4.3.3 The north brick twin tunnel section

The north section of the brick lined twin tunnels is approximately 30m in length and runs from north west to south east. There is no connection between the two tunnels and they are both identical with the exception that the western tunnel has two refuges, one at the north end and one at the south, whilst the eastern tunnel has only one refuge at its southern end. The refuges are built with the same dimensions as those of the single tunnel, though there is a break in brick plinth (not present in the single tunnel) to allow for each refuge.

Photo 34. The southern end of the western brick twin tunnel, looking south east towards the steel twin section with a refuge on the left.

The walls of the brick twin tunnels are built of Gault bricks in English bond up to a height of 2.7m where the bond changes to stretcher as the vault of the tunnel roof begins. There is no gradual increase in height with the gradual addition of stretcher courses as there is in the single tunnel. The twin tunnels are approximately 5.2m in height from the track bed which represents an overall drop in the height of the tunnel at this point of around 3.3m. This drop in height was part of the original designs of the tunnel to allow the railway to pass beneath the Connaught Passage.

4.3.4 The central steel lined section

As the brick built, northern twin tunnel section finishes the brick walkways on either side of the tunnels terminate in a concrete ramp, leading up to a higher concrete walkway, 0.55m–0.6m above the track bed (Photo 34 and Photo 38). The next section of tunnel is lined with cast steel plates bolted together forming a ring and each of the two sections central of tunnel has a total of 80 cast steel rings. At the junction between brick built twin sections (both north and south) and the central steel twin tunnel the height drops to approximately 4.4m within the steel section. Therefore 0.8m or just over 2½ feet was the amount by which the tunnel needed to be lowered in 1935 (see Fig 6), in order to allow the Connaught Passage to be deepened. This is less than a figure given in an article in the Institution of Civil Engineers Journal in 1939, where the depth of the Connaught Road Passage is stated as having been increased in depth from 28 feet to 31 feet (Robson Liddell 1939).

The work to increase the depth of the Connaught Passage in 1935 (work that needed divers and miners in a diving bell) required the reduction of the cover of brickwork over the twin tunnel from 4 feet 6 inches to just 1 foot 6 inches (Robson Liddell 1939). This removal of three feet of brickwork was made possible by the strengthening of the tunnel with the steel lining, a technique not used in Britain before. The steel was finely manufactured to a tolerance of, or accuracy of 1/64th of an inch and cast “in accordance with castings for marine purposes of quality 26 to 35 tons per square inch tensile strength” (Robson Liddell 1939).

The steel panels that form the rings have an outer flange and are all 0.54m wide internally (1 foot 9 and ½ inches), with the total width including the two 1 ¼ inch flanges at 0.61m (2 feet). However there is considerable variation in their length, some being 1.83m (6 feet) or 1.54m (5 feet ½ inch), whilst the smaller panels are 1.32m (4 feet 4 inches), with the smallest at 0.388m (1 foot 3 and ¼ inches). Each ring is made from a combination of all the various sizes of panel bolted together with 1 ¾ inch bolts (45mm) with 2 ¾ inch washers (7mm). The rings are fitted together in an alternating or staggered arrangement so that no two panels of the same size are side by side (Photo 35). According to the Institute of Engineers Journal of 1935 each ring was assembled prior to the machining of the circumferential joints and water tightness was achieved between the circumferential joints with the use of a “red-headed hemp grummet” as well as lead grummets, the joints being electrically seam welded, whilst the inner face of the steel lining was coated with a mixture of coal tar, Russian tallow and unslaked lime.

Photo 35 the view north west along the western section of steel lined twin tunnel.

There are two cross passages built into the steel section, approximately 17.8m apart within the central wall, allowing access between the two tunnels (Photo 36), a feature not seen elsewhere in the brick twin sections of the tunnel, and none appear to b depicted on the original drawings of the tunnel (Fig 2, Fig 3 and Fig 5). Whilst the drainage in the brick built section of the single tunnel utilises a brick built culvert beneath the track bed within the inverted arch (visible in the original drawings, see Fig 3), the steel lined section of the tunnel has an open culvert below the sleepers of the railway track (Photo 37). This presumably links to the two culverts serving the brick twin sections, which connects to the single culvert in the single tunnel.

Originally two brick culverts ran alongside the tunnel to the south-west, whilst a brick sewer, oval in profile, ran alongside to the north east. These can be seen illustrated at the bottom left of the original engineering drawings of the brick twin tunnels (Fig 5). These culverts, occasionally assumed by some to be service passages, have long since been abandoned (Glover 1969), and were not observed during the heritage survey. The same original drawings of the tunnel show the tunnel in plan and the depiction of central area includes the location of the pump house and the culvert that leads from the tunnel into its shaft.

Photo 36 the northernmost of the two cross passages in the steel lined section of the tunnel, looking north east.

Photo 37. The open culvert running beneath the sleepers in the steel lined section of the tunnel.

4.3.5 The southern brick twin tunnel

The southern junction between the steel lined twin tunnel and the southern brick twin tunnel is comparable to the northern junction as the amount by which the height of the steel section is reduced is the same. Similarly the concrete walkways either side of the steel lined section of twin tunnels ends in a ramp down to the lower level of a brick built walkway a drop of approximately 0.36m and identical to that seen in the north section of twin tunnel. The southern brick built twin tunnels are in the region of 35m in length and the eastern tunnel has two refuges, one at its north end on the west wall and one at the south end on its east wall, whilst the western tunnel has one refuge at its north end on the western wall (see plan of central tunnel area).

Photo 38 The junction between the steel lined twin tunnel and the southern brick twin section, looking south.

4.3.6 The southern shaft, bell mouth and tunnel

The southern brick twin tunnel joins the southern single tunnel in an identical manner to that seen in the northern part of the tunnel. The fanning out of the single tunnel is again evident but here it is over a shorter distance of approximately 45m. The bell mouth at the base of the southern air vent is built in the same manner as that of the north, though the modern drainage of the shaft is configured without a gutter (Photo 39)

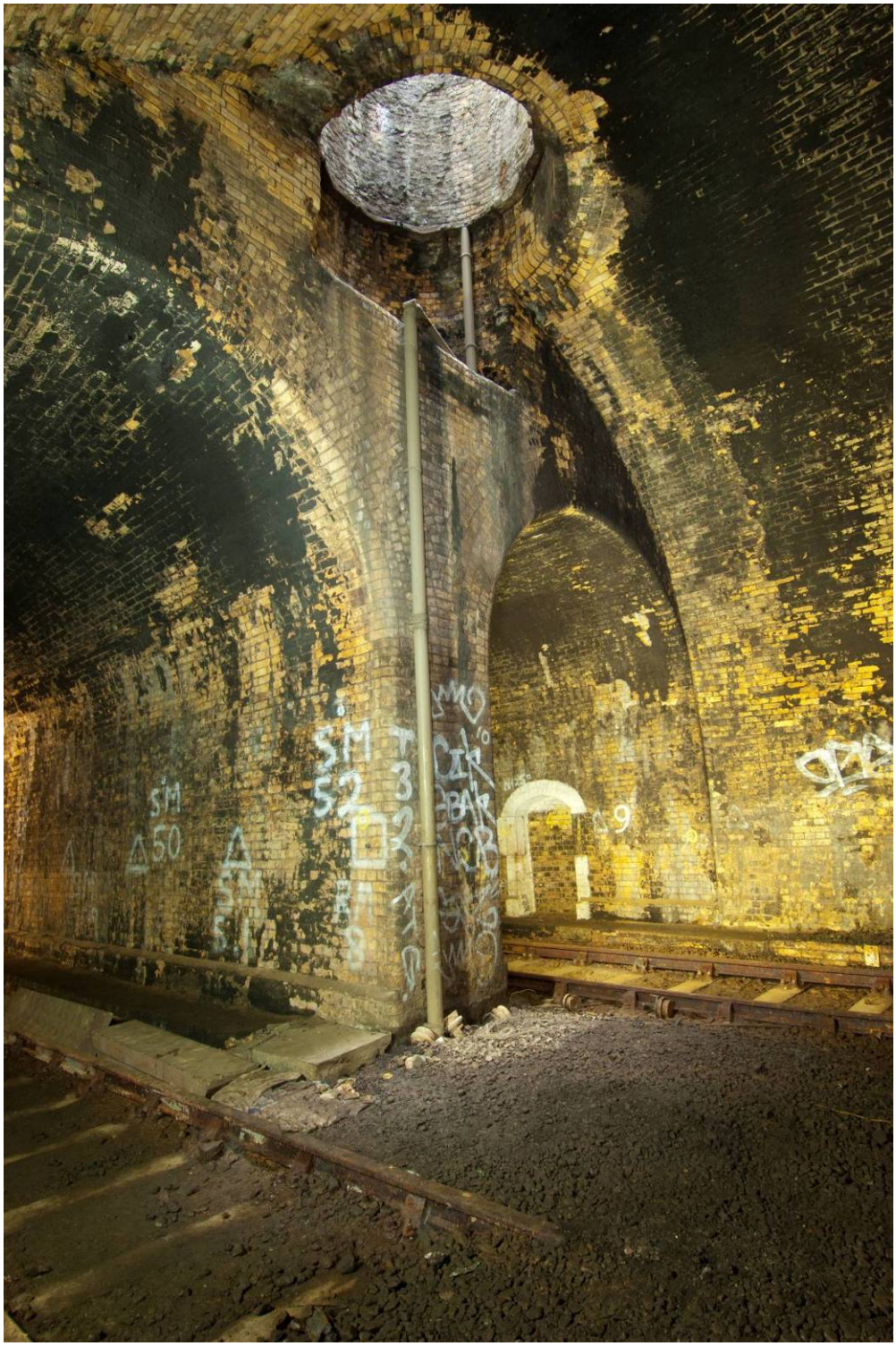

Photo 39 The junction between the southern twin and single sections of tunnel with the bell mouth of the vent shaft, looking north.

Photo 40 The view south down the southern brick single section of tunnel.

The southern single tunnel is approximately 215m in length and as seen in the northern section has refuges on both sides, offset and spaced approximately 39m apart on each side. The walls are built using English bond to a height of approximately 2.2m above the track bed, while the vault of the arch is in stretcher bond.

Photo 41The view south through the southern portal towards the buttresses of the southern cutting.

Unlike the north portal, the southern portal is not covered by a modern structure but open to the sky. The portal itself however is identical to that at the northern end of the tunnel, with a date plaque (Photo 43), chamfered along its edges, above the seven course brick arch. The concrete above the brick is again identical in appearance, with horizontal lifts or bands indicating the height of the shuttering and the various stages by which the concrete was poured. The horizontal banding continues along the cutting walls and the arched buttresses. Two pairs of buttresses (from the north buttresses 7/8 and 10/11) have been covered over with concrete slabs. This is likely to have been a necessary precautionary measure to prevent objects falling into the cutting as the DLR passes over head above buttress 9.

Photo 42 The south portal looking north.

Photo 43 The plaque above the southern portal, probably of Portland stone.

Photo 44 Arched buttresses in the southern cutting, looking east.

4.3.7 Other railway related objects.

Other railway related objects were recorded within the Connaught Tunnel and its cuttings. The largest of these was a former gallows signal with a timber platform overhanging the southern side of the cutting (Photo 45). None of the former signals, lights or semaphore signs remain. However a pulley wheel is visible on the underside of the platform suggesting that structure was used for mechanical, semaphore signals. Further along the same side of the south cutting are more pulley wheels, some fixed directly to the cutting wall (Photo 46), whilst one larger example is mounted onto timber, fixed into the concrete (Photo 47). These were mounted approximately 1.6m above the track bed and the pulleys fixed directly to the wall continued into the Connaught tunnel for its entire length, on the western wall only. Also only present on this wall were cable brackets (Photo 46) fixed slightly above the line of small pulley wheels, each spaced just under a meter apart.

Photo 45 The gallows signal at the southern end of the south cutting looking north west.

Photo 46 A pulley wheel and cable bracket on the south-western site of the southern cutting

Photo 47 The larger pulley wheel mounted on timber, set into the cutting wall, looking south.

On the south wall of the south cutting, 0.66m outside the south portal are the remnants of a recessed drain pipe (Photo 48), now broken and much covered by moss. No other recessed pipes were noted either within the tunnel or in the cuttings. Due to the fact that the pipe is receded within the concrete this may be an original feature intended to resolve a localised drainage issue.

Photo 48 The recessed drain pipe outside the south portal looking south.

Within the southern single tunnel was a timber box with a hinged door and an electric bell mounted on the outside (Photo 49) with a further bell and box on the inside. The hinged cover to the box in the interior had the names Southern, Abbey Gates (?), Abbey Mills, Custom House and Silverton scratched into its surface (Photo 50).

Photo 49. the timber box with the electric bell found in the southern single tunnel, looking north west.

Photo 50 The names scratched into the surface of the box mounted in the interior of the timber box.

Inside the north portal on the north side of the tunnel wall is an iron marker plate with the number 636. This may be a distance marker, though the figure of 636 seems rather high for either feet, yards or meters (metric distance markers appear after the electrification of the railways). Alternatively it seems more likely that it is a structure number as all railways numbered their structures such as bridges and tunnels. British Rail introduced an oval shape to such markers and they were also colour coded to show who was responsible for the structure's maintenance. An eight sided marker such as this may well predate the foundation of British Rail (or British Railways) in 1948.

Photo 51 the iron marker plate inside the north portal.

Connaught Tunnel – Primary Sources Consulted

Archive Location	Archive Reference	Description
Museum of Docklands Sainsbury Study Centre (MLDSSC)	5/14/197	London & St Katharine Docks Company Court of Directors Meetings (1876-81)
Museum of Docklands Sainsbury Study Centre (MLDSSC)	5/14/201	London & St Katharine Docks Company Special Committee Minutes (1872-85)
Museum of Docklands Sainsbury Study Centre (MLDSSC)	5/15/212	London & St Katharine Docks Company Dock & Account Committee Minutes (1873-78)
Museum of Docklands Sainsbury Study Centre (MLDSSC)	5/15/213	London & St Katharine Docks Company Dock & Account Committee Minutes (1879-84)
Museum of Docklands Sainsbury Study Centre (MLDSSC)	5/15/219	London & St Katharine Docks Company General Meetings Minutes (1874-90)
Museum of Docklands Sainsbury Study Centre (MLDSSC)	5/15/221	London & St Katharine Docks Company Committee on Victoria Dock Extension (1874-76)
Museum of Docklands Sainsbury Study Centre (MLDSSC)	7/59/0001-0003	Connaught Road Passage Railway Tunnel
Museum of Docklands Sainsbury Study Centre (MLDSSC)	7/59/2001-2049	Connaught Road Passage Railway Tunnel
Museum of Docklands Sainsbury Study Centre (MLDSSC)	23896 – Album B	Photographs of the Royal Albert Dock, 1935
London Metropolitan Archives (LMA)	SC/PHL/02-SSo4 0921-30	Royal Albert Dock – Air Shaft (1977)
London Metropolitan Archives (LMA)	SC/PHL/02-SSo4 0921-31	Royal Albert Dock – Air Shaft (1977)
London Metropolitan Archives (LMA)	LCC/PP/HIG/134	Port of London Authority: Albert Dock Extension
London Metropolitan Archives (LMA)	COL/RMD/PA/05/02/1926	Port of London Act (1935)
National Archives (NA)	RAIL 227/208	General Index To Minutes 1874-5
National Archives (NA)	RAIL 227/209	General Index To Minutes 1876-77
National Archives (NA)	RAIL 227/210	General Index To Minutes 1878-79
National Archives (NA)	RAIL 227/211	General Index To Minutes 1880-89
National Archives (NA)	RAIL 227/115	Locomotive and Way & Works Committee 1875
National Archives (NA)	RAIL 227/116	Locomotive and Way & Works Committee 1876
National Archives (NA)	RAIL 227/117	Locomotive and Way & Works Committee 1877
National Archives (NA)	RAIL 227/118	Locomotive and Way & Works Committee 1878
National Archives (NA)	RAIL 227/119	Locomotive and Way & Works Committee 1879
National Archives (NA)	RAIL 227/120	Locomotive and Way & Works Committee 1880
National Archives (NA)	RAIL 227/280	Tenders 1875-88
National Archives (NA)	HO 192/331	Ministry of Home Security – Air Raid Damage 19 April 1941
National Archives (NA)	ZSPC 11/345/27	Cutting from *The Railway Magazine* May 1939, 'Silvertown Tunnel'

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Site Photographs 04-10-11 - Tunnel pumphouse and air vents

Oracle Number	Crossrail Archive	Original File	Description	Direction
974/13/1	041011-1.jpg	DSCN6107.JPG	North elevation of pumphouse	S
974/13/2	041011-2.jpg	DSCN6108.JPG	North elevation of pumphouse showing detail of ground level relieving arch	S
974/13/3	041011-3.jpg	DSCN6109.JPG	North elevation of pumphouse showing blocked up door arch	SW
974/13/4	041011-4.jpg	DSCN6110.JPG	North elevation of pumphouse showing a former window converted into an air vent	SW
974/13/5	041011-5.jpg	DSCN6111.JPG	East elevation of pumphouse	W
974/13/6	041011-6.jpg	DSCN6112.JPG	South-east elevation of pumphouse	NW
974/13/7	041011-7.jpg	DSCN6113.JPG	South elevation of pumphouse	N
974/13/8	041011-8.jpg	DSCN6114.JPG	West elevation of pumphouse	E
974/13/9	041011-9.jpg	DSCN6115.JPG	View of pumphouse showing relationship to the Connaught Bridge	N
974/13/10	041011-10.jpg	DSCN6116.JPG	South elevation of pumphouse	N
974/13/11	041011-11.jpg	DSCN6117.JPG	West elevation of pumphouse with the underside of the Connaught Bridge above	E
974/13/12	041011-12.jpg	DSCN6118.JPG	North elevation of pumphouse	S
974/13/13	041011-13.jpg	DSCN6119.JPG	North elevation of pumphouse	S
974/13/14	041011-14.jpg	DSCN6120.JPG	East elevation of pumphouse	W
974/13/15	041011-15.jpg	DSCN6121.JPG	East elevation of pumphouse	W
974/13/16	041011-16.jpg	DSCN6122.JPG	North elevation of pumphouse	S
974/13/17	041011-17.jpg	DSCN6123.JPG	Detail of ground level relieving arch	SE
974/13/18	041011-18.jpg	DSCN6124.JPG	Detail of brickwork on north elevation	S
974/13/19	041011-19.jpg	DSCN6125.JPG	Detail of roll moulding around hood of window on west elevation	E
974/13/20	041011-20.jpg	DSCN6126.JPG	Detail of window glazing bars on west elevation	E
974/13/21	041011-21.jpg	DSCN6127.JPG	Detail of window glazing bars on east elevation	W
974/13/22	041011-22.jpg	DSCN6128.JPG	South east elevation of pumphouse with north-western air vent and Connaught Bridge in the background	NW
974/13/23	041011-22.jpg	DSCN6129.JPG	South-east elevation of north-western air vent	NW
974/13/24	041011-23.jpg	DSCN6130.JPG	South elevation of north-western air vent	N
974/13/25	041011-24.jpg	DSCN6131.JPG	North elevation of north-western air vent	S
974/13/26	041011-25.jpg	DSCN6132.JPG	North-east elevation of north-western air vent	SW
974/13/27	041011-26.jpg	DSCN6133.JPG	Detail of north-west elevation of air vent plinth with Connaught Bridge and pumphouse in the background	SE
974/13/28	041011-	DSCN6134.JPG	East elevation of north-western air	W

	27.jpg		vent	
974/13/29	041011-28.jpg	DSCN6135.JPG	General view of north-western air vent, Connaught Bridge and pumphouse	NE
974/13/30	041011-29.jpg	DSCN6136.JPG	View of south-east elevation of south-eastern air vent, Connaught Bridge and pumphouse	NW
974/13/31	041011-30.jpg	DSCN6137.JPG	View of south elevation of south-eastern air vent, Connaught Bridge and pumphouse	N
974/13/32	041011-31.jpg	DSCN6138.JPG	North elevation of south-eastern air vent	S
974/13/33	041011-32.jpg	DSCN6139.JPG	Detail of south elevation of south-eastern air vent plinth with Connaught Bridge in the background	NW
974/13/34	041011-33.jpg	DSCN6140.JPG	View of pumphouse, bridge and NW air vent	N
974/13/35	041011-34.jpg	DSCN6141.JPG	View of pumphouse with DLR	N
974/13/36	041011-35.jpg	DSCN6142.JPG	View of pumphouse with DLR	N
974/13/37	041011-36.jpg	DSCN6143.JPG	View of pumphouse with DLR & bridge	N
974/13/38	041011-37.jpg	DSCN6144.JPG	View of pumphouse, air vents & bridge	W
974/13/39	041011-38.jpg	DSCN6145.JPG	View of pumphouse, air vents & bridge	S
974/13/40	041011-39.jpg	DSCN6146.JPG	View of pumphouse and bridge	S
974/13/41	041011-40.jpg	DSCN6147.JPG	Detail of iron rungs in shaft	N/A
974/13/42	041011-41.jpg	DSCN6148.JPG	Detail of I-bar in shaft	N/A
974/13/43	041011-42.jpg	DSCN6149.JPG	Detail of hydraulic pump in shaft	N/A
974/13/44	041011-42.jpg	DSCN6150.JPG	Detail of severed I-beams in shaft	N/A
974/13/45	041011-43.jpg	DSCN6151.JPG	Detail of hydraulic pump in shaft	N/A
974/13/46	041011-44.jpg	DSCN6152.JPG	Detail of hydraulic pump in shaft	N/A
974/13/47	041011-45.jpg	DSCN6153.JPG	View of hydraulic pump in shaft	N/A
974/13/48	041011-46.jpg	DSCN6154.JPG	View of hydraulic pump in shaft	N/A
974/13/49	041011-47.jpg	DSCN6155.JPG	View of hydraulic pump in shaft	N/A
974/13/50	041011-48.jpg	DSCN6156.JPG	Detail of hydraulic pump in shaft	N/A
974/13/51	041011-49.jpg	DSCN6157.JPG	Detail of hydraulic pump in shaft	N/A
974/13/52	041011-50.jpg	DSCN6158.JPG	Detail of hydraulic pump in shaft	N/A
974/13/53	041011-51.jpg	DSCN6159.JPG	Detail of hydraulic pump in shaft	N/A
974/13/54	041011-52.jpg	DSCN6160.JPG	Detail of hydraulic pump in shaft	N/A
974/13/55	041011-53.jpg	DSCN6161.JPG	Detail of hydraulic pump in shaft	N/A
974/13/56	041011-54.jpg	DSCN6162.JPG	Detail of hydraulic pump in shaft	N/A
974/13/57	041011-55.jpg	DSCN6163.JPG	Detail of hydraulic pump in shaft	N/A

974/13/58	041011-56.jpg	DSCN6164.JPG	Detail of hydraulic pump in shaft	N/A
974/13/59	041011-57.jpg	DSCN6165.JPG	Inlet at base of shaft	N/A
974/13/60	041011-58.jpg	DSCN6166.JPG	Reverse arch at base of shaft	N/A
974/13/61	041011-59.jpg	DSCN6167.JPG	View of base of shaft	N/A
974/13/62	041011-60.jpg	DSCN6168.JPG	Detail of iron rungs at base of shaft	N/A
974/13/63	041011-61.jpg	DSCN6169.JPG	Detail of hydraulic pump in shaft	N/A
974/13/64	041011-62.jpg	DSCN6170.JPG	View of hydraulic pump in shaft	N/A
974/13/65	041011-63.jpg	DSCN6171.JPG	Detail of hydraulic pump in shaft	N/A
974/13/66	041011-64.jpg	DSCN6172.JPG	Detail of hydraulic pump in shaft	N/A
974/13/67	041011-65.jpg	DSCN6173.JPG	View of timber roof structure of pumphouse	N/A
974/13/68	041011-66.jpg	DSCN6174.JPG	Internal SE elevation of pumphouse	NW
974/13/69	041011-67.jpg	DSCN6175.JPG	Internal NW elevation of pumphouse	SE
974/13/70	041011-68.jpg	DSCN6176.JPG	Internal SW elevation of pumphouse	NE
974/13/71	041011-69.jpg	DSCN6177.JPG	View of timber roof structure of pumphouse	N/A
974/13/72	041011-70.jpg	DSCN6178.JPG	Internal N elevation of pumphouse	S
974/13/73	041011-71.jpg	DSCN6179.JPG	Detail of metal lifting wheel on roof structure	N/A
974/13/74	041011-72.jpg	DSCN6180.JPG	Detail of metal lifting wheel on roof structure	N/A
974/13/75	041011-73.jpg	DSCN6181.JPG	Detail of internal brickwork	SW
974/13/76	041011-74.jpg	DSCN6182.JPG	View of timber roof structure of pumphouse	N/A
974/13/77	041011-75.jpg	DSCN6183.JPG	View of interior of pumphouse	W
974/13/78	041011-76.jpg	DSCN6184.JPG	View of interior of pumphouse	N
974/13/79	041011-77.jpg	DSCN6185.JPG	Entrance to shaft	NW
974/13/80	041011-78.jpg	DSCN6186.JPG	View of timber roof structure of pumphouse	N/A
974/13/81	041011-79.jpg	DSCN6187.JPG	SE interior elevation	NW
974/13/82	041011-80.jpg	DSCN6188.JPG	Detail of brickwork on S elevation	NW
974/13/83	041011-81.jpg	DSCN6189.JPG	SW elevation of pumphouse	NE
974/13/84	041011-82.jpg	DSCN6190.JPG	Upper S elevation showing cornice	N
974/13/85	041011-83.jpg	DSCN6191.JPG	Detail of pumphouse cornice	N/A
974/13/86	041011-84.jpg	DSCN6192.JPG	Detail of grazing bar florette	N/A
974/13/87	041011-86.jpg	DSCN6194.JPG	Detail of ground level relieving arch	SE
974/13/88	041011-87.jpg	DSCN6195.JPG	Detail of blocked door arch and cornice above	S

974/13/89	041011-88.jpg	DSCN6196.JPG	Detail of window converted to air vent	SW
974/13/90	041011-89.jpg	DSCN6197.JPG	Detail of cill beneath air vent	SW
974/13/91	041011-90.jpg	DSCN6198.JPG	Detail of pumphouse sunken panel	W
974/13/92	041011-91.jpg	DSCN6199.JPG	Detail of pumphouse sunken panel	NE

Site photographs 10-10-11 - Connaught Tunnel

Oracle Number	Crossrail Archive	Original File	Description	Direction
974/13/93	101011-1.jpg	DSCN6251.JPG	Flying buttresses in SE cutting	NW
974/13/94	101011-2.jpg	DSCN6252.JPG	Flying buttresses in SE cutting	NW
974/13/95	101011-3.jpg	DSCN6253.JPG	Cutting refuge	W
974/13/96	101011-4.jpg	DSCN6254.JPG	Cutting refuge, cable fixings and signalling gear	SW
974/13/97	101011-5.jpg	DSCN6255.JPG	Cable fixings and signalling gear	W
974/13/98	101011-6.jpg	DSCN6256.JPG	Signalling gear	W
974/13/99	101011-7.jpg	DSCN6257.JPG	Signalling gear	SW
974/13/100	101011-8.jpg	DSCN6258.JPG	Cable fixings and signalling gear	W
974/13/101	101011-9.jpg	DSCN6259.JPG	Tunnel SE portal	NW
974/13/102	101011-10.jpg	DSCN6260.JPG	Tunnel SE portal	NW
974/13/103	101011-11.jpg	DSCN6261.JPG	Tunnel SE portal date plate	NW
974/13/104	101011-12.jpg	DSCN6262.JPG	Flying buttress soffit	E
974/13/105	101011-13.jpg	DSCN6263.JPG	Flying buttress soffit	E
974/13/106	101011-14.jpg	DSCN6264.JPG	Drainage pipe in cutting	W
974/13/107	101011-15.jpg	DSCN6265.JPG	Drainage pipe in cutting	W
974/13/108	101011-16.jpg	DSCN6266.JPG	Tunnel interior view from SE portal	NW
974/13/109	101011-17.jpg	DSCN6267.JPG	Tunnel interior view from SE portal	NW
974/13/110	101011-18.jpg	DSCN6269.JPG	N twin tunnel portal	S
974/13/111	101011-19.jpg	DSCN6270.JPG	N twin tunnel portal	S
974/13/112	101011-20.jpg	DSCN6271.JPG	N air vent interior	S
974/13/113	101011-21.jpg	DSCN6272.JPG	N air vent interior	S
974/13/114	101011-22.jpg	DSCN6273.JPG	Brick transition between single & twin tunnel	E
974/13/115	101011-23.jpg	DSCN6274.JPG	Brick transition between single & twin tunnel	E
974/13/116	101011-24.jpg	DSCN6275.JPG	Detail of brick transition between single & twin tunnel	E
974/13/117	101011-25.jpg	DSCN6276.JPG	Tunnel refuge	E
974/13/118	101011-26.jpg	DSCN6277.JPG	Transition between brickwork and cast steel tunnel	W
974/13/119	101011-27.jpg	DSCN6278.JPG	Transition between brickwork and cast steel tunnel	SW
974/13/120	101011-28.jpg	DSCN6279.JPG	Transition between brickwork and cast steel tunnel	SW
974/13/121	101011-29.jpg	DSCN6280.JPG	Interior of E cast steel twin tunnel	SE
974/13/122	101011-	DSCN6281.JPG	Detail of cast steel construction	E

	30.jpg			
974/13/123	101011-31.jpg	DSCN6282.JPG	Detail of drain in twin tunnel	SW
974/13/124	101011-32.jpg	DSCN6283.JPG	Detail of drain in twin tunnel	SW
974/13/125	101011-33.jpg	DSCN6284.JPG	Detail of drain in twin tunnel	SW
974/13/126	101011-34.jpg	DSCN6285.JPG	Cast steel construction & doorway	NW
974/13/127	101011-35.jpg	DSCN6286.JPG	Roof of cast steel construction	N/A
974/13/128	101011-36.jpg	DSCN6287.JPG	Doorway through cast steel construction	E
974/13/129	101011-37.jpg	DSCN6288.JPG	Doorway through cast steel construction	NE
974/13/130	101011-38.jpg	DSCN6289.JPG	Tunnel refuge	W
974/13/131	101011-39.jpg	DSCN6290.JPG	Tunnel refuge	W
974/13/132	101011-40.jpg	DSCN6291.JPG	N twin tunnel portal	S
974/13/133	101011-41.jpg	DSCN6292.JPG	Refuge and brick transition of twin tunnel	S
974/13/134	101011-42.jpg	DSCN6293.JPG	Tunnel refuge	W
974/13/135	101011-43.jpg	DSCN6294.JPG	Tunnel refuge	W
974/13/136	101011-44.jpg	DSCN6295.JPG	Detail of crown of tunnel and air vent	S
974/13/137	101011-45.jpg	DSCN6296.JPG	Detail of crown of tunnel and air vent	S
974/13/138	101011-46.jpg	DSCN6297.JPG	Detail of air vent	S
974/13/139	101011-47.jpg	DSCN6298.JPG	View down W twin tunnel	S
974/13/140	101011-48.jpg	DSCN6299.JPG	View down W twin tunnel	S
974/13/141	101011-49.jpg	DSCN6300.JPG	Cast steel doorawy	E
974/13/142	101011-50.jpg	DSCN6301.JPG	Concrete repair to tunnel wall	E
974/13/143	101011-51.jpg	DSCN6302.JPG	Concrete block and drain	N/A
974/13/144	101011-52.jpg	DSCN6303.JPG	Concrete block and drain	N/A
974/13/145	101011-53.jpg	DSCN6304.JPG	Signalling gear	N/A
974/13/146	101011-54.jpg	DSCN6305.JPG	Signalling gear	N/A
974/13/147	101011-55.jpg	DSCN6306.JPG	Detail of cast steel construction roof	N/A
974/13/148	101011-56.jpg	DSCN6307.JPG	Detail of cast steel construction wall	N/A
974/13/149	101011-57.jpg	DSCN6308.JPG	Working shot in cast steel construction	E
974/13/150	101011-58.jpg	DSCN6309.JPG	Flying buttresses from SE portal	SE
974/13/151	101011-59.jpg	DSCN6310.JPG	Flying buttresses and refuge in SE cutting	E
974/13/152	101011-60.jpg	DSCN6311.JPG	Flying buttresses and refuge in SE cutting	E
974/13/153	101011-	DSCN6312.JPG	Flying buttresses in SE cutting	NW

	61.jpg			
974/13/154	101011-62.jpg	DSCN6313.JPG	SE cutting	SE
974/13/155	101011-63.jpg	DSCN6314.JPG	Flying buttresses and cutting	NE
974/13/156	101011-64.jpg	DSCN6315.JPG	Signalling gear	N/A
974/13/157	101011-65.jpg	DSCN6316.JPG	Signalling gear	N/A
974/13/158	101011-66.jpg	DSCN6317.JPG	Signalling gear	N/A
974/13/159	101011-67.jpg	DSCN6318.JPG	Signalling gear	N/A
974/13/160	101011-68.jpg	DSCN6338.JPG	Cast steel doorway	W
974/13/161	101011-69.jpg	DSCN6339.JPG	Cast steel doorway	W
974/13/162	101011-70.jpg	DSCN6340.JPG	Cast steel doorway	W
974/13/163	101011-71.jpg	DSCN6341.JPG	Elevation of transition between cutting and tunnel	E
974/13/164	101011-72.jpg	DSCN6342.JPG	Elevation of transition between cutting and tunnel	E
974/13/165	101011-73.jpg	DSCN6343.JPG	Elevation of transition between cutting and tunnel	E
974/13/166	101011-74.jpg	DSCN6344.JPG	Cutting tunnel and flying buttresses	E
974/13/167	101011-75.jpg	DSCN6345.JPG	Cutting tunnel and flying buttresses	E
974/13/168	101011-76.jpg	DSCN6346.JPG	Tunnel SE portal date plate	NW
974/13/169	101011-77.jpg	DSCN6347.JPG	Tunnel SE portal date plate	NW
974/13/170	101011-78.jpg	DSCN6348.JPG	Riser brick coursing in single tunnel	E
974/13/171	101011-79.jpg	DSCN6349.JPG	Riser brick coursing in single tunnel	E
974/13/172	101011-80.jpg	DSCN6350.JPG	Riser brick coursing in single tunnel	E
974/13/173	101011-81.jpg	DSCN6351.JPG	Riser brick coursing in single tunnel	E

Site photographs 08-11-11 - Connaught Tunnel, pumphouse, air vents and surrounding area

Crossrail Archive	Oracle Number	Description	Direction
081111-1.tif	31311001.tif	View of the Victoria Dock	SE
081111-2.tif	31311002.tif	S elevation of pumphouse	N
081111-3.tif	31311003.tif	S elevation of pumphouse	N
081111-4.tif	31311004.tif	S elevation of pumphouse	N
081111-5.tif	31311005.tif	E elevation of pumphouse	W
081111-6.tif	31311006.tif	E elevation of pumphouse	W
081111-7.tif	31311007.tif	N elevation of pumphouse	S
081111-8.tif	31311008.tif	N elevation of pumphouse	S
081111-9.tif	31311009.tif	W elevation of pumphouse	E
081111-10.tif	31311010.tif	W elevation of pumphouse	E
081111-11.tif	31311011.tif	S elevation of pumphouse	N
081111-12.tif	31311012.tif	S elevation of pumphouse	N
081111-13.tif	31311013.tif	S elevation of pumphouse	N
081111-14.tif	31311014.tif	W elevation of NW air vent	E
081111-15.tif	31311015.tif	W elevation of pumphouse	E
081111-16.tif	31311016.tif	N elevation of pumphouse	S
081111-17.tif	31311017.tif	Detail of pumphouse blocked doorway	S
081111-18.tif	31311018.tif	Detail of pumphouse blocked doorway	S

081111-19.tif	31311019.tif	Detail of ground level relieving arch	S
081111-20.tif	31311020.tif	Detail of ground level relieving arch	S
081111-21.tif	31311021.tif	NE elevation of NW air vent	SW
081111-22.tif	31311022.tif	NW elevation of NW air vent	SE
081111-23.tif	31311023.tif	S elevation of NW air vent	N
081111-24.tif	31311024.tif	S elevation of SE air vent	N
081111-25.tif	31311025.tif	E elevation of SE air vent	W
081111-26.tif	31311026.tif	E elevation of SE air vent	W
081111-27.tif	31311027.tif	E elevation of SE air vent	W
081111-28.tif	31311028.tif	N elevation of SE air vent	S
081111-29.tif	31311029.tif	N elevation of SE air vent	S
081111-30.tif	31311030.tif	W elevation of SE air vent	E
081111-31.tif	31311031.tif	W elevation of SE air vent	E
081111-32.tif	31311032.tif	Connaught Bridge and pumphouse	N
081111-33.tif	31311033.tif	Connaught Bridge and pumphouse	N
081111-34.tif	31311034.tif	Pumphouse from above	NE
081111-35.tif	31311035.tif	Pumphouse from above	E
081111-36.tif	31311036.tif	Pumphouse from above	E
081111-37.tif	31311037.tif	Pumphouse from above	SE
081111-38.tif	31311038.tif	General view of SE air vent from above	SE
081111-39.tif	31311039.tif	General view of SE air vent from above	SE
081111-40.tif	31311040.tif	SE elevation of pumphouse	NW
081111-41.tif	31311041.tif	S elevation of pumphouse	N
081111-42.tif	31311042.tif	W elevation of pumphouse	E
081111-43.tif	31311043.tif	W elevation of pumphouse	E
081111-44.tif	31311044.tif	Interior of pumphouse	N
081111-45.tif	31311045.tif	Interior of pumphouse	N
081111-46.tif	31311046.tif	Interior of pumphouse	NE
081111-47.tif	31311047.tif	Timber roof structure of pumphouse	N/A
081111-48.tif	31311048.tif	Timber roof structure of pumphouse	N/A
081111-49.tif	31311049.tif	Detail of interior brickwork	NW
081111-50.tif	31311050.tif	Entrance to shaft	NW
081111-51.tif	31311051.tif	Interior of pumphouse	SE
081111-52.tif	31311052.tif	Interior of pumphouse	S
081111-53.tif	31311053.tif	Detail of hydraulic pipes	N/A
081111-54.tif	31311054.tif	View down shaft	N/A
081111-55.tif	31311055.tif	View down shaft	N/A
081111-56.tif	31311056.tif	View down shaft	N/A
081111-57.tif	31311057.tif	Working shot at pumphouse	E
081111-58.tif	31311058.tif	Working shot at pumphouse	N
081111-59.tif	31311057.tif	Working shot at pumphouse	N
081111-60.tif	31311060.tif	Working shot at pumphouse	N
081111-61.tif	31311061.tif	Detail of glazing bar florette	N/A
081111-61.tif	32411001.tif	Tunnel NW cutting & flying buttresses	SE
081111-62.tif	32411002.tif	Tunnel NW cutting & flying buttresses	SE
081111-63.tif	32411003.tif	Cutting refuge	E
081111-64.tif	32411004.tif	NW tunnel portal	SE
081111-65.tif	32411005.tif	Cutting refuge	E
081111-66.tif	32411006.tif	Detail of signalling gear	W
081111-67.tif	32411007.tif	Detail of cutting	W
081111-68.tif	32411008.tif	NW cutting from above	SW
081111-69.tif	32411009.tif	NW cutting from above	NW
081111-70.tif	32411010.tif	NW cutting from above	NW
081111-71.tif	32411011.tif	NW cutting from above	SE
081111-72.tif	32411012.tif	NW cutting from above	SE
081111-73.tif	32411013.tif	NW cutting from above	NW
081111-74.tif	32411014.tif	NW tunnel portal	SE
081111-75.tif	32411015.tif	NW tunnel portal	SE
081111-76.tif	32411016.tif	NW tunnel portal date plate	SE
081111-77.tif	32411017.tif	Bomb damage to tunnel wall	NE
081111-78.tif	32411018.tif	Bomb damage to tunnel wall	NE

081111-79.tif	32411019.tif	Brick riser courses in single tunnel	E
081111-80.tif	32411020.tif	Brick riser courses in single tunnel	E
081111-81.tif	32411021.tif	Brick riser courses in single tunnel	E
081111-82.tif	32411022.tif	Tunnel refuge	E
081111-83.tif	32411023.tif	NW twin tunnel portal	SE
081111-84.tif	32411024.tif	NW twin tunnel portal	SE
081111-85.tif	32411025.tif	NW twin tunnel portal	SE
081111-86.tif	32411026.tif	NW twin tunnel portal	SE
081111-87.tif	32411027.tif	NW twin tunnel portal	SE
081111-88.tif	32411028.tif	View up air vent	SE
081111-89.tif	32411029.tif	View up air vent	SE
081111-90.tif	32411030.tif	View of W twin tunnel	SE
081111-91.tif	32411031.tif	Detail of cast steel wall	SE
081111-92.tif	32411032.tif	Detail of cast steel doorway	E
081111-93.tif	32411033.tif	View of cast steel wall	NE
081111-94.tif	32411034.tif	View of cast steel construction	NW
081111-95.tif	32411035.tif	View of cast steel construction	NW
081111-96.tif	32411036.tif	Detail of transition between cast steel and brickwork	NW
081111-97.tif	32411037.tif	View of transition between cast steel and brickwork	SE
081111-98.tif	32411038.tif	View of transition between cast steel and brickwork	SE
081111-99.tif	32411039.tif	SE twin tunnel portal	NE
081111-100.tif	32411040.tif	SE twin tunnel portal	NW
081111-101.tif	32411041.tif	View up air vent	NW
081111-102.tif	32511001.tif	Working shot in cast steel doorway	E
081111-102.tif	32411002.tif	Working shot in cast steel tunnel	E
081111-103.tif	32411003.tif	View of SE single tunnel	SE
081111-104.tif	32411004.tif	View of SE single tunnel portal	SE
081111-105.tif	32411005.tif	View of SE single tunnel portal	SE
081111-106.tif	32411006.tif	View of SE cutting and flying buttresses	SE
081111-107.tif	32411007.tif	View of SE tunnel portal date plate	NW
081111-108.tif	32411008.tif	View of SE tunnal portal	NW
081111-109.tif	32411009.tif	SE Cutting W elevation	E
081111-110.tif	32411010.tif	SE Cutting W elevation	E
081111-111.tif	32411011.tif	SE Cutting W elevation	E
081111-112.tif	32411012.tif	Signal gantry over SE cutting	NW
081111-113.tif	32411013.tif	Signal gantry over SE cutting	NW
081111-114.tif	32411014.tif	View of SE cutting	SE
081111-115.tif	32411015.tif	Working shot in SE cutting	NW
081111-116.tif	32411016.tif	Working shot in SE cutting	NE
081111-117.tif	32411017.tif	Number plate in NW single tunnel	E

081111-118.tif	32411018.tif	Number plate in NW single tunnel	E
081111-119.tif	32411019.tif	View of NW cutting	SE
081111-20.tif	32411020.tif	View of NW cutting	SE

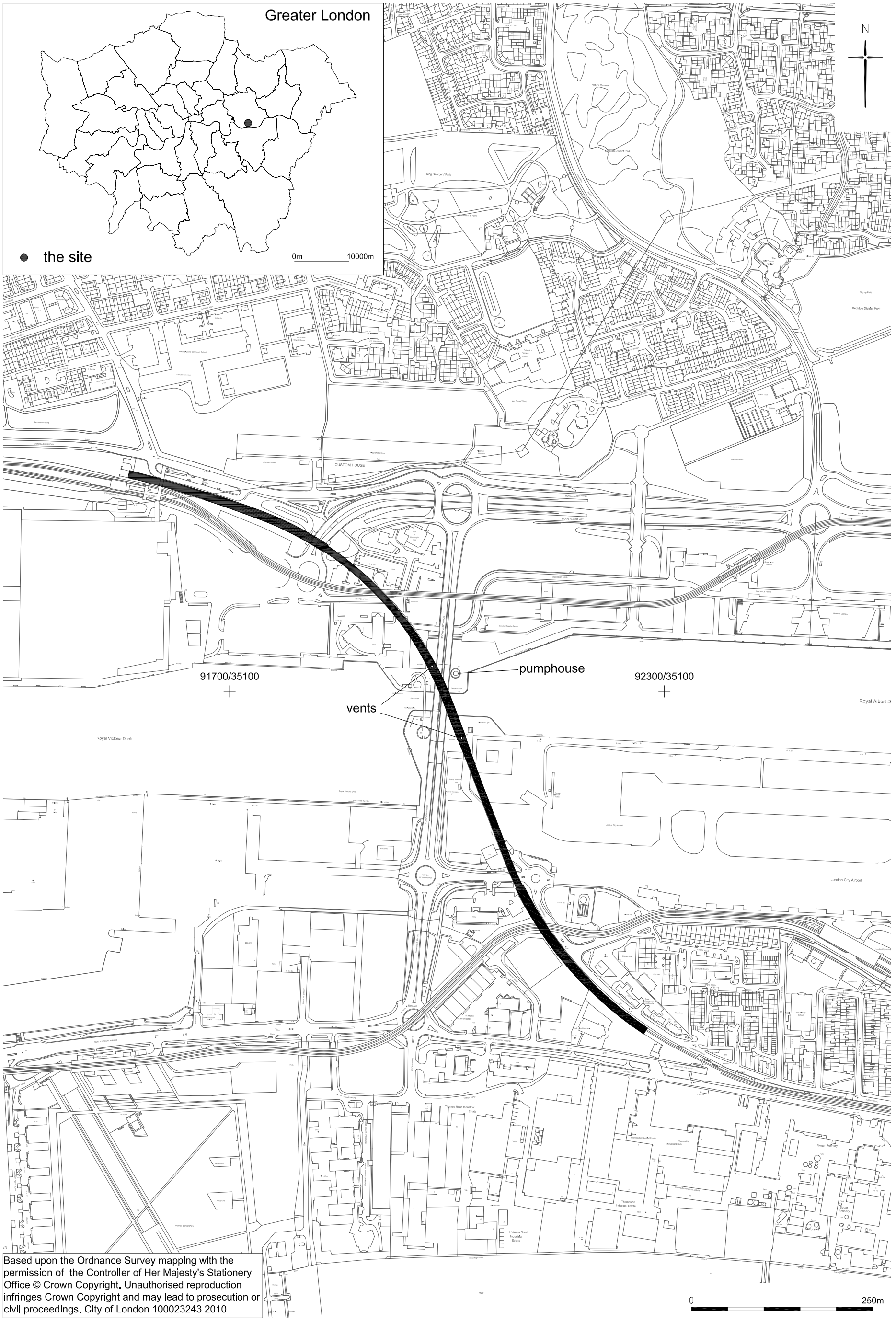

Fig 1 Site location plan

MUL T11051SBR11#01

Connaught Tunnel Non-Listed Built Heritage recording

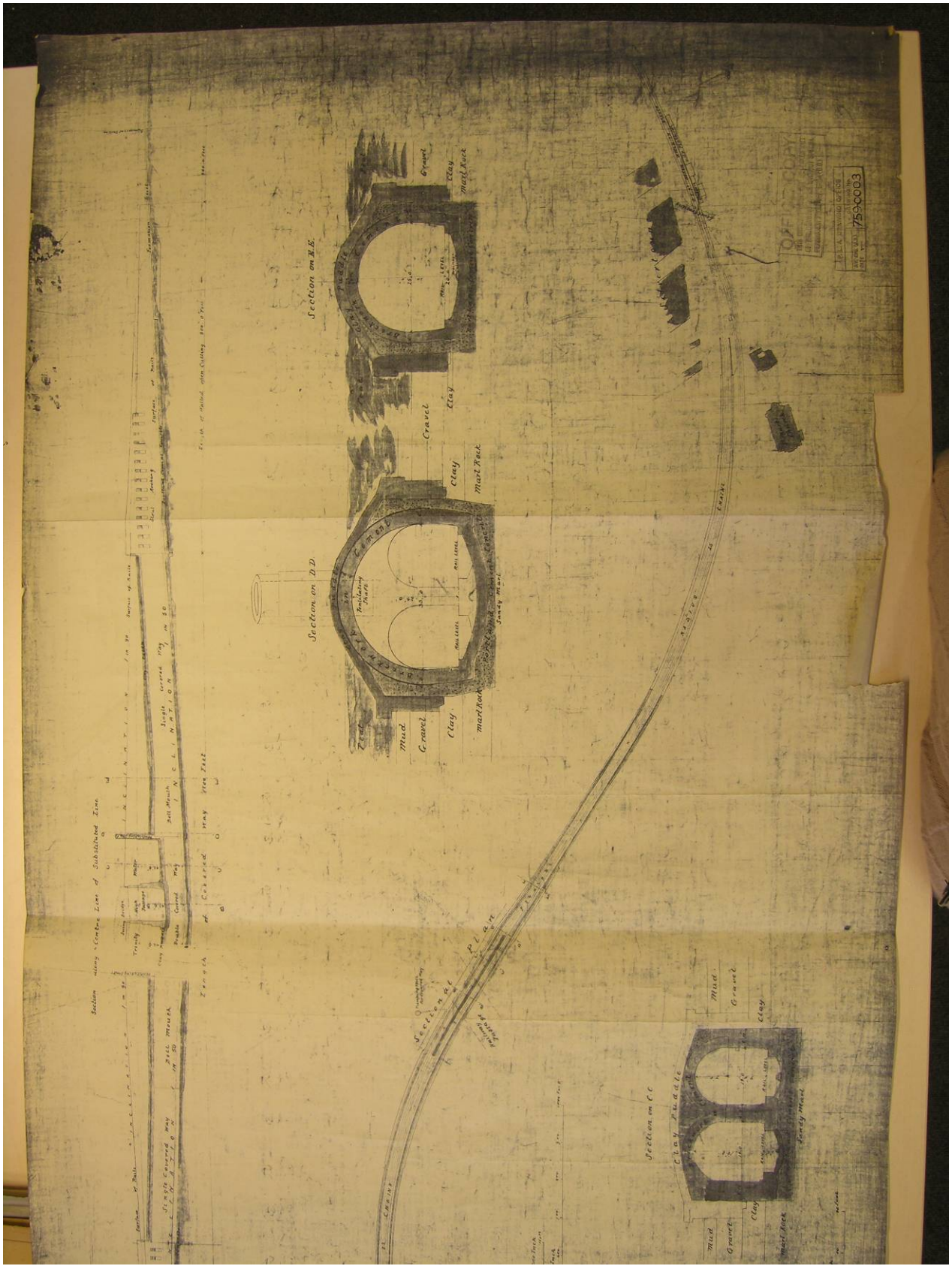

Fig 2 Part of the original engineer's drawings for the tunnel from 1876 held at the Museum of London Docklands (MLDSSC 7/59/0001-0003, 7/59/2001-2049)

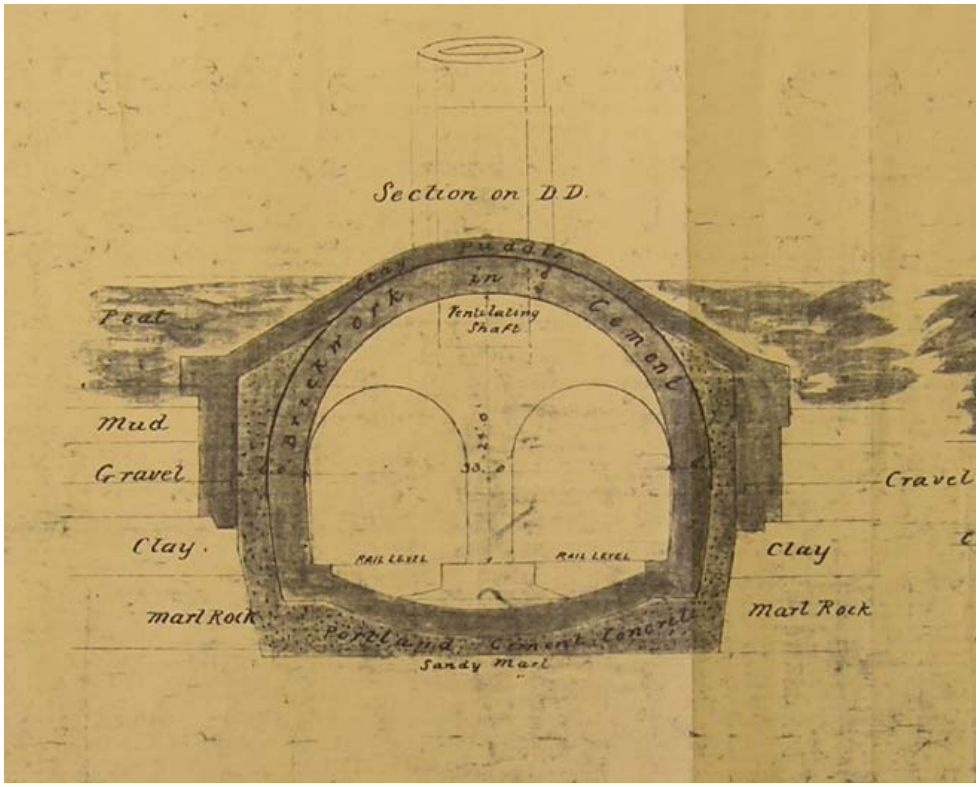

Fig 3. Detail from the original drawing showing the junction from the single to twin tunnels and the air vent. (MLDSSC 7/59/0001-0003, 7/59/2001-2049)

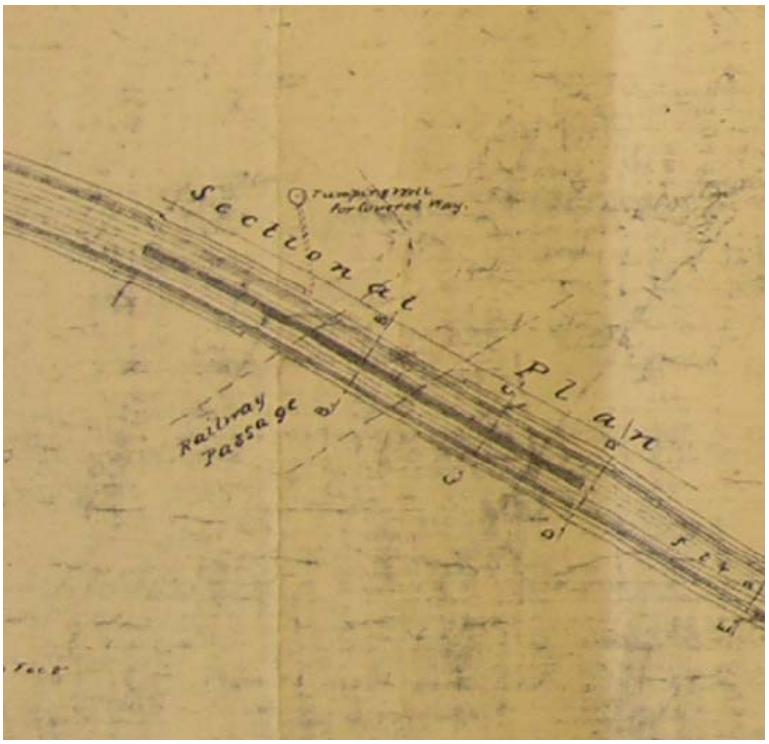

Fig 4. Detail from the original drawings showing the central twin tunnel, with the pumphouse shaft and culvert indicated above the words "Sectional Plan". (MLDSSC 7/59/0001-0003, 7/59/2001-2049)

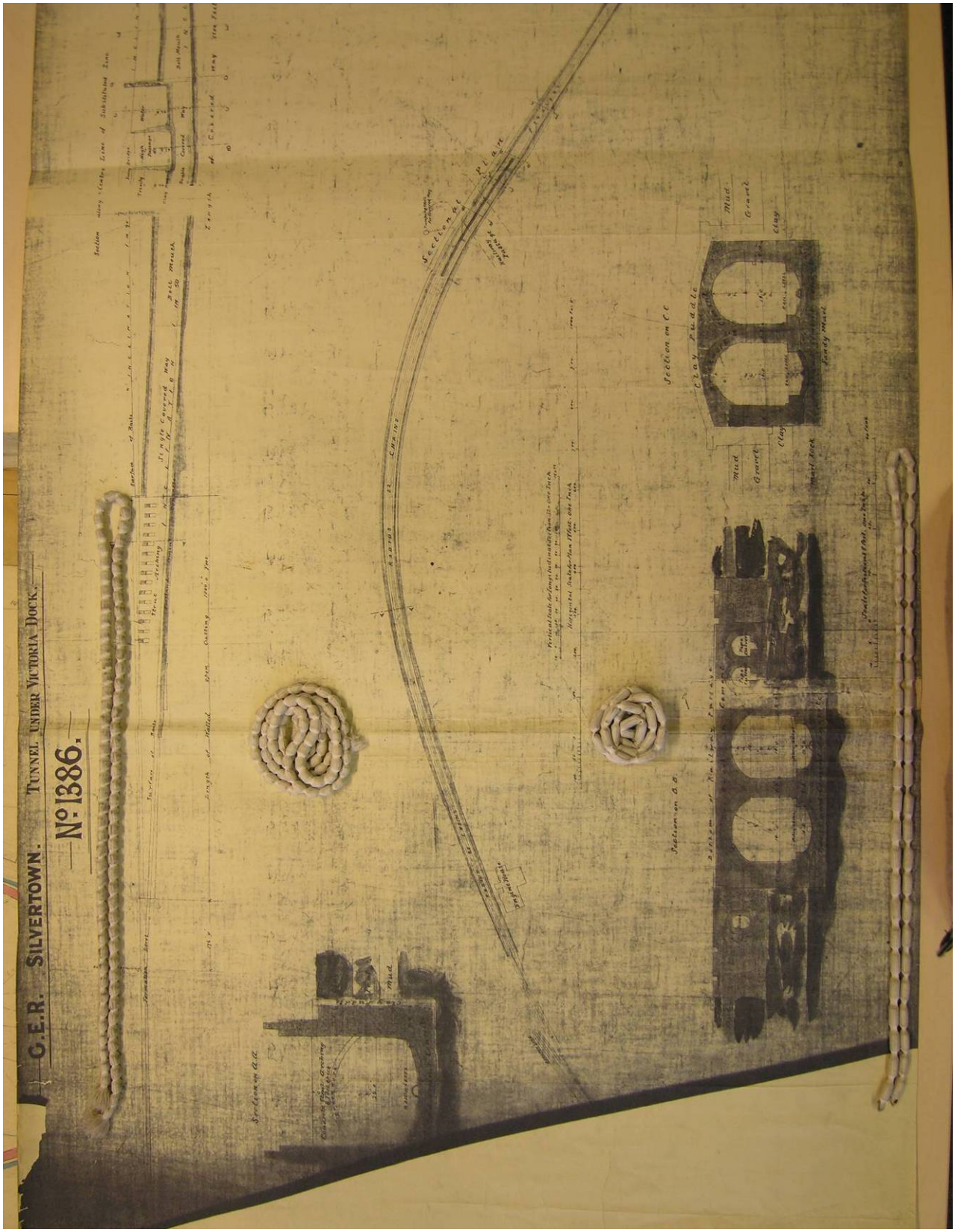

Fig 5 The remaining part of the original 1876 engineers drawings for the tunnel held at the Museum of London Docklands (MLDSSC 7/59/0001-0003, 7/59/2001-2049)

Fig 6. A photograph taken in 1935 during the lowering of the tunnel height and construction of the cast steel central section of the tunnel. (MLDSSC 23896 – Album B)

Fig 7 DSCN6814 A 1935 photograph from Museum of London Docklands showing access to the tunnel works via the via southern ventilation shaft in the left of the photo next to the crane. (MLDSSC 23896 – Album B)

Fig 8. The pumphouse from the north west taken in 1937(MLDSSC 23896 – Album B)

Fig 9 The pumphouse entrance from the south, taken 1977. (LMA SC/PHL/02-SSo4 0921-30)

Fig 10 The eastern elevation looking west, taken 1977. (LMA SC/PHL/02-SSo4 0921-30)

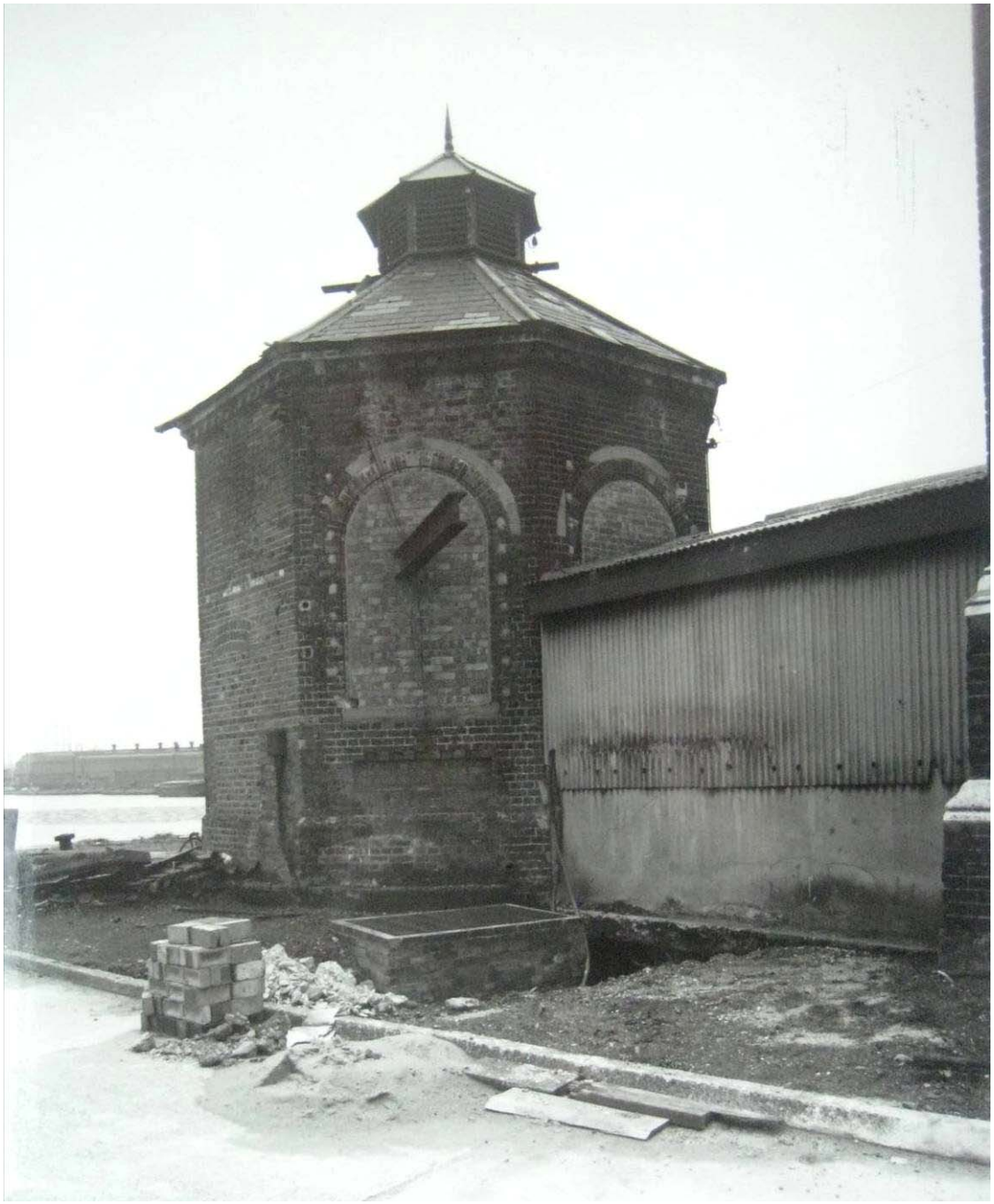

Fig 11. The north-western elevation looking south east, taken 1977. (LMA SC/PHL/02-SSo4 0921-31)

Fig 12 A section, elevation and plan drawing of the pump house

Fig 13. A plan showing the different components of the Connaught Tunnel and the locations of the section drawings.

Fig 14. Section A showing the west facing aspect of the structure of the north cutting, also showing the second buttress from the west in elevation

Fig 15.Section B looking south east showing the air vent above and below ground (also in elevation), the junction between the north single tunnel and the brick twin tunnel

Fig 16. Section C looking south showing the cast steel reinforcement of the twin tunnel, along with a cross passage, constructed in 1935

Fig 17. Section D looking north through the south cutting showing the south portal in elevation

Fig 18.Section E looking east, through the south portal and the first two buttresses of the south cutting.

Fig 19 An elevation drawing of a representative portion of the steel rings in the west twin tunnel, looking east. The view is not in the vertical plane but drawn closely to the curve showing the pattern of the steel plates. .

Fig 20 A plan of the central area of the Connaught Tunnel showing the north brick twin, central steel and southern brick twin tunnels.

Fig 21 Cross section through the twin tunnel showing the cast steel reinforcement rings, looking south

5.1 OASIS ID: molas1-114656

Project details	
Project name	The Connaught Tunnel, the Pumphouse and Air Vents
Short description of the project	A standing building survey was undertake on the non-listed Connaught Tunnel and associated surface structures, the pump house and two brick air vents to the tunnel. The Tunnel, vents and pump house were built in 1878 by the London and St Katherin Dock Co. to enable the Woolwich branch of the Great Easterb Railway to pass under the Royal Albert Dock and its link to the Roal Victoria dock. The tunnel, finally abandoned in 2006 is due to be widened for use in the Crossrail scheme, while the above ground structures - the octagonal pumphouse and air vents - are to be demolished with the pumphouse being possibly rebuilt elsewhere.
Project dates	Start: 26-09-2011 End: 24-11-2011
Previous/future work	No / Yes
Any associated project reference codes	XSY11 - Sitecode
Type of project	Building Recording
Current Land use	Transport and Utilities 2 - Other transport infrastructure
Monument type	RAILWAY TUNNEL Post Medieval
Monument type	PUMP HOUSE Post Medieval
Project location	
Country	England
Site location	GREATER LONDON NEWHAM CANNING TOWN Connaught Tunnel
Study area	3500.00 Square metres
Site coordinates	TQ 41050 80945 51.5093021734 0.03275391357880 51 30 33 N

	000 01 57 E Point

Project creators

Name of Organisation	MOL Archaeology
Project brief originator	Crossrail
Project design originator	MOL Archaeology
Project director/manager	David Divers
Project supervisor	David Sorapure
Type of sponsor/funding body	Crossrail Ltd
Name of sponsor/funding body	Crossrail Ltd

Project archives

Physical Archive Exists?	No
Digital Media available	'Images raster / digital photography'
Paper Media available	'Drawing','Notebook - Excavation',' Research',' General Notes','Photograph','Plan','Report','Section','Survey ','Unpublished Text'

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Connaught Tunnel, The Pumphouse and Air Vents Non-Listed Built

	Heritage
Author(s)/Editor(s)	Sorapure D and Wright J
Other bibliographic details	TBC
Date	2011
Issuer or publisher	MOL Archaeology
Place of issue or publication	London
Description	Unpublished client report
Entered by	David Sorapure (dsorapure@museumoflondon.org.uk)
Entered on	25 November 2011

6 Addendum: Results of Connaught Tunnel watching brief

6.1 Introduction

The Connaught Tunnel watching brief took place between 26/4/11 and 11/6/13 within the Central Worksite only. The work was requested by Crossrail Ltd in reaction to the decision to remove the steel twin tunnel inserted during the lowering of the tunnel during 1935-6. This section of the document should be read in conjunction with Fig 21.

6.2 Scope

The Non-listed Built Heritage (NLBH) recording forms part of the archaeological mitigation for Crossrail and the definition of NLBH follows Information Paper D22 Archaeology and Crossrail Generic WSI (Document Reference 14022008-44-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 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 industrial and defence archaeology of significance.

The fieldwork, conducted between 26/4/11 and 11/6/13, covered only the part of the structure of the Connaught Tunnel which lay directly beneath the Connaught Passage. As described in section 3.3.2 of the Crossrail Document *Method Statement Watching Briefs, Non Listed Building recording and trench evaluation, Connaught Tunnel* (document number: C263-MLA-X-RGN-CRG07-50023) the objective of the watching brief was to monitor the works and produce a document outlining the observations of the archaeologists on site which would compliment the EH Level 3 NLBH recording of the entire structure Of the Connaught Tunnel.

6.3 Methodology and objectives

The NLBH watching brief was undertaken according to the methods and practices laid out in the Crossrail document *Connaught Tunnel and Surface Rail Non-Listed Built Heritage Assessment* (document number C122-OVE-T1-RSI-CR146_WS158-00001).

In addition the fieldwork, the off-site analytical study and the reporting in this document comply with the relevant guidelines from the Institute for Archaeologists, (IFA 1996), English Heritage (EH 1991, GLAAS 1998, 2000, 2006 and 2008), the Museum of London Archaeology Health and Safety Policy (MOLA 2008), and the Museum of London Archaeology Service site manual (MoLAS1994).

The Crossrail document *Connaught Tunnel and Surface Rail Archaeological Written Scheme of Investigation* (document number C122-OVE-T1-GMS-CR146_WS158-

00002) stated that the Connaught Tunnel should be subjected to a Level 3 Historic Building Record (as specified by English Heritage, 2008).

The survey subsequently by MOLA focussed on monitoring and recording the structures during demolition and alteration. Details and surviving railway features within the tunnel were photographed and their locations noted.

Photography included wide and general views along with detail of more complex or unusual features and those of architectural interest. A scale was not used as access was restricted to a viewing platform above the works.

Access was permitted into the bottom of the coffer dam within the Connaught Passage. From here the archaeologists were able to monitor the works from viewing platforms either side of the Connaught Tunnel however access was not granted into the worksite itself.

The specific research aims for the watching brief were laid out in Paragraph 3.2.1.7 of the Crossrail document *Method Statement Watching Briefs, Non Listed Building recording and trench evaluation, Connaught Tunnel* (document Number: C263-MLA-X-RGN-CRG07-50023) and are as follows:

> Further to the standing building recording survey described above, a programme of monitoring, or a watching brief is intended to be carried out on the removal of the central CSL rings, excavations and demolition of the structure below the current track bed. This is likely to be further along in the construction programme and will take place during the construction work, currently programmed to take place between the third quarter of 2011 and the fourth quarter of 2014. It is likely to only be necessary for a targeted NLBH watching brief to be applied to the four areas that would have been recorded to a Level 3), in order to provide a complete record of those specific areas. However the opportunity to record any other unexpected features of interest should they appear can also be taken.

6.4 Results

The yellow London stock brick of the top of the Connaught Tunnel was initially observed in the lower part of the northern dock wall. It was noted that the masonry was laid with a very high cementitious mortar (Photo 52). The brickwork had been cut back during the 1935-6 construction works when the dock passage was lowered and this has left visible scarring on the masonry.

Gradually the top of the steel rings of the twin tunnel were exposed leaving an artificial section of brickwork visible on both sides of tunnels within the bottom of the dock passage. The upper part of the steel rings were then removed using oxy-fuel cutters (Photo 53). After the removal of the top of the steel rings vertical reinforced concrete lateral walls of the new tunnel were constructed (Photo 54).

Originally the trackbed and ballast of the twin tunnels was laid upon a layer of concrete which in turn was laid on the inverted arch of the bottom of the steel rings. Horizontal timbers were noted, perpendicular to the alignment of the tunnel, embedded in concrete and may have been part of the original track bed (Photo 55).

Photo 52 Brickwork at the bottom of the Connaught Passage

Photo 53 Removal of the upper section of the steel rings

Photo 54 Concrete wall of the new tunnel masking brickwork and steel rings of the former structure

Photo 55 Timbers encased in concrete possibly relating to the former trackbed

The central partition wall between the twin tunnels was constructed in yellow London stock brick with high cementitious mortar. A cement grout had been poured between the brickwork and the steel to tie the structures together. The masonry was identical to that above the steel rings and it is therefore clear that substantial amounts of the 1870s build of the central section of the tunnel was still in situ despite the works to increase the depth of the dock during the 1930s (Fig 21).

Photo 56 Masonry below the steel rings

Two upright timber posts were exposed below 1870s brick masonry beneath the steel rings inserted during the lowering of the tunnel during 1935-6 (Photo 57). A further group of three timbers was recorded approximately 3 metres to the south of the two posts referred to above and were below the alignment of the shared wall of the twin tunnel. These again consisted of two upright timbers, smaller to those mentioned above, and an additional smaller upright post. No measurements were taken due to the inaccessibility of the site. The location and observed size of the timbers suggests that they may have been part of a system of timber piling intended to support and distribute the weight of the 1870s masonry build of the Connaught Tunnel through what was a very waterlogged and marshy area (see Chapter 3).

Photo 57 Timber posts supporting masonry of the 1870s construction

6.5 List of photographs taken during watching brief

Image No./ Archive No.	Description	Direction of view	Date Taken
1205/13/1	Work in progress, building the new tunnel, looking south-east	SE	31/05/2013
1205/13/2	Original brickwork visible in the sections and below the steel rings	NE	31/05/2013
1205/13/3	Brickworks between the two steel rings	SE	31/05/2013
1205/13/4	Original brickworks visible in the section under the steel rings	NE	31/05/2013
1205/13/5	Original brickworks visible in the section under the steel rings	NE	31/05/2013
1205/13/6	Brickworks between the steel rings	SE	31/05/2013
1205/13/7	Work in progress, centering for the new tunnel	N	31/05/2013
1205/13/8	Breaking of the original brickworks beyond the north boundary of the dock passage for bigger tunnel	NE	31/05/2013
1205/13/9	Timber posts under the brickworks, in centre of the tunnel	SE	31/05/2013
1205/13/10	Close shot of the timber posts underneath the tunnel brickwork	SE	31/05/2013
1205/13/11	Close shot of the timber posts underneath the tunnel brickwork	SE	31/05/2013
1205/13/12	Close shot of the timber posts underneath the tunnel brickwork	SE	31/05/2013
1205/13/13	Breaking of the base of the dock thus the top of the tunnel	NW	29/04/2013
1205/13/14	Breaking of the base of the dock thus the top of the tunnel	SE	29/04/2013
1205/13/15	Cutting of the steel rings of the tween tunnel	N	29/04/2013
1205/13/16	Breaking of the base of the dock thus the top of the tunnel	SE	29/04/2013
1205/13/17	Breaking of the base of the dock thus the top of the tunnel	NE	29/04/2013
1205/13/18	Exposed steel rings of the tween tunnel, brickswork is visible in the north section	NE	29/04/2013
1205/13/19	North-east corner of the coffer dam built for the construction of the new tunnel	NE	29/04/2013
1205/13/20	Cutting of the steel rings of the tween tunnel	NE	29/04/2013
1205/13/21	Breaking of the base of the dock thus the top of the tunnel	NE	29/04/2013
1205/13/22	Exposed steel rings of the twin tunnel, view from the top of the coffer dam	NW	29/04/2013
1205/13/23	Exposed and cut steel rings and brickwork of the twin tunnel	SE	09/05/2013
1205/13/24	Exposed and cut steel rings and	SE	09/05/2013

Image No./ Archive No.	Description	Direction of view	Date Taken
	brickwork of the twin tunnel		
1205/13/25	Exposed and cut steel rings and brickwork of the twin tunnel	NE	09/05/2013
1205/13/26	Exposed and cut steel rings and brickwork of the twin tunnel	NE	09/05/2013
1205/13/27	Close view of the profile of the steel rings		09/05/2013
1205/13/28	Inner side of the steel rings	N	09/05/2013
1205/13/29	South jetty (?) Wall of the dock in the coffer dam area	SE	26/04/2013
1205/13/30	Steel ring section	N	09/05/2013
1205/13/31	Brickwork and steel rings of the twin tunnel are visible in the north facing section	S	09/05/2013
1205/13/32	Brickwork and steel rings of the twin tunnel are visible in the north facing section	S	09/05/2013
1205/13/33	Brickwork of the twin tunnel visible in the south facing section	N	09/05/2013
1205/13/34	Brickwork of the twin tunnel visible in the south facing section	N	26/04/2013
1205/13/35	Brickwork of the twin tunnel visible in the south facing section	N	26/04/2013
1205/13/36	Brickwork of the twin tunnel visible in the south facing section	N	26/04/2013
1205/13/37	Base surface of the dock above the twin tunnel	S	26/04/2013
1205/13/38	Base surface of the dock above the twin tunnel	S	26/04/2013
1205/13/39	Work in progress, construction of the new tunnel	SE	14/05/2013
1205/13/40	Removal of the steel rings of the twin tunnel	E	14/05/2013
1205/13/41	Work in progress, removal of the twin tunnel and construction of the new tunnel	NE	14/05/2013
1205/13/42	Work in progress, removal of the twin tunnel and construction of the new tunnel	NE	14/05/2013
1205/13/43	Work in progress, removal of the twin tunnel and construction of the new tunnel	SE	14/05/2013
1205/13/44	Brickwork of the twin tunnel beyond the dock area	S	14/05/2013
1205/13/45	Brickwork and steel ring profile visible in the west section	W	14/05/2013
1205/13/46	Work in progress, removal of the twin tunnel and construction of the new tunnel	S	14/05/2013
1205/13/47	Work in progress, removal of the twin tunnel and construction of the new tunnel	S	14/05/2013
1205/13/48	Work in progress, removal of the twin tunnel and construction of the new tunnel	S	14/05/2013

Image No./ Archive No.	Description	Direction of view	Date Taken
1205/13/49	Work in progress, removal of the twin tunnel and construction of the new tunnel	SE	22/05/2013
1205/13/50	Work in progress, removal of the twin tunnel and construction of the new tunnel	E	22/05/2013
1205/13/51	Original brickwork of the tunnel visible under the side wall of new tunnel	E	22/05/2013
1205/13/52	Work in progress, removal of the twin tunnel and construction of the new tunnel	NE	22/05/2013
1205/13/53	Timber posts visible under the brickwork of the original twin tunnel	E	07/06/2013
1205/13/54	Work in progress, construction of the new tunnel side wall	E	07/06/2013
1205/13/55	Timber posts visible after the removal of the brickwork of the original tunnel	S	07/06/2013
1205/13/56	Horizontal timber visible in the west side of the original trackbed inside the steel rings	SW	07/06/2013
1205/13/57	Horizontal timber visible in the west side of the original trackbed inside the steel rings	SW	07/06/2013
1205/13/58	Brickwork and steel rings in the section	NE	07/06/2013
1205/13/59	Brickwork and steel rings in the section		07/06/2013
1205/13/60	Work in progress, removal of the twin tunnel and construction of the new tunnel, view from the top of the coffer dam	NE	07/06/2013
1205/13/61	Brickwork of the twin tunnel visible in the south facing section of the dock passage	NE	16/05/2013
1205/13/62	Work in progress, construction of the new tunnel	SE	16/05/2013
1205/13/63	Brickwork of the original tunnel visible in the north facing section	NE	16/05/2013
1205/13/64	Brickwork of the original tunnel visible in the south facing section	NE	16/05/2013
1205/13/65	Brickwork of the original tunnel visible in the south facing section	NE	16/05/2013
1205/13/66	Brickwork of the original tunnel visible in the west facing section	E	16/05/2013
1205/13/67	Work in progress, removal of the twin tunnel and construction of the new tunnel	SE	16/05/2013
1205/13/68	Work in progress, removal of the twin tunnel and construction of the new tunnel, view from the top of the coffer dam	NE	11/06/2013
1205/13/69	Work in progress, removal of the twin tunnel and construction of the new tunnel	SE	16/05/2013
1205/13/70	Work in progress, removal of the twin tunnel and construction of the new tunnel	E	11/06/2013
1205/13/71	Brickwork and steel rings of the original twin tunnel visible in a section during the removal	SE	11/06/2013

Image No./ Archive No.	Description	Direction of view	Date Taken
1205/13/72	Work in progress, removal of the twin tunnel	E	11/06/2013
1205/13/73	Work in progress, removal of the twin tunnel and construction of the new tunnel	S	16/05/2013
1205/13/74	Work in progress, removal of the twin tunnel and construction of the new tunnel	S	16/05/2013
1205/13/75	Work in progress, removal of the twin tunnel and construction of the new tunnel	N	16/05/2013
1205/13/76	Inner side of the steel rings used in the twin tunnel	S	16/05/2013
1205/13/77	Concrete of the track bed inside the steel ring and brickwork of the twin tunnel	SE	11/06/2013
1205/13/78	Work in progress, removal of the twin tunnel and construction of the new tunnel	NE	16/05/2013
1205/13/79	Work in progress, removal of the twin tunnel and construction of the new tunnel	E	11/06/2013
1205/13/80	Work in progress, removal of the twin tunnel andconstruction of the new tunnel		11/06/2013
1205/13/81	Steel rings of the twin tunnel	NE	16/05/2013
1205/13/82	Base of the steel rings of the twin tunnel	SW	16/05/2013
1205/13/83	Work in progress, removal of the twin tunnel and construction of the new tunnel	S	16/05/2013
1205/13/84	Work in progress, removal of the twin tunnel and construction of the new tunnel, view from the top of the coffer dam	NE	20/05/2013
1205/13/85	Work in progress, removal of the twin tunnel and construction of the new tunnel, view from the top of the coffer dam	NE	20/05/2013
1205/13/86	Work in progress, removal of the twin tunnel and construction of the new tunnel, view from the top of the coffer dam	E	20/05/2013
1205/13/87	Work in progress, removal of the twin tunnel and construction of the new tunnel	SE	20/05/2013
1205/13/88	Work in progress, removal of the twin tunnel and construction of the new tunnel	E	28/05/2013
1205/13/89	Work in progress, removal of the twin tunnel and construction of the new tunnel	NE	20/05/2013
1205/13/90	Work in progress, removal of the twin tunnel and construction of the new tunnel	SE	20/05/2013
1205/13/91	Work in progress, removal of the twin tunnel and construction of the new tunnel	E	20/05/2013
1205/13/92	Work in progress, removal of the twin tunnel and construction of the new tunnel	NE	28/05/2013
1205/13/93	A haki staircase on the south-west corner in the cofferdam to access the Central Worksite.	SW	28/05/2013
1205/13/94	Work in progress, removal of the twin tunnel and construction of the new tunnel	SE	28/05/2013
1205/13/95	Work in progress, removal of the twin	SE	28/05/2013

Image No./ Archive No.	Description	Direction of view	Date Taken
	tunnel and construction of the new tunnel		
1205/13/96	Work in progress, removal of the twin tunnel and construction of the new tunnel	SE	28/05/2013
1205/13/97	Work in progress, removal of the twin tunnel and construction of the new tunnel	SE	28/05/2013
1205/13/98	Work in progress, removal of the twin tunnel, brickwork between the steel rings	SE	28/05/2013
1205/13/99	Work in progress, removal of the twin tunnel and construction of the new tunnel	NE	28/05/2013
1205/13/100	Work in progress, removal of the twin tunnel and construction of the new tunnel	NE	28/05/2013
1205/13/101	Work in progress, removal of the twin tunnel and construction of the new tunnel	E	28/05/2013
1205/13/102	Timber posts visible under the brickwork of the twin tunnel	S	28/05/2013
1205/13/103	Brickwork and steel rings of the twin tunnel visible in a section during their removal	SE	28/05/2013
1205/13/104	Brickwork and steel rings of the twin tunnel visible in a section during their removal	SW	28/05/2013
1205/13/105	Work in progress, removal of the twin tunnel and construction of the new tunnel, view from top of the coffer dam	NE	28/05/2013
1205/13/106	Work in progress, removal of the twin tunnel and construction of the new tunnel, view from the top of the dam	NW	03/06/2013
1205/13/107	Work in progress, removal of the twin tunnel and construction of the new tunnel	NE	03/06/2013
1205/13/108	Work in progress, removal of the twin tunnel and construction of the new tunnel	SE	03/06/2013
1205/13/109	Work in progress, removal of the twin tunnel and construction of the new tunnel	SW	03/06/2013
1205/13/110	Work in progress, removal of the twin tunnel and construction of the new tunnel	SW	03/06/2013
1205/13/111	Work in progress, construction of the new tunnel	W	03/06/2013
1205/13/112	Work in progress, construction of the new tunnel	E	03/06/2013