



Development Consent Order

Application Reference Number: WW010001

Documents for Certification September 2014

We, Lindsay Speed and Sarah Fairbrother hereby certify that this is a true copy of the environmental statement referred to in Article 61 (1) (f) of the Thames Water Utilities Limited (Thames Tideway Tunnel) Order 2014.

Lindsay Speed

Sarah Fairbrother

September 2014

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Thames Tideway Tunnel
Thames Water Utilities Limited



Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.05**

Volume 5: Hammersmith Pumping Station appendices

APFP Regulations 2009: Regulation **5(2)(a)**

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Appendix A: Introduction

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Appendix A: Introduction

A.1 Summary

- A.1.1 This document presents the appendices that accompany the *Environmental Statement* Volume 5 Hammersmith Pumping Station site assessment.
- A.1.2 Figures associated with the appendices are provided within a separate volume of figures.
- A.1.3 For consistency and ease of use Volumes 3 to 27 of the *Environmental Statement* all utilise the same appendices contents and labelling protocol. For these volumes the appendices are as follows:
- a. Appendix A: Introduction
 - b. Appendix B: Air quality and odour
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 - m. Appendix M: Water resources – flood risk
 - n. Appendix N: Development schedule.
- A.1.4 Where a topic has not been assessed the associated appendix does not include any supporting information. Also, if a topic has been assessed but does not need to present any supporting information then the appendix is intentionally empty.

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Appendix B: Air quality and odour

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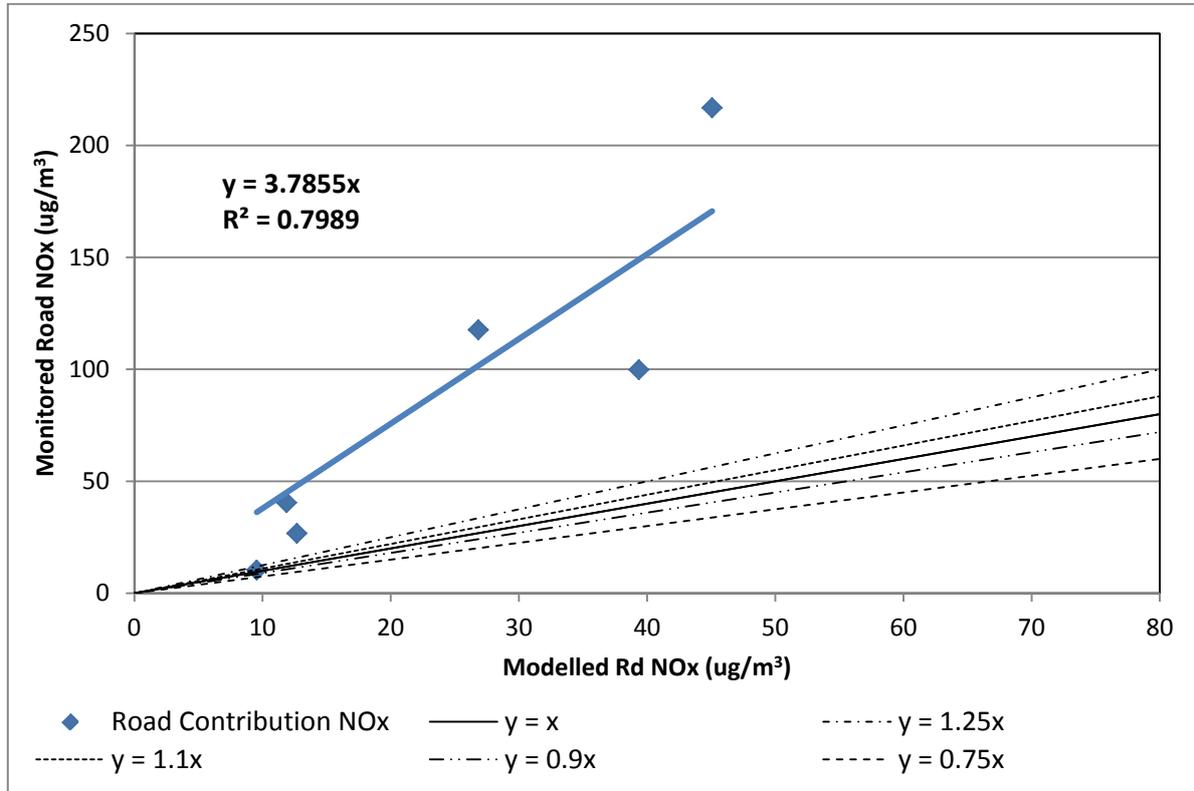
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Appendix B: Air quality and odour

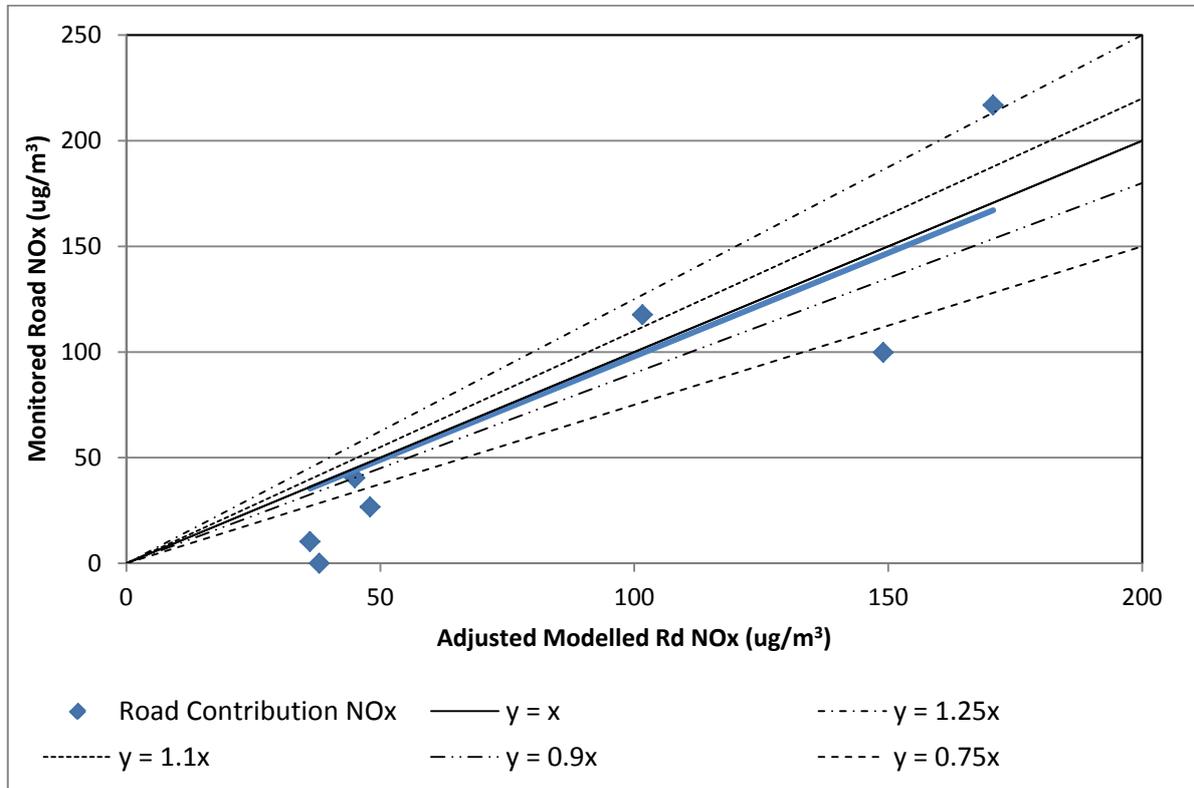
B.1 Model verification

- B.1.1 Modelled NO₂ concentrations have been plotted against monitored concentrations at six diffusion tube sites (HAMM1-HAMM4, HF32 and RuT22) as shown in Vol 5 Figure 4.4.1 (see separate volume of figures).
- B.1.2 This showed that the modelled results underestimated NO₂ concentrations by between -10% and 43%. As the model has been optimised and no further improvement of the model was considered feasible (such as reducing vehicle speeds or using different pollutant backgrounds, etc), a model adjustment factor was therefore deemed necessary.
- B.1.3 To derive the adjustment factor, modelled road NO_x concentrations were plotted against calculated monitored road NO_x concentrations (see Vol 5 Plate B.1 below). An adjustment factor of 3.79 was calculated for adjusting modelled roadside NO_x concentrations, in accordance with LAQM.TG(09)¹ and subsequently applied. This factor was also applied to the PM₁₀ results as no local PM₁₀ monitoring data were available for an area where traffic data were also available.
- B.1.4 Applying the NO_x adjustment factor and then calculating NO₂ concentrations, as shown in Vol 5 Plate B.2, provides better overall agreement between actual and predicted data. The subsequent linear regression calculation for monitored versus modelled total NO₂, as shown in Vol 5 Plate B.3, indicated that two of the six modelled concentrations were within 10% of the measured value and that the other four were within 25% of the modelled value.

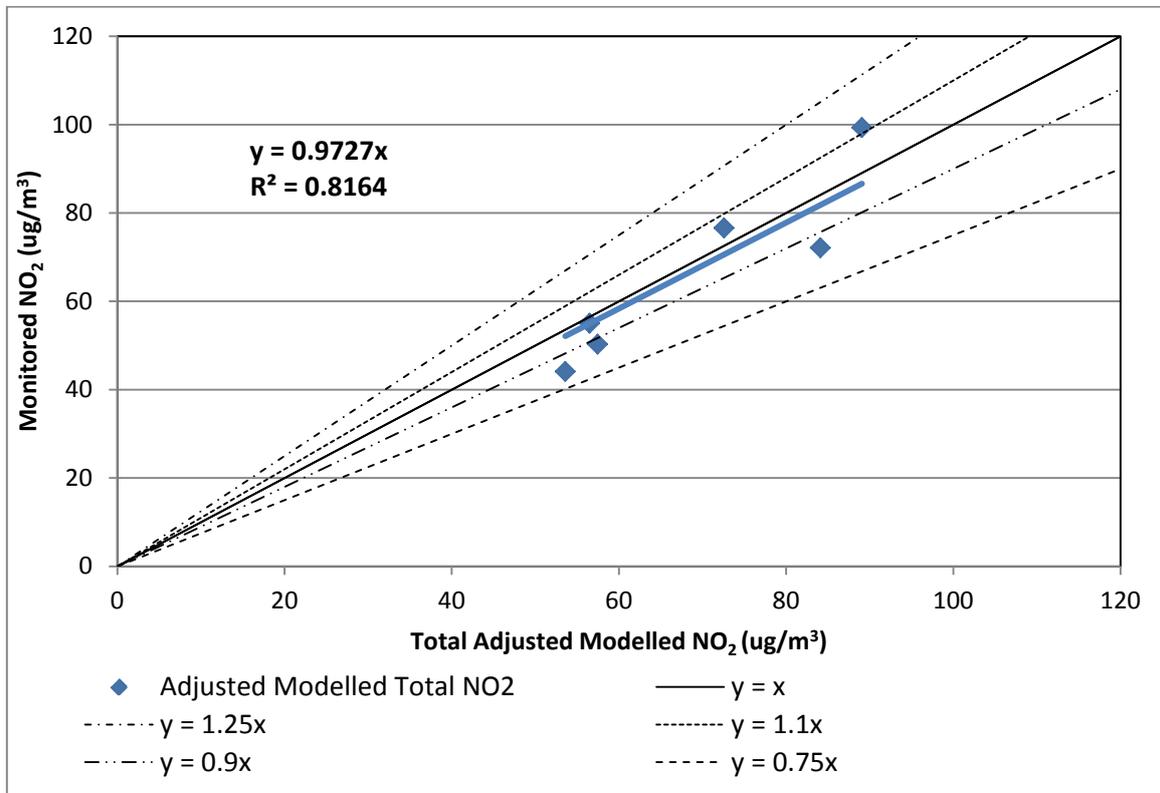
Vol 5 Plate B.1 Air quality - monitored road NO_x vs. modelled road NO_x



Vol 5 Plate B.2 Air quality – monitored road NO_x vs. adjusted modelled road NO_x



Vol 5 Plate B.3 Air quality – total monitored NO₂ vs. total adjusted modelled NO₂



B.2 Traffic data

B.2.1 The traffic data used in the air quality modelling for the Hammersmith Pumping Station site are shown in Vol 5 Table B.1.

Vol 5 Table B.1 Air quality - traffic data model inputs

Source	Road link	2010 baseline AADT*	Baseline % HGV >3.5t	Speed limit (mph)	Model input speed (mph)	Growth factor % (2009 - 2018)	Peak construction year AADT	Peak construction year scheme construction HGV (>3.5t)	Peak construction year development case (total AADT)	Peak construction year development case AADT % HGV (>3.5t)
CTC** survey	Fulham Palace Road A219	31113	7.3%	30	12.7	9.1%	33937	20	34003	7.3%
CTC survey	Chancellor's Road	2216	3.0%	30	30.0	9.1%	2417	20	2437	3.8%
CTC survey	Fulham Palace Road A219	29359	7.6%	30	22.5	9.1%	32024	0	32050	7.6%
CTC survey	Hammersmith Road A315	23658	10.2%	30	12.1	9.1%	25806	0	25832	10.2%
CTC survey	Lillie Road A3218	10033	15.0%	30	6.2	9.1%	10944	0	10950	15.0%
CTC survey	Fulham Palace Road A219	18965	12.1%	30	21.9	9.1%	20687	0	20706	12.0%
TfL Model	Hammersmith Bridge A306	22045	0.0%	30	22.1	9.1%	24047	0	24053	0.0%
TfL Model	Great West	101424	3.8%	40	31.1	9.1%	110630	42	110696	3.9%

Source	Road link	2010 baseline AADT*	Baseline % HGV >3.5t	Speed limit (mph)	Model input speed (mph)	Growth factor % (2009 - 2018)	Peak construction year AADT	Peak construction year AADT scheme HGV (HGV >3.5t)	Peak construction year development case (total AADT)	Peak construction year development case AADT % HGV (>3.5t)
	Road A4									
TfL Model	Hammersmith Flyover A4	74893	4.3%	40	29.9	9.1%	81692	30	81724	4.3%
TfL Model	Talgarth Road A4	80789	4.4%	30	22.4	9.1%	88123	36	88161	4.4%
TfL Model	King Street A315	9776	2.9%	30	21.9	9.1%	10664	0	10665	2.9%
TfL Model	Beadon Road A315	21559	3.1%	30	23.8	9.1%	23516	0	23525	3.1%
TfL Model	Shepherd's Bush Road A219	14732	7.3%	30	16.4	9.1%	16070	0	16088	7.3%
TfL Model	Hammersmith Road A315	5283	6.6%	30	17.6	9.1%	5763	0	5763	6.6%

* AADT – annual average daily traffic. ** CTC – classified traffic count.

B.3 Construction plant emission factors

B.3.1 For the purpose of the assessment, the following listed equipment in Vol 5 Table B.2 has been modelled for the peak construction year at the Hammersmith Pumping Station site.

Vol 5 Table B.2 Air quality - construction plant assessment model inputs

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time*	Power (kW)	NO _x emission rate (g/s/m ²)	PM ₁₀ emission rate (g/s/m ²)	
Site set up	Ground level behind hoarding	Compressor 250cfm*	1	50	104	5.1 x 10 ⁻⁷	3.2 x 10 ⁻⁸	
	Ground level behind hoarding	Generator - 200kVA	1	100	160	1.6 x 10 ⁻⁶	9.7 x 10 ⁻⁸	
	Ground level behind hoarding	JCB with hydraulic breaker	1	50	67	3.3 x 10 ⁻⁷	2.0 x 10 ⁻⁸	
	Ground level behind hoarding	Cutting equipment (diamond saw)	2	10	2.3	1.1 x 10 ⁻⁸	2.5 x 10 ⁻⁸	
	Ground level behind hoarding	Telescopic handler / FLT**	1	30	60	1.8 x 10 ⁻⁷	1.1 x 10 ⁻⁸	
	Ground level behind hoarding	Hiab*** lorry/crane	1	5	56	2.7 x 10 ⁻⁸	1.7 x 10 ⁻⁹	
	Within excavation	Shotcrete robot	1	20	14	2.7 x 10 ⁻⁸	1.7 x 10 ⁻⁹	
	Drive connection tunnel in sprayed concrete lining. Construction of in situ junction with main tunnel from connection tunnel.	Ground level behind hoarding	Concrete deliveries (agitating)	1	80	223	1.7 x 10 ⁻⁶	1.1 x 10 ⁻⁷

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time*	Power (kW)	NO _x emission rate (g/s/m ²)	PM ₁₀ emission rate (g/s/m ²)
Removal of opening set	Ground level behind hoarding	Concrete deliveries (discharging)	1	20	223	4.3 x 10 ⁻⁷	2.7 x 10 ⁻⁸
	Within excavation	Butor tunnel excavator	1	50	30	1.5 x 10 ⁻⁷	9.1 x 10 ⁻⁹
	Ground level behind hoarding	Piccini dumpers	2	50	81	7.9 x 10 ⁻⁷	4.9 x 10 ⁻⁸
	Ground level behind hoarding	100t crawler crane	1	50	240	1.9 x 10 ⁻⁶	1.2 x 10 ⁻⁷
	Ground level behind hoarding	25t mobile crane	1	20	275	5.3 x 10 ⁻⁷	3.3 x 10 ⁻⁸
	Ground level behind hoarding	25t excavator	1	50	125	6.1 x 10 ⁻⁷	3.8 x 10 ⁻⁸
	Ground level behind hoarding	400cfm compressor	1	50	104	5.1 x 10 ⁻⁷	3.2 x 10 ⁻⁸
	Ground level behind hoarding	100t crawler crane	1	50	240	1.2 x 10 ⁻⁶	7.3 x 10 ⁻⁸
	Ground level behind hoarding	Service Crane 40t mobile Crane	1	25	275	6.7 x 10 ⁻⁷	4.2 x 10 ⁻⁸
	Ground level behind hoarding	Concrete deliveries (discharging)	1	20	223	4.3 x 10 ⁻⁷	2.7 x 10 ⁻⁸
Shaft and connection tunnel secondary lining	Ground level behind hoarding	Concrete pump	2	20	223	8.7 x 10 ⁻⁷	5.4 x 10 ⁻⁸

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time*	Power (kW)	NO _x emission rate (g/s/m ²)	PM ₁₀ emission rate (g/s/m ²)
Culvert works	Ground level behind hoarding	Service crane – 100t mobile crane	1	50	280	1.4 x 10 ⁻⁶	8.5 x 10 ⁻⁸
	Ground level behind hoarding	25t excavator	1	50	125	6.1 x 10 ⁻⁷	3.8 x 10 ⁻⁸
	Ground level behind hoarding	Dumper	1	50	81	3.9 x 10 ⁻⁷	2.5 x 10 ⁻⁸
	Ground level behind hoarding	Concrete deliveries (discharging)	1	20	223	4.3 x 10 ⁻⁷	2.7 x 10 ⁻⁸
	Ground level behind hoarding	Concrete boom pump	1	20	223	4.3 x 10 ⁻⁷	2.7 x 10 ⁻⁸
	Ground level behind hoarding						

*Note: For the purposes of this assessment, the above listed equipment has been modelled for the peak construction year. The data assumes a 10 hour working day. This schedule provides an illustration of typical plant that could be used in the construction of the Thames Tideway Tunnel at this site. The appointed Contractor must comply with section 6 of the CoCP but may vary the method and plant to be used. This schedule therefore represents the most reasonable assumption for the assessment that can be made at this stage. * cfm – cubic feet per minute. ** FLT – fork lift truck. ***Hiab – loader crane.*

References

¹ Defra, *Local Air Quality Management - Technical Guidance*, LAQM.TG(09) (2009).

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Appendix C: Ecology - aquatic

APFP Regulations 2009: Regulation **5(2)(a)**

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Appendix C: Ecology - aquatic

C.1 Introduction

- C.1.1 Construction and operational effects assessments at this site for this topic do not require the provision of any supporting information, so this appendix is intentionally empty.

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Appendix D: Ecology - terrestrial

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Appendix D: Ecology – terrestrial

D.1 Notable species survey report

Introduction

- D.1.1 Surveys for bats were undertaken at Hammersmith Pumping Station as suitable habitat for these species was recorded on site during the Phase 1 Habitat Survey conducted on 17 May 2011.
- D.1.2 The purpose of the surveys was to determine the presence or likely absence of these species at the site.
- D.1.3 The survey area for each species is described with reference to the habitat types identified during the Phase 1 Habitat Survey as having potential for notable species (paras. D.1.5 and D.1.7). The results from the surveys are then presented (paras. D.1.8 and D.1.13). The final section provides an interpretation of the results (paras. to D.1.14 to D.1.16). Figures referred to in this report are contained within Vol 5 Hammersmith Pumping Station Figures (see separate volume of figures).
- D.1.4 Information on legislation, policy and methodology can be found in Volume 2 of the *Environmental Statement*. Information on site context can be found in Section 2 Site context of this volume.

Survey area

Bats

- D.1.5 Bats are associated with a diverse range of habitats, including woodland, scrub, riparian habitats and buildings. They roost in trees and buildings where suitable features are present, and they commute along linear features such as hedgerows, watercourses and tree lines, and forage around vegetation such as scrub, hedgerows, grassland, trees and river corridors.
- D.1.6 A remote recording (bat triggering) survey was undertaken using remote Anabat™ recording devices. Based on the habitat types identified during the Phase 1 Habitat Survey and their potential to support foraging and commuting bats, one location was chosen for the installation of the remote recording devices as shown on Vol 5 Figure 6.4.3 (see separate volume of figures). The remote recording device was attached to the pumping station building to record bats passing through the site, and foraging activity associated with trees, ephemeral short perennial habitat and scattered scrub on and in close proximity to the proposed development site.
- D.1.7 The bat activity recorded during the remote recording survey did not trigger the need for any further bat surveys. Therefore, no further surveys were undertaken.

Results

Desk Study

- D.1.8 Vol 4 Table D.1 indicates species recorded within 500m of the site from 2001 to 2011, as supplied by Greenspace Information for Greater London (GIGL).

Vol 4 Table D.1 Terrestrial ecology – species recorded within 500m of the site from 2001 to 2011

Common name	Species name (Latin)	Record count
Mammals		
West European hedgehog	<i>Erinaceus europaeus</i>	2
Grey seal	<i>Halichoerus grypus</i>	2
Common seal	<i>Phoca vitulina</i>	1
Bats	<i>Vespertilionidae</i>	1
Common pipistrelle	<i>Pipistrellus pipistrellus</i>	3
Birds		
Caspian gull	<i>Larus cachinnans</i>	2
Common frog	<i>Rana temporaria</i>	2
Eurasian hobby	<i>Falco subbuteo</i>	1
House sparrow	<i>Passer domesticus</i>	13
Redwing	<i>Turdus iliacus</i>	1
Song thrush	<i>Turdus philomelos</i>	1
Invertebrates		
Stag beetle	<i>Lucanus cervus</i>	3
Plants		
Hybrid black poplar	<i>Populus nigra subsp. betulifolia</i>	2

Bats

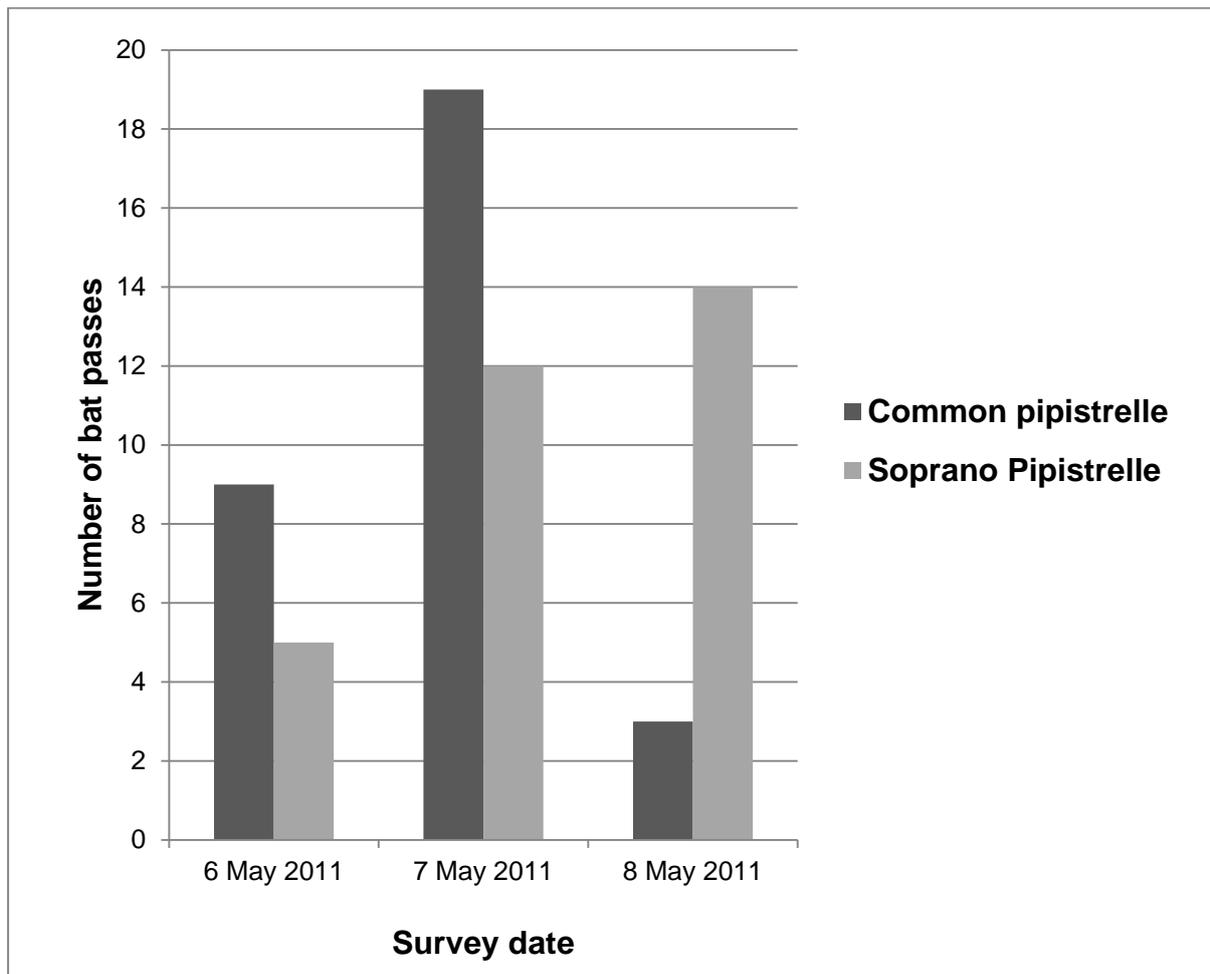
- D.1.9 The bat triggering (remote recording) survey was undertaken over three nights between 6 and 8 May 2011 in suitable weather conditions (see Vol 4 Table D.2).
- D.1.10 The survey recorded two species of bat using the site: common pipistrelle (*Pipistrellus pipistrellus*); and soprano pipistrelle (*Pipistrellus pygmaeus*) (see Vol 4 Plate D.1). A maximum of 19 common pipistrelle bat passes across the three nights was recorded on the second night. Fewer passes were recorded on the first and third nights (nine and three bat passes respectively).

- D.1.11 Similar numbers of soprano pipistrelle bat passes were recorded on the second and third nights (12 and 14 bat passes), with a lower number of passes recorded on the first night (five bat passes).
- D.1.12 There were no bat records within half an hour after sunset or within the hour preceding dawn.
- D.1.13 Based on the bat triggering survey criteria, no further bat surveys were considered necessary at this site.

Vol 4 Table D.2 Terrestrial ecology – bat survey weather conditions

Survey visit	Weather conditions
6/05/2011	10°C, calm, no cloud cover, no precipitation
7/05/2011	16°C, calm, 15% cloud cover, no precipitation
8/05/2011	15°C, calm, 15% cloud cover, no precipitation

Vol 4 Plate D.1 Terrestrial ecology – bat passes recorded during remote recording survey at Hammersmith Pumping Station



Interpretation

Bats

- D.1.14 In accordance with the bat triggering criteria (Vol 2 Section 6), as only two common bat species (common pipistrelle and soprano pipsitrelle) were recorded, there were no records close to sunrise or sunset and less than 50 bat passes were recorded, no further bat surveys were considered necessary at this site.
- D.1.15 The remote recording surveys recorded small numbers of bat passes on site with a maximum count of 19 common pipistrelle bat passes and 14 soprano pipistrelle bat passes across the three survey nights. This is considered to represent a small number of common and soprano pipistrelle bats commuting through the site to the River Thames to the west of the site, and foraging around the trees on site and trees, scattered scrub, tall ruderal and ephemeral short perennial vegetation present adjacent and in close proximity to the site.
- D.1.16 As there were no bat passes close to sunset and sunrise (when bats leave and return to their roosts), it is considered unlikely that bats are currently roosting within any of the buildings or trees on or in close proximity to the site.

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Appendix E: Historic environment

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Appendix E: Historic environment

E.1 Gazetteer of known heritage assets

- E.1.1 Details of known heritage assets within the assessment area are provided in Vol 5 Table E.1 below, with their location shown on the historic environment features map (Vol 5 Figure 7.4.1, see separate volume of figures).
- E.1.2 All known heritage assets within the assessment area are referred to by a historic environment assessment (HEA) number. Assets within the site are referred to (and labelled in the historic environment features map) with the prefix 1, eg, **HEA 1A, 1B, 1C**. References to assets outside the site but within the assessment area begin with 2 and continue onwards, eg, **HEA 3, 4, 5**. Where appropriate, the table includes the asset's reference number from the Greater London Historic environment Record (GLHER) and / or the fieldwork site code allocated by the London Archaeological Archive and Research Centre.

Vol 5 Table E.1 Historic environment – gazetteer of known heritage assets within the site and assessment area

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
1A	Hammersmith Pumping Station. A modern (1960s) complex of concrete buildings including a control station (incorporating a bronze plaque from the original pumping station) and The Screen House.	---
1B	Hammersmith Embankment, Winslow Road, Distillery Road, W6. An archaeological evaluation by Museum of London Archaeology Service (MoLAS, now MOLA) in 2001. Evidence for a medieval or earlier water channel (Parr's Ditch, which was covered in the 19th century) was found in the eastern part of the site, overlaid by brick foundations of 18th-century date. An undated gully, lined with posts, was uncovered in another area. Elsewhere substantial deposits of made ground indicated that the site had been severely truncated in the 19th century.	WIO01
1C	Hammersmith Embankment, Winslow Road / Chancellor's Road, W6. An archaeological excavation by MoLAS in 2005. Three areas of excavations were undertaken. Evidence of Early Saxon activity was recorded in the form of pits and ditches. Extensive remains associated with 17th-century glass bead manufacture were recorded. The remains of a brick clamp presumably associated with documented brick making by Nicholas Crisp(e) in the 17th	WIZ05

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	<p>century was also recorded.</p> <p>An archaeological watching brief was undertaken by MoLAS in 2007. Most of the remains recorded were basements and structures associated with Victorian and later industrial buildings such as a distillery and sugar factory. The line of Parr's Ditch was also investigated and traced across the northern part of the site. Some evidence of 17th-century glass manufacture was found in a few areas.</p>	
2	<p>Hammersmith Embankment, Winslow Road, W6. An archaeological evaluation and excavation by MoLAS in 1999. The excavation consisted of an area measuring approximately 46m by 43m. About 1.2m of modern overburden overlay evidence of a number of phases of activity. They included three or four pits containing prehistoric pottery and worked flint including a leaf-shaped arrowhead. An Early Saxon 'sunken featured building' was identified in the northeast of the site and contained an assemblage of pottery including imported wheel-thrown ware: eight lead weights, six Roman copper alloy coins, glass beads and worked bone were also found. To the south of this building substantial posthole alignments were identified containing Early Saxon pottery possibly defining a timber hall. A number of Early Saxon rubbish pits were also revealed, and five undated hearths or ovens found across the site may also relate to this period of activity. Post-medieval remains included a brick-built structure interpreted as part of a kiln for the production of glass beads in the 17th century, and an 18th-century brick-built cellar infilled with glass working waste and kiln fragments. Linear features may relate to the 18th-century formal gardens on the site.</p>	HWR99
3	<p>The Distillery site, Winslow Road, Manbre Road, W6. An archaeological watching brief by MoLAS in 1997. Natural brickearth, in which was found a prehistoric flint flake, was cut by several pits and a narrow gully or slot. Some of these were of late medieval and early post-medieval date. A number of other pits probably dated to the 19th century, and six postholes were undated.</p>	<p>WLR97 MLO7152505 4279 MLO7152605 4280 MLO7152705 4281 MLO71528 054282 MLO71529 054283</p>
4	<p>Distillery Site, Winslow Road, W6. An archaeological excavation by the former Department of Greater London</p>	HAM90

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	Archaeology, Museum of London (DGLA) in 1990. Excavations exposed a few sherds of Roman pottery and three rectangular 'sunken-featured buildings' of Early Saxon date, aligned east–west and with postholes set at the mid-points of the two short sides. Other associated postholes were also located.	
5	Thames channel The approximate location of a Roman coin recovered from the banks of the Thames and recorded by the Portable Antiquities Scheme (PAS).	PAS-29F1B6
6	Winslow Road (Hammersmith Embankment Thames Foreshore). A foreshore survey carried out in 2007 by the Thames Archaeological Survey. The survey included recording the riverside wall and a topographic survey of the foreshore. During the survey of the site several previously unrecorded features were observed, including the remains of post medieval structures. Artefact scatters were recorded and sampled.	FHM03 MLO99357
7	The site of the cemetery of a Benedictine Nunnery which was in use before 1829. Included in the 1896 survey of London burial grounds by Mrs Basil Holmes (Holmes, B., 1896) ¹ .	Holmes ID 22 054209
8	Nurses' home on the north side of Lochaline Street. Grade II listed.	1286859
9	The site of a post-medieval house, documented as divided into two tenements (rented properties), now demolished. Recorded on the GLHER.	MLO7629 050743
10	The site of a medieval bridge which crossed the Parr's Ditch. Recorded on the GLHER.	MLO1095305 0579
11	Medieval Hammersmith was referred to as Hammersmythstrete in the Court Rolls, and was centred on what is now Queen Caroline Street (formerly Queen Street). The first mention of Hammersmith occurs at the end of the 13th century, the name derived from 'hammer' and 'smithy'. Recorded on the GLHER.	MLO6874705 3003
12	7–51 Queen Caroline Street, W6. An archaeological excavation by the Inner London Archaeological Unit (ILAU) in 1976 to investigate the medieval settlement of Hammersmith. Evidence only of large-scale 18th-century dumping was found.	QCS76
13	Former Hammersmith Pumping station.	---

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	<p>Locally listed building</p> <p>Small brick building dating to c. 1922, now in use as Thames Water offices. One floor above ground with sunken working floor at basement level.</p>	
14	Bazalgette's Low Level Sewer, dated 1856–1888	---
15	<p>Hammersmith Bridge</p> <p>Grade II* listed Hammersmith Bridge was begun for the Metropolitan Board of Works in 1884 and was opened by the Prince of Wales on 18 June 1887. It cost £71,500 and was designed by the Board's chief engineer, Sir Joseph Bazalgette (1819-91). In 1973-6 the bridge was strengthened and repaired in extensive works; in June 2000, Hammersmith Bridge was the target of a terrorist bomb attack and, after repairs, was reopened subject to a weight limit.</p> <p>The bridge rests on pier foundations constructed for an earlier bridge on the site. The original Hammersmith Bridge, built in 1824-27 to designs by William Tierney Clark (1783-1852), was the first iron suspension bridge to span the Thames. Despite having been declared 'highly satisfactory' by Thomas Telford, as early as the 1850s there were structural concerns about Clark's design. Crowds of spectators rushing from side to side to watch the annual University Boat Race caused the deck to sway alarmingly, and by the 1870s, there was further anxiety as Boat Race crowds of up to 12,000 people congregated on the bridge. Despite the dramatic effect of such unusual live loading, the bridge survived until the early 1880s, when the Metropolitan Board of Works chose to replace the bridge to a design by Bazalgette. In 1884, a temporary bridge was erected across the river and used until Bazalgette's structure was completed in 1887.</p>	1079819
16	<p>Riverwall from Brandenburg House to Chancellors Road</p> <p>Locally listed building</p>	
17	<p>The Chancellors PH</p> <p>Locally listed building</p> <p>Two storey, white stuccoed upper floor. Black timber and glazed green brick shop front to lower floor.</p>	
18	<p>St Marks Church</p> <p>Locally listed building</p> <p>Brick built, single storey church building, with gothic</p>	

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	detailing.	
19	48 to 64 Chancellors Road Locally listed building Row of nineteenth century two storey and basement terraced housing. The houses are built of brick, with stone door cases and window architraves.	
20	Peabody Buildings Locally listed building Five storey flats, brick built, in the 'Queen Anne' style.	
21	87 and 89 Fulham Palace Road Locally listed building Semi detached two storey and basement villas. Brick with stone dressings. Bow windows to the ground floor.	

E.2 Site location, topography and geology

Site location

E.2.1 The site includes the current Thames Water Hammersmith Pumping Station (**HEA 1A**) and land to the east and southeast and the Hammersmith Pumping Station highway works site. It is bounded by Chancellors Road to the north, Distillery Road to the east and a recently cleared area of land to the south/southwest. The site lies approximately 100m to the northeast of the River Thames.

Topography

E.2.2 The site and surrounding area are generally flat. Ground level within the site is c. 105.0m ATD (above Tunnel Datum: the equivalent of 5.0m Ordnance Datum). Away from the site, the ground rises up to the northeast, up to 110.0m ATD around 450m to the northeast.

Geology

E.2.3 The site is located entirely upon the Kempton Park Gravels river terrace formation (British Geological Survey digital data). The site is on the outer edge of a meander of the River Thames where the river cuts into the gravel terrace (ie there is no alluvial floodplain compared to the south side of the river).

E.2.4 In places the gravels are capped with Brickearth (also known as the Langley Silt Complex), a fine-grained silt believed to have accumulated by a mixture of processes (eg, wind, slope and freeze-thaw) mostly since the Last Glacial Maximum around 17,000BP. Brickearth has been used extensively as a building material, however, and in London much of it was quarried away during the Roman period or later.

- E.2.5 The former course of the Parr's Ditch, one of London's 'lost' rivers runs through the central part of the site, flowing towards the Thames from north east to south west. Its course in this area is very straight: it has been suggested that this is an entirely artificial watercourse, dug as a boundary between the parishes of Fulham and Hammersmith, but it may be more likely that it originated as a natural stream, and was later straightened. It was converted into a covered sewer in 1876 (Barton, 1992)².
- E.2.6 Eight geological boreholes have been carried out on the site in the past, and a number of the logs are modern and detailed. One of the boreholes (SA1118) just southwest of the pumping station recorded untruncated gravel at 101.6m ATD (2.9m below ground level/mbgl) with alluvium at 102.0m ATD. The level of gravels suggests the river terrace is not much higher than the floodplain of the Thames in this area, and the alluvium represents flooding of the natural terrace gravel, either from the Thames or Parr's Ditch.
- E.2.7 In the centre of the site (borehole no. PR1117), natural gravels were recorded at 101.1m ATD. In the cluster of boreholes in the northwest (borehole nos. GG1809B-2; GG1809B-2A and GG1809B-4), gravels were between 100.6–100.7m ATD. In the northern part of the site (Soil Mechanics BH3), gravels were recorded at 101.72m ATD and in the east (Soil Mechanics BH1) gravels were recorded at 101.63m ATD.
- E.2.8 In all boreholes, made ground between 2.9–4.0m thick was observed at 104.5–104.9m ATD. All the made ground is recorded as a mix of clay, sand, brick and concrete, suggesting that it is largely of modern derivation. The presence of made ground directly over the gravels, with no alluvium or brickearth, suggest that these deposits have been removed and the top of the gravels truncated by past human activity.

E.3 Past archaeological investigations within the assessment area

- E.3.1 Extensive archaeological investigations have been carried out over a number of years in the area immediately to the south and west of the site (**HEA 2, 3 and 4**), extending across the southwestern part of the site (**HEA 1B and HEA 1C**) outside the Thames Water Pumping Station. The areas investigated are shown on Vol 5 Plate E.15.
- E.3.2 In 1999, to the immediate southwest of the site (**HEA 2**) at Hammersmith Embankment between Winslow Road and Chancellor's Road, a MoLAS trial trench evaluation and subsequent excavation of an area c. 46m by 43m revealed probable prehistoric pits and artefacts, and evidence of Early Saxon settlement. A brick-built structure was interpreted as part of a kiln for the production of glass beads in the 17th century, and an 18th-century brick-built cellar.
- E.3.3 In 2001, MoLAS conducted a watching brief on 13 geotechnical test pits and an evaluation comprising five trial trenches to the south and southeast of the existing pumping station and partially within the site (**HEA 1B**). Parts of truncated brick structures were recorded, possibly associated with outbuildings of an early-17th century mansion (later known as

Brandenburgh House) which stood to the south of the site. Natural brickearth was cut by an undated gully 3m below ground level (mbgl) flanked by stakeholes. Features were also identified running onto the site from the neighbouring site (**HEA 2**) to the southwest, including a large – possibly Saxon – cut feature, and part of a post-medieval kiln for the production of glass beads.

- E.3.4 In 2005, three open area archaeological excavations were carried out by MoLAS (**HEA 1C**). The largest area excavated (Area 1) was c. 20m outside the site boundary to the southwest. Here, natural brickearth and gravels had been cut through by Parr's Ditch, filled by a succession of waterlain deposits. One pit was identified as of Saxon date, with other features possibly contemporary. A ditch may have marked the eastern limit of the Saxon settlement. 17th-century features comprised a series of brick-built structures probably associated with Brandenburgh House, linear features and dumping relating to glass bead manufacture and water/waste management. There was evidence of 18th-century garden features, and of the early 19th-century abandonment of the house. Area 2, 12m by 17m, was immediately outside the southeastern site boundary, and revealed features related to brick production in the early-17th century. Area 3 was 19m by 32m, located in the eastern corner of the site adjacent to Distillery Road. No archaeological features were identified within it, and truncated brickearth was recorded c. 1.5m bgl.
- E.3.5 In 2007, a further watching brief took place on drain runs and 69 pile pits across most of the land between Winslow Road and Chancellor's Road, including the southeastern part of the site. Most of the pile pits measured c. 3m by 3m centred at c. 10m intervals. Almost all the remains recorded were basements and structures associated with Victorian and later industrial buildings, such as a distillery and sugar refinery, and no evidence was found for any activity before the post-medieval period, nor any remains associated with Brandenburgh House: evidence for glass bead manufacture was found in a few areas.
- E.3.6 As a result of these investigations, archaeological remains have been removed entirely from within the trial trenches, excavated areas and pile pits, although truncated and localised remains are likely to survive between them.
- E.3.7 Four other archaeological investigations have taken place within the 300m-radius assessment area around the site. A watching brief at the Distillery on Winslow Road, 170m to the south of the site (**HEA 3**) recorded cut features of medieval or possibly earlier date, and a prehistoric flint flake. In 1990, an archaeological excavation 175m to the south of the site (**HEA 4**) revealed evidence of Early Saxon occupation, and Roman pottery mixed with deposits of later date. A foreshore survey by the Thames Archaeological Survey in the 1990s, approximately 100m to the southwest of the site (**HEA 6**) recorded post-medieval structures and artefact scatters on the Thames foreshore at low tide. In 1976, an archaeological excavation 200m to the north of the site (**HEA 12**) recorded large scale 18th-century dumping.

E.3.8 The results of these investigations, along with other known sites and finds within the assessment area, are discussed by period, below.

E.4 Archaeological and historical background of the site

E.4.1 The following section provides a detailed archaeological and historical background for the site. It should be read alongside the research framework presented in Appendix C to Vol 2 Appendix E2, which sets the overall Thames Tideway Tunnel project, and the individual site-specific assessments, within a broader historic environment context (i.e. past landscapes and human activity within such landscapes). It identifies the main route-wide heritage themes, of which the built and buried heritage assets identified within this assessment form a part.

Prehistoric period (700,000 BC–AD 43)

E.4.2 The gravel terrace on which the site is located would have been favoured for agriculture and settlement from the earliest times, particularly at this location as there was direct access to the river, without the need to cross the intertidal marshes found elsewhere along stretches of the Thames. If an earlier, natural, course of Parr's Ditch existed this would have also been a focus for prehistoric activity and indirect evidence for this activity, as well as environmental evidence for past landscape reconstruction might be preserved in its fills.

E.4.3 Archaeological investigation immediately to the southwest of the site (**HEA 2**), recorded pits containing undated prehistoric pottery, and an early Bronze Age leaf-shaped flint arrowhead. A prehistoric flint flake was also recovered during archaeological investigations (**HEA 3**) 170m to the south of the site. These finds suggest prehistoric activity in the vicinity of the site, but much of the ancient land surface has been truncated by later development, and the archaeological evidence disturbed or removed.

Roman period (AD 43–410)

E.4.4 The main settlement of London (Londinium) was established in around AD50, in the area of the City of London, 9km northeast of the site. A major Roman road passed westwards from Londinium through Hammersmith to Silchester, on the line of Goldhawk Road and Shepherds Bush Road, 1.6km to the north of the site. King Street and Hammersmith Road, 300m north of the site, are thought to preserve the route of a lesser road which probably led to a small settlement in the area of Fulham, 1.8km to the southeast (Mills and Whipp, 1980)³.

E.4.5 These roads, and the riverside, are likely to have attracted settlement and other activity, although there is little evidence of such within the assessment area, and the landscape would have been predominantly rural with a scatter of farmsteads. Archaeological excavation immediately southwest of the site (**HEA 2**) recovered six Roman copper alloy coins and pottery. These finds were residual, from within an early-Saxon feature, and may represent Roman activity in the area: they could, however, have been brought from further away. A few sherds of Roman pottery were

also recovered during archaeological excavations 175m to the south of the site (**HEA 4**), but no Roman features were recorded. The PAS records the findspot of a Roman coin (**HEA 5**) 250m to the northwest of the site.

- E.4.6 It is likely that during this period the site was in open land, possibly under cultivation or used as pasture.

Early medieval (Saxon) period (AD 410–1066)

- E.4.7 In AD 631 the manor (estate) of Fulham was granted by the Bishop of Hereford to the Bishop of London (Walford, 1878)⁴. Fulham gained its name from the Saxon word “Fullenham” which means the resort or habitation of birds, as it is believed that there was an abundance of waterfowl here (Walford, 1878)⁵. The Saxon manor house of Fulham is believed to have been located in the vicinity of Fulham Palace, 1.8km to the southeast of the site, and an early medieval church was probably built there, preceding the current All Saints church⁶.
- E.4.8 The Hammersmith area, which formed a part of Fulham manor, was also occupied in this period. Domesday Book (AD 1086) refers to the area as ‘Hermoderwode’. According to Faulkner (Faulkner, 1838)⁷, the name is derived from the Saxon ‘ham’, meaning town or dwelling, and ‘hyde’, meaning harbour. The ‘wode’ probably referred to the extensive woodland behind the river. According to Draper (Draper, 1913)⁸, the place name possibly derives from ‘Hamoder’s Hithe’, meaning ‘Hamoder’s haven’ (harbour). Both place names suggest a riverside settlement.
- E.4.9 Evidence for Early Saxon settlement has been found adjacent to the site. Archaeological excavations immediately southwest of the site (**HEA 2**) and 175m to the south of the site (**HEA 4**) revealed remains of a number of ‘sunken featured buildings’. These are characteristic of the Early to Middle Saxon period and generally consist of a rectangular pit and two post holes, which supported a roof. Such structures are thought to have been used for storage and as work-spaces for crafts such as weaving, or possibly with a raised floor over the pit to provide living space. Four ovens, or hearths, and numerous pits and post holes were also found, in addition to evidence of metal working. A possible Saxon pit may have extended into the southwestern part of the site (**HEA 1B**), although the eastern boundary of the Saxon settlement may have been marked by a ditch running roughly parallel to and c. 120m from the edge of the Thames (**HEA 1C**, Area 1). Its alignment, if projected north, would pass through the extreme southwestern part of the site. To the northeast of this ditch, the site may have been in an area used for cultivation, pasture or waste disposal.

Later medieval period (AD 1066–1485)

- E.4.10 Settlement at Hammersmith is mentioned in documentary sources dated to 1294, by which time it appears to have shifted north, to the vicinity of Queen Caroline Street, (**HEA 11**) 250m to the north of the site. The reason for the apparent abandonment of the site of the Saxon settlement is unknown and the extent of the later medieval village has not been determined (Denny, 1995)⁹. The Thames foreshore would have been important in the transportation of resources from the agricultural fields at Hammersmith into the growing city of London. The site probably lay

outside of the area of settlement, in open fields possibly under arable cultivation: evidence of medieval plough-marks has been found during archaeological investigations immediately outside the southern edge of the site (**HEA 1C**, Area 1). An archaeological watching brief 170m to the south of the site (**HEA 3**) recorded pits and gullies, some of which were thought to date to the later medieval period.

- E.4.11 A possibly ancient water channel flowed from Shepherds Bush and under Hammersmith Road near St Mary's Church, running southwest to cross what is now Fulham Palace Road (c. 160m east of the site) and across the centre of the site before reaching the Thames: its lower course was known as Parr's Ditch. Its course can be seen on post-medieval maps (Vol 5 Plate E.2, Vol 5 Plate E.3 and Vol 5 Plate E.4) and largely formed the parish boundary, although it is possible that it was actually constructed to mark the boundary. Physical evidence of the ditch was recorded during archaeological investigations within the site (**HEA 1B** and **HEA 1C**, Area 1) and on the foreshore (**HEA 6**), 150m to the southwest of the site, in 2007. There are a number of medieval and Tudor references to Parr's Ditch and bridge. The earliest known use of the place-name, (le) Perre, is in 1270, and it subsequently appears in connection with the ditch and bridge in various forms through the 15th and 16th centuries (Gover et al., 1942)¹⁰. The site of the medieval bridge (**HEA 10**) over Parr's Ditch has been recorded 200m to the northeast of the site.

Post-medieval period (AD 1485–present)

- E.4.12 By the early post-medieval period Hammersmith was an established riverside settlement, with the surrounding land being mainly agricultural (Hasker, 1992)¹¹. With the continually growing population of London, the need for food increased and areas such as Hammersmith, surrounded by productive farmland and located on the banks of the River Thames for water transport, were heavily relied on to meet the demand (Hasker, 1992)¹². Agricultural production in the area remained high throughout this period, although the Industrial revolution brought with it high levels of pollution within the River Thames, and fishing declined (Hasker, 1992)¹³.
- E.4.13 From the early 17th century until 1823 a mansion (known in the late-18th century as Brandenburgh House) stood just to the southwest of the site. It was built by Sir Nicholas Crisp (or Crispe) during King Charles I's reign (1625–1649). Crisp had inherited the land from his mother, Lady Katherine Pye, along with her house known as 'Le Lady Pye's House' which was demolished prior to the construction of the mansion (Fèret, 1900)¹⁴, (McLoughton A, 1971)¹⁵.
- E.4.14 Crisp's business concerns included the development of new brick making methods, and reputedly, the mansion was built with bricks manufactured using his own techniques. It was cornered with stone quoins and finished with a handsome cupola, and contained several grand rooms that were spacious and finely furnished. The foundations and walls were substantial, with arched vaults apparently arched in an extraordinary manner (Fèret, 1900)¹⁶. Archaeological excavations c. 20m outside the site boundary to the southwest (**HEA 1C**, Area 1) identified 17th-century brick structures probably associated with Crisp's mansion. A brick-built

and tile-covered structure recorded during the 2007 watching brief (**HEA 1C**) in the eastern part of the site may have related to brick manufacture. Evidence for brick manufacture was also recorded immediately outside the southeastern site boundary (**HEA 1C**, Area 2) in the form of a brick clamp (a basic oven) and burnt brick rubble.

- E.4.15 Crisp was also involved in the manufacture and sale of glass beads, probably for the West African slave trade in which he was an active participant from the 1620s until the 1660s. Glass-making was at the time uncommon in Africa, and beads were a major part of the currency exchanged for people and products. As glassmaking technologies developed in Europe, such beads proved to be a cheap and efficient means of exploiting African resources (Victoria and Albert Museum website, 2012)¹⁷. The remains of at least two glass-working furnaces were recorded during archaeological investigations to the southwest of the site (**HEA 1B** and **HEA 1C**, Area 1 and **HEA 2**), together with beads and glass waste. This bead-making site is potentially unique in the British archaeological record. The archaeological watching brief in the northeastern part of the site (**HEA 1C**) recorded quantities of uncut glass beads and other glass waste.
- E.4.16 Crisp's mansion was plundered during the early part of the Civil War and in August 1647 became the general headquarters of Sir Thomas Fairfax, commander in chief of the New Model Army, but was returned to Crisp at the Restoration of the monarchy in 1660. It was sold in 1683 (Weinreb, B et al., 1993)¹⁸.
- E.4.17 Rocque's map of 1746 (Vol 5 Plate E.1) shows general topographic detail, the main roads and settlement areas and major buildings. The site is in an area of gardens and trees, crossed by the Parr's Ditch, with Crisp's mansion, outbuildings, and formal gardens to the south and southwest: the main approach to the house appears to be from the south. Most of the surrounding area is under arable cultivation or used for market gardens, with the village of Hammersmith on what is now Queen Caroline Street to the northwest.
- E.4.18 The mansion was extensively refurbished during the 18th century, and in 1792 was bought by the Margrave of Brandenburg-Anspach. Further works included a conservatory and a 'gothic ruin', in castellated form, constructed as a theatre for his wife's use (Fèret, 1900)¹⁹. Faulkner's map of 1813 (Vol 5 Plate E.2) shows Brandenburg House directly to the south of the site. An orchard or a tree lined avenue, perhaps by that time the principal approach to the house, and the Parr's Ditch, cross the site from northeast to southwest. Possible 18th and 19th century garden and water-management features have been identified adjacent to the site during archaeological investigations (**HEA 1C**, Area 1 and **HEA 2**). The last occupant of Brandenburg House was Caroline of Brunswick, the estranged wife of the Prince of Wales (later George IV) who died there in 1821. The building materials, fixtures and fittings were auctioned and the demolition of the house was completed by 1823. A large quantity of dumped high-status pottery and glass was found within a brick-lined tank during archaeological investigations to the southwest of the site (**HEA 1C**,

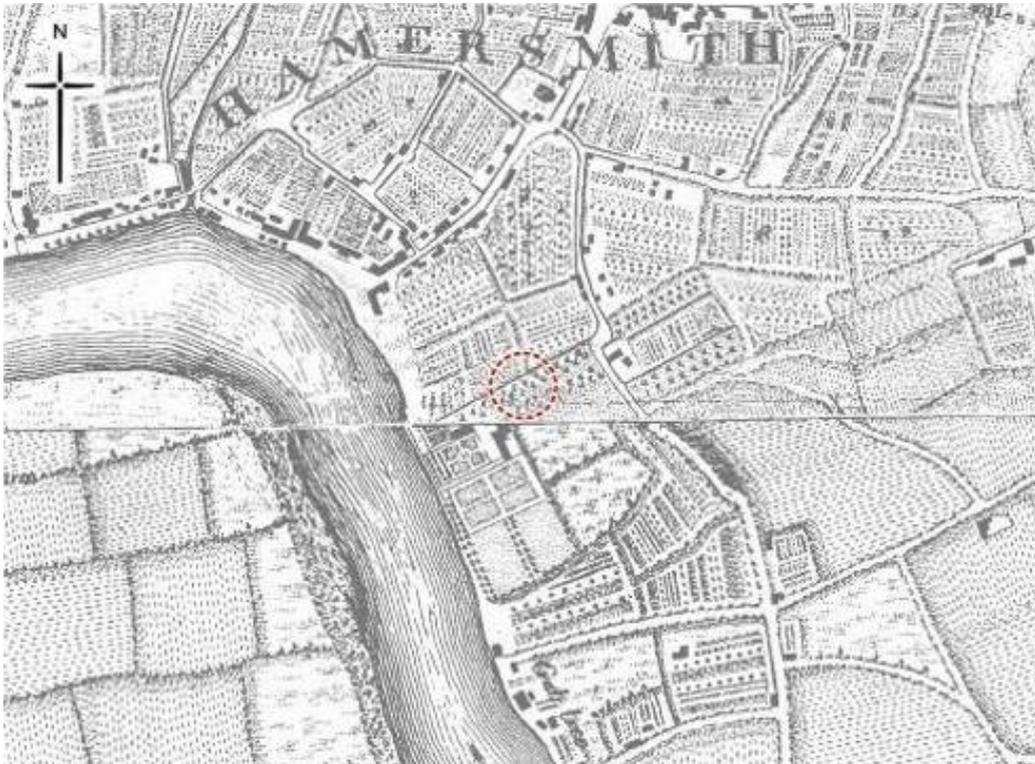
- Area 1). The grounds were for the most part incorporated in the Brandenburg Farm Estate (Fèret, 1900)²⁰.
- E.4.19 On Stanford's map of 1862 (Vol 5 Plate E.3), the site of Brandenburg House is occupied by smaller buildings and gardens or orchards. Two large distillery buildings have been constructed to the southwest of the site. The majority of the site is shown to be undeveloped, with the distillery yard and main access road from Fulham Road, and fields in the southeast corner. Chancellor Road, on the northwestern edge of the site, has been laid out, with possible terraced houses on its south side, potentially within the site. The former market gardens to the north of the site have been developed for housing, beside the Hammersmith Suspension Bridge. The bridge was built by WT Clarke in 1824–7 and was the first suspension bridge in London. It was replaced in 1883–7 by the present bridge, designed by Joseph Bazalgette (Weinreb et al., 2008)²¹.
- E.4.20 The Ordnance Survey 1st edition map of 1869–74 (Vol 5 Plate E.4) shows the site in greater detail. The course of Parr's Ditch is largely indicated by the line of the parish boundary and crosses through the middle of the site on a northeast/southwest alignment. The terraced houses fronting Chancellor Road are still shown in the northern part of the site. Most of the southern half of the site falls within the open yard of the distillery, with a circular tank possibly within the southwestern part of the site, and a possible large semi-rectangular tank in the centre of the site. The main distillery building lies to the west of (outside) the site.
- E.4.21 The Ordnance Survey 2nd edition 25" mile map of 1896 (Vol 5 Plate E.5) shows an expansion of the Hammersmith Distillery buildings to the west and south of the site, and identifies the associated rectangular tank within the site as previously shown. Distillery Lane runs into the site from the northeast, with small houses on its north side.
- E.4.22 The Ordnance Survey 3rd edition 25" mile map of 1909 (Vol 5 Plate E.6) shows the addition within the site of a number of small buildings at the edge of the distillery yard. In the southern part of the site two more circular tanks have been built. To the east of the site, streets of terraced houses have been laid out. The Ordnance Survey 3rd edition revised 25":mile map of 1935 and the 1:10,000 scale map of 1948 (not reproduced) show no change within the site.
- E.4.23 By the time of the Ordnance Survey 1:2500 scale map of 1952 (Vol 5 Plate E.7) additional industrial or storage buildings had been constructed within the southern and central parts of the site to the north of the tanks and along the eastern site boundary.
- E.4.24 Then Ordnance Survey 1:10,000 scale map of 1976 (Vol 5 Plate E.8) no longer shows the terraced houses in the northern part of the site: these have been demolished and replaced with a single industrial building and the existing pumping station. The houses to the east of the site have been demolished, and the area – including the old Distillery Lane – is now an open space with the new Distillery Road on its southwestern side, forming the northeastern site boundary. To the south, the buildings of the distillery have also been replaced by other industrial buildings.

The current site

- E.4.25 Currently the site is mostly open, with the exception of the existing 1960s Hammersmith Pumping Station which falls within the western boundary of the site (**HEA 1A**). This is a small complex of modern concrete frame buildings. The main building contains a large amount of electrical pump control equipment, while the smaller building of the complex is known as 'The Screen House'. The southern half of the site falls within open land, cleared in advance of the Fulham Reach development.

E.5 Plates

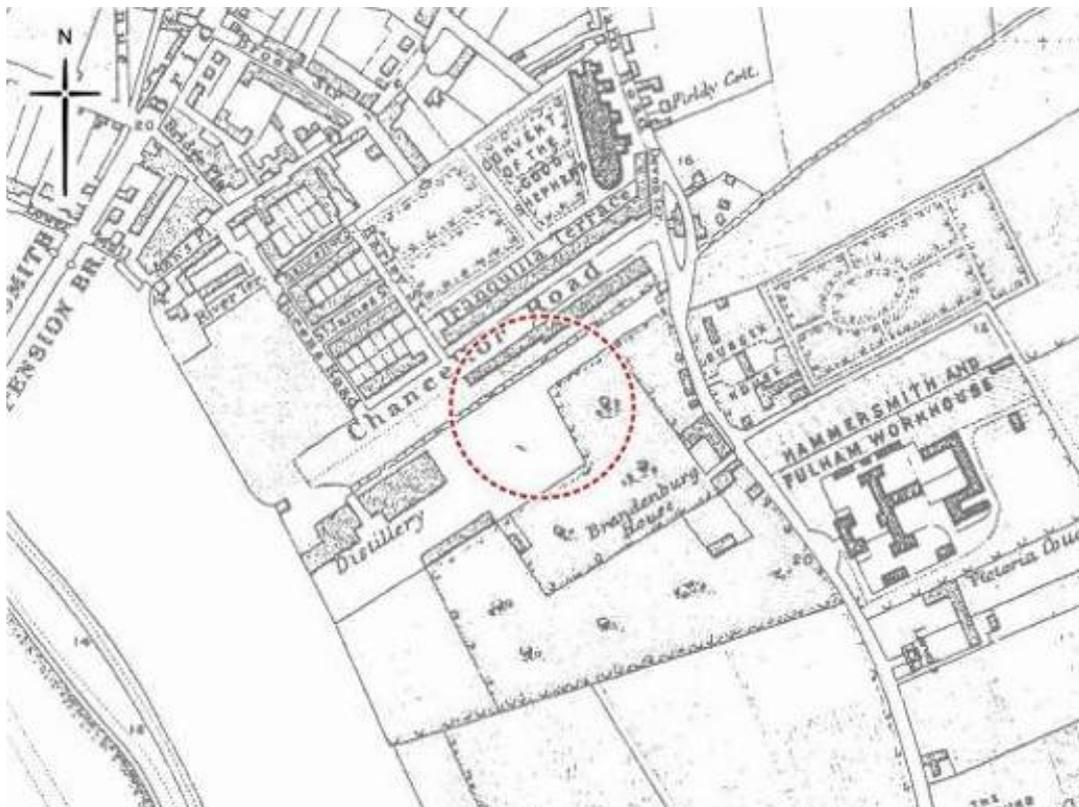
Vol 5 Plate E.1 Historic environment – Rocque's map of 1746



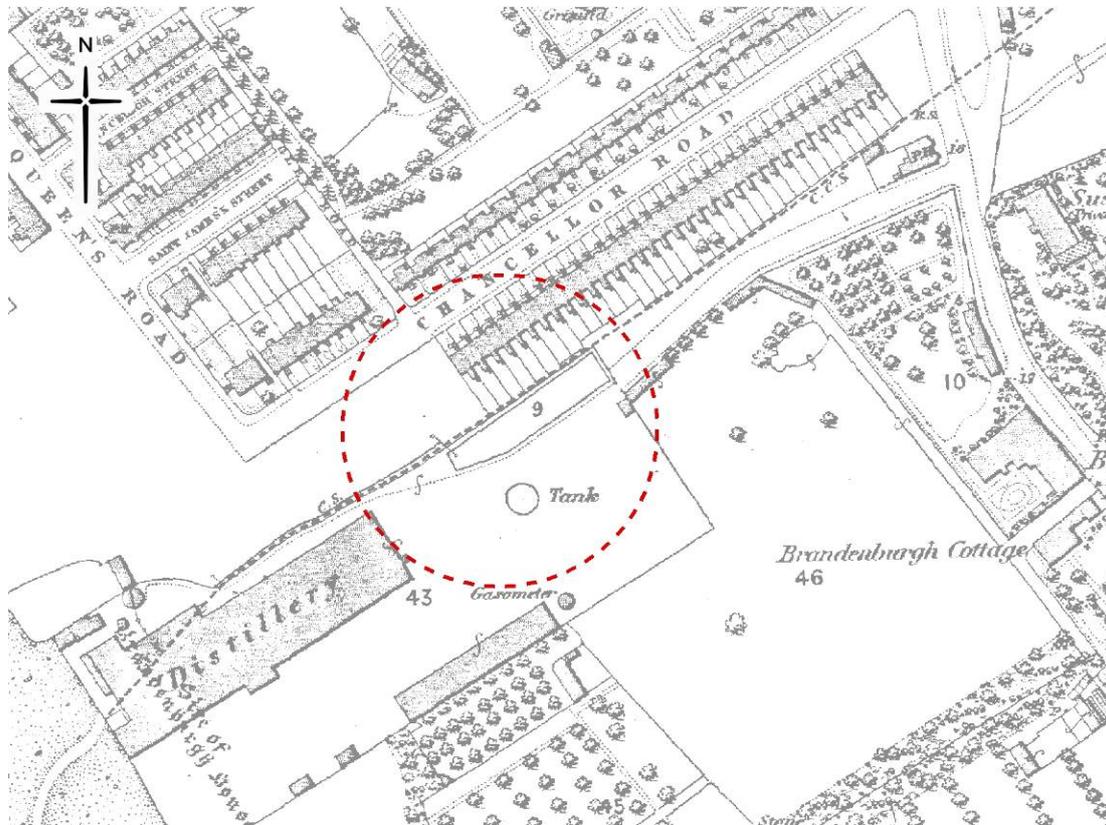
Vol 5 Plate E.2 Historic environment – Faulkner’s map of 1813



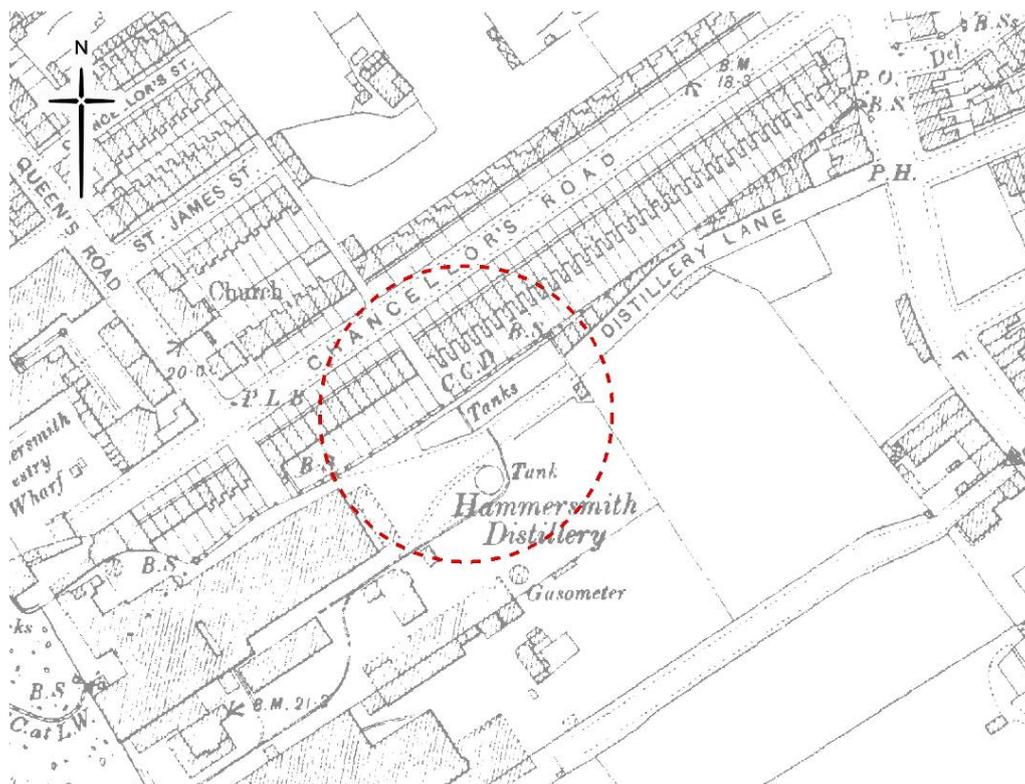
Vol 5 Plate E.3 Historic environment – Stanford’s map of 1862



Vol 5 Plate E.4 Historic environment – Ordnance Survey 1st edition 25” scale map of 1869–74 (not to scale)



Vol 5 Plate E.5 Historic environment – Ordnance Survey 2nd edition 25” scale map of 1896 (not to scale)



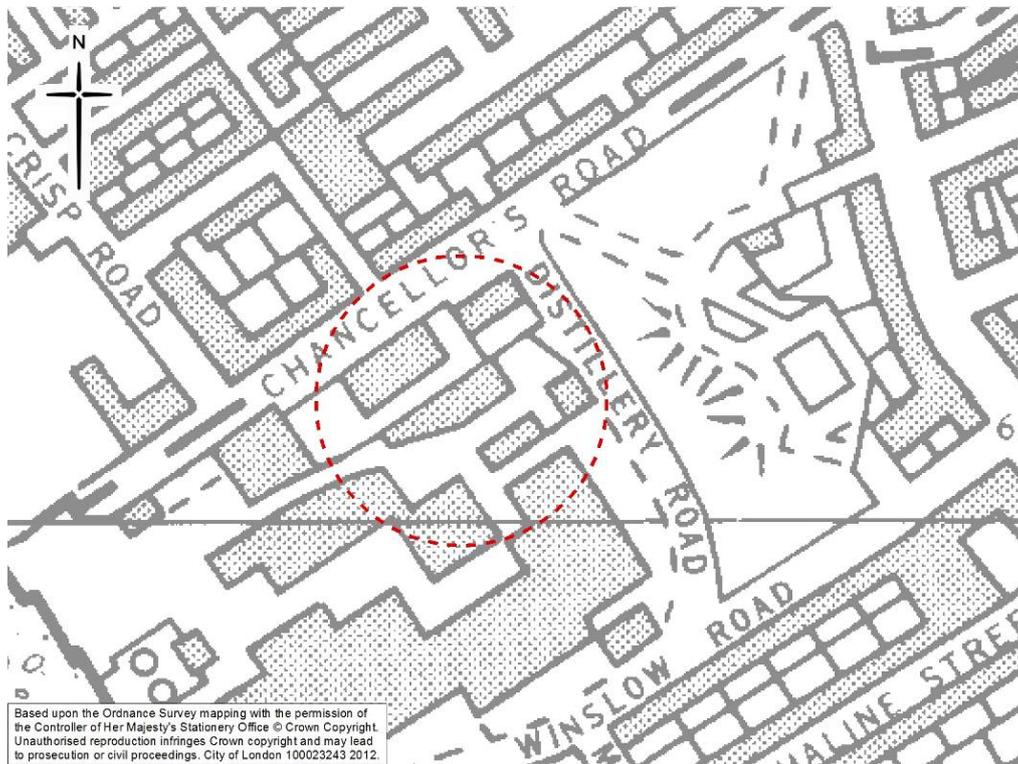
Vol 5 Plate E.6 Historic environment – Ordnance Survey 3rd edition 25” scale map of 1909 (not to scale)



Vol 5 Plate E.7 Historic environment – Ordnance Survey 1:10,000 scale map of 1952 (not to scale)



Vol 5 Plate E.8 Historic environment – Ordnance Survey 1:10,000 scale map of 1976 (not to scale)



Vol 5 Plate E.9 Historic environment – south side of the Hammersmith Pumping Station (HEA 1A)



March 2011; standard lens, looking west (MOLA 2011)

Vol 5 Plate E.10 Historic environment – The Screen House, Hammersmith Pumping Station (HEA 1A)



March 2011; standard lens, looking north (MOLA 2011)

Vol 5 Plate E.11 Historic environment – internal view of Hammersmith Pumping Station (HEA 1A), ground floor



March 2011; standard lens (MOLA 2011)

Vol 5 Plate E.12 Historic environment – brass plaque from the original Hammersmith Pumping Station (HEA 13) on ground floor of current building (HEA 1A)



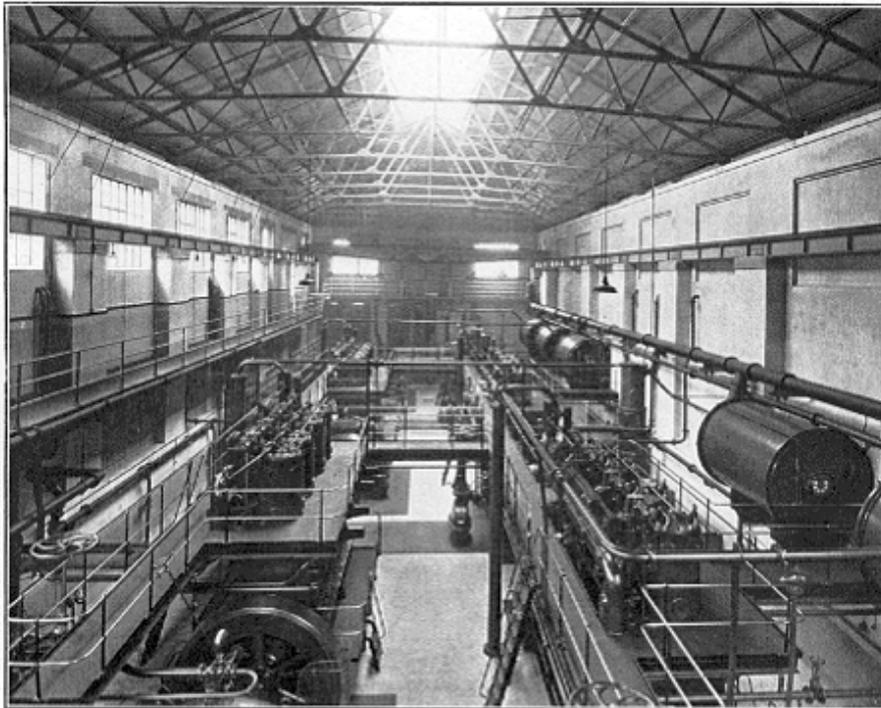
March 2011; standard lens (MOLA 2011)

Vol 5 Plate E.13 Historic environment – the low brick building in the centre is the Thames Water offices on Chancellors Road, formerly the Hammersmith Pumping Station of c 1922 (HEA 13)



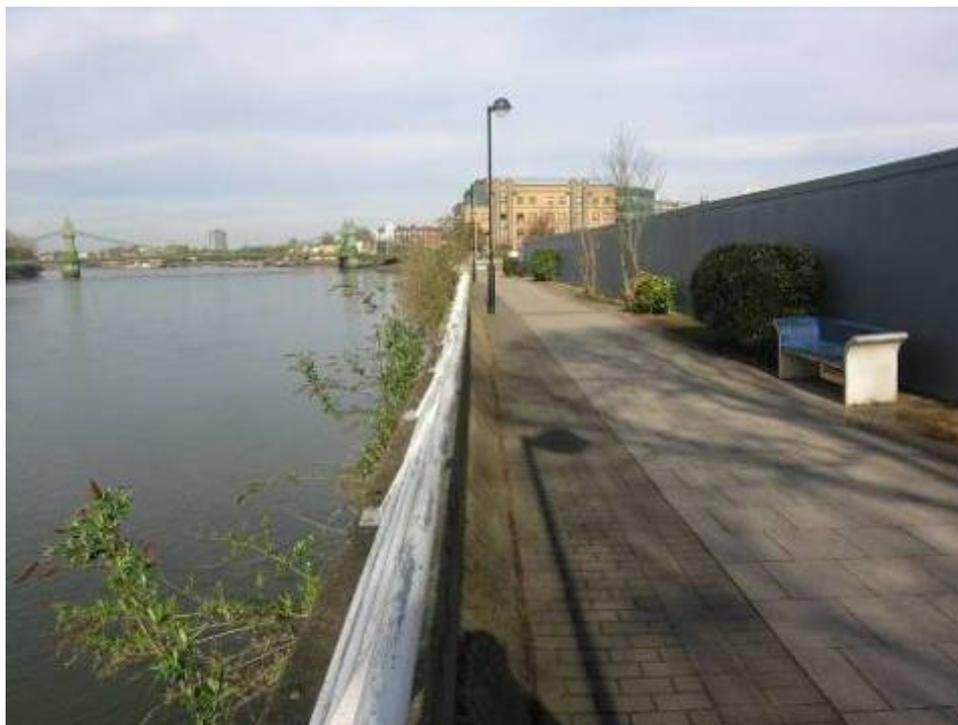
March 2011; standard lens, looking north from the site (MOLA 2011)

Vol 5 Plate E.14 Historic environment – view within the original Hammersmith Pumping Station (HEA 13) from the article *Main Drainage of London* by Sir G. W. Humphreys, 1930. His name appears on the plaque now in the 1966 building



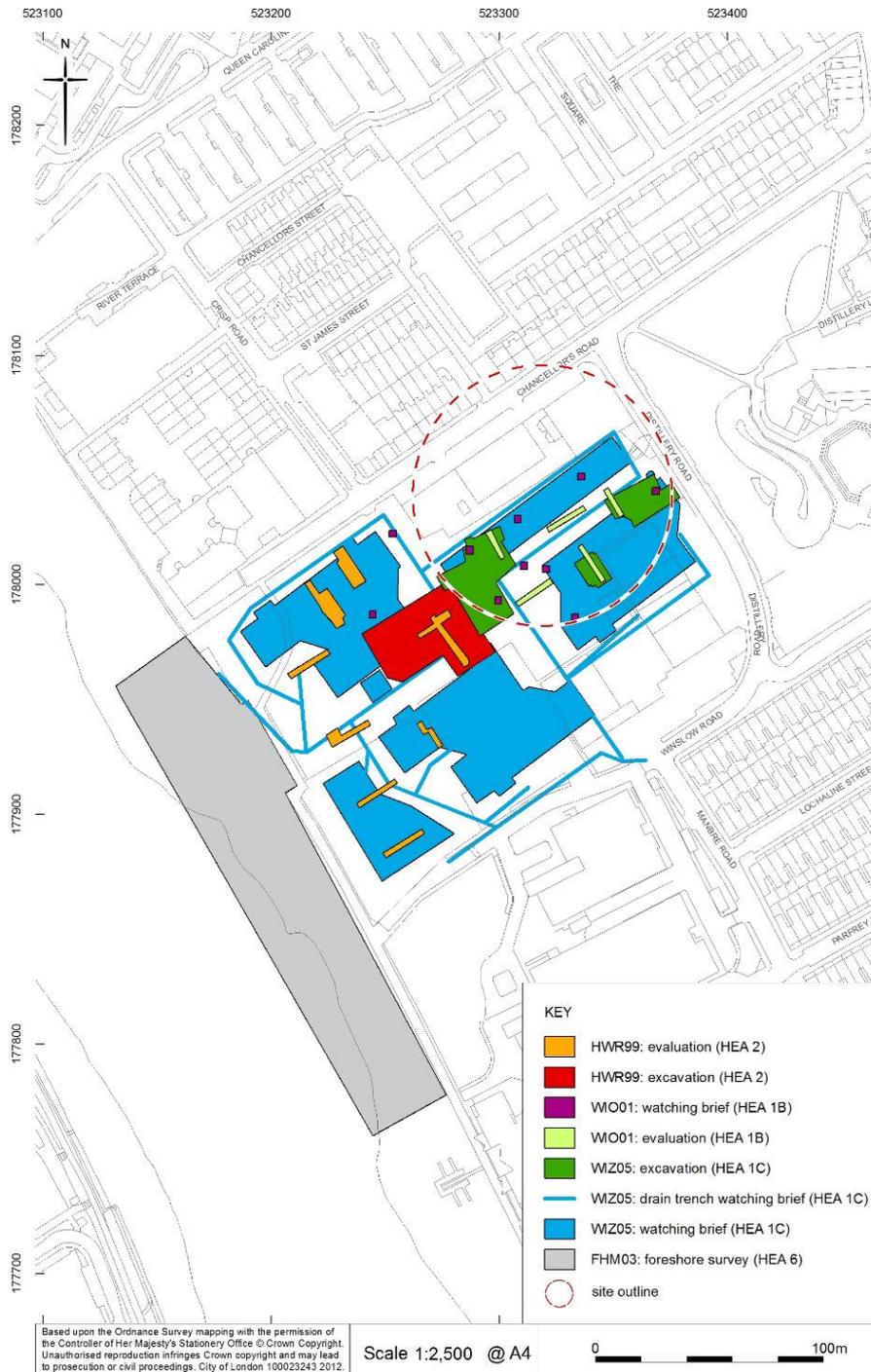
HAMMERSMITH STORM WATER PUMPING STATION—GAS ENGINES AND CENTRIFUGAL PUMPS.
1922-24.

Vol 5 Plate E.15 Historic environment – a view along the riverside path



March 2011; standard lens; looking northwest from the western edge of the site, (MOLA 2011)

Vol 5 Plate E.16 Historic environment – areas of archaeological investigation in the vicinity of the site, 1999–2007



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Thames Tideway Tunnel
Thames Water Utilities Limited



Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.05**

Volume 5: Hammersmith Pumping Station appendices

Appendix F: Land quality

APFP Regulations 2009: Regulation **5(2)(a)**

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Thames Tideway Tunnel

Environmental Statement

Volume 5 Appendices: Hammersmith Pumping Station site assessment

Appendix F: Land quality

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Appendix F: Land quality

F.1 Baseline report

- F.1.1 Baseline data is sourced from:
- a. walkover survey
 - b. the Landmark Information Group database, including historic maps and environmental records
 - c. stakeholder consultation
 - d. the initial results from a preliminary intrusive ground investigation.

F.1.2 The baseline report relates only to the main Hammersmith Pumping Station site. The Highway site is referred to explicitly where relevant.

Site walkover

F.1.3 A site walkover survey of Hammersmith Pumping Station was undertaken on 15th November 2010.

F.1.4 The aim of the walkover survey was to inspect the condition of the site and surrounding areas in order to identify evidence of historic or ongoing contamination sources, as well as any nearby sensitive receptors.

F.1.5 The proposed development site comprises an area of currently unoccupied, brownfield land within Hammersmith Embankment and the Hammersmith Pumping Station.

F.1.6 The site is contained within hoarding and a number of excavated material and rubble heaps were observed as well as several pieces of pipework within the vicinity of the pumping station.

F.1.7 The Hammersmith Industrial Estate, which has recently been demolished, was previously situated in the north-eastern corner of the site.

F.1.8 Detailed site walkover notes are provided in the Vol 5 Table F.1 below.

Vol 5 Table F.1 Land quality – site walkover report

Item (Site ref: PHF2X, Hammersmith Pumping Station)	Details	
Date of walkover	15th November 2010	
Site location and access	Thames Water operated Hammersmith Pumping Station and vacant land within the wider area. Site is situated on Chancellors Road and Distillery Road. The site consists of the main construction site and Hammersmith Pumping Station highway works site, located in Chancellors Road.	
Size and topography of site and	Record elevation in relation to surroundings, any	Entirely flat.

Item (Site ref: PHF2X, Hammersmith Pumping Station)		Details
surroundings	hummocks, breaks of slope etc	
Neighbouring site use (in particular note any potentially contaminative activities or sensitive receptors)	North	Open park land and children's playground (Frank Banfield Park) located northeast on Distillery Road.
	South	Residential properties on Winslow Road.
	East	Commercial and residential properties located on Distillery Lane/Chancellors Road.
	West	Thames Path and River Thames.
Site buildings	Record extent, size, type and usage. Any boiler rooms / electrical switchgear	The proposed main worksite is located at the Thames Water owned Hammersmith Pumping Station and also encompasses an area of currently vacant, brownfield land, adjacent to the station. This area is located on Hammersmith Embankment. Adjacent to the southern boundary of the site is a car park.
Surfacing	Record type and condition	Hardstanding
Vegetation	Any evidence of distress, unusual growth or invasive species such as Japanese Knotweed	Areas of hardstanding but the area is mostly dominated by cleared land and pockets of grasses and scrub.
Services	Evidence of buried services	None observed
Fuels or chemicals on-site	Types/ quantities	None observed
	Tanks (above ground or below ground)	None observed
	Containment systems (eg, bund, drainage interceptors). Record condition and standing liquids	None observed
	Refill points located inside bunds or on impermeable surfaces etc	None observed

Item (Site ref: PHF2X, Hammersmith Pumping Station)		Details
Vehicle servicing or refuelling on-site	Record locations, tanks and inspection pits etc	None observed
Waste generated/stored on-site	Adequate storage and security. Evidence of fly tipping	A number of excavated material and rubble heaps were observed as well as several pieces of pipework within the vicinity of the Pumping Station. Site is surrounded by hoarding.
Surface water	Record on-site or nearby standing water	The River Thames is located approximately 110m to the west.
Site drainage	Is the site drained, if so to where? Evidence of flooding?	The River Thames borders the site to the west.
Evidence of previous site investigations	eg trial pits, borehole covers	None observed
Evidence of land contamination	Evidence of discoloured ground, seepage of liquids, strong odours?	None observed
Summary of potential contamination sources		No obvious potential contaminative sources were identified during the survey.
Any other comments	Eg access restrictions/ limitations	Presence of excavated material and rubble heaps.

Review of historical contamination sources

- F.1.9 Historical mapping (dating between 1868 and 1988) has been reviewed in order to identify potentially contaminating land-uses at the site and within the 250m assessment area. The data has been supplemented with information supplied by the London Borough of Hammersmith and Fulham (LBHF) which is presented in Section F2 and summarised in paras F.1.105 to F.1.109.
- F.1.10 Vol 5 Table F.2 tabulates the potentially contaminating land-uses, inferred dates of operation and typical contaminants associated with the land-uses in question. Information on the potential contaminants are sourced from CLR8: *Potential contaminants for the assessment of land* (Defra and EA, 2011)¹ and former Department of the Environment industry profiles (Department of the environment, 2011)².

F.1.11 All dates are approximate, where no other information is available the dates relate to when the items first appeared and disappeared from the mapping rather than actual dates of construction, operation or demolition.

F.1.12 Items listed in the table below are also shown on Vol 5 Figure F.1.1 (see separate volume of figures). In addition, figures illustrating the historical environment of the site and surrounding area as received from stakeholder consultation are provided in Section F.3 along with figures provided in Vol 5 Appendix E.

Vol 5 Table F.2 Land quality – potentially contaminating land- uses

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item1·2
On-site			
1	(a) Distillery (including gasometer)	c1869-c1959	Volatile organic compounds (VOC), total petroleum hydrocarbons (TPH), heavy metals, ethanol/methanol, ammonia, chlorinated alkalis, benzene, toluene, ethylbenzene and xylenes, arsenic, complex and free cyanide, sulphates, asbestos, phenol, poly aromatic hydrocarbons (PAHs)
	(b) Methylated spirits manufacture	c1959-c1960	ethanol/methanol, VOCs, wood naphtha, pyridine, mineral naphtha (petroleum oil) synthetic organic dyestuff (methyl violet), isopropyl alcohol, acetone, methyl ethyl ketone, methyl isobutyl ketone, denatonium
	c) Chemical storage (and latterly British Petroleum (BP) site)	c1960-c1970	Heavy metals, arsenic, boron, selenium, free cyanide, nitrates, sulphates, sulphides, asbestos, PAHs, phenols, acetones, aromatic hydrocarbons, PCBs, dioxins, furans
4	Sewage pumping station	c1951-present	Heavy metals, arsenic, free cyanide, nitrates, ammonium, phosphates, sulphates, sulphides, asbestos, oil/fuel hydrocarbons, chlorinated aliphatic hydrocarbons, chlorinated aromatic hydrocarbons, polychlorinated biphenyls (PCBs), pathogens
Off-site*			
2	Saccharine works (sugar refinery) (30m south)	c1896-c1962	Oils, fuels, greases, diesel associated with machinery and back-up power, toluene, sulphides, acids, chlorine, ammonia, heavy metals
3	Coal yard (40m	c1951	Heavy metals, arsenic, hydrocarbons

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item ^{1,2}
	south)		
5	Chemical storage (75m southwest)	c1972-c1983	Heavy metals, arsenic, boron, selenium, free cyanide, nitrates, sulphates, sulphides, asbestos, PAHs, phenols, acetones, aromatic hydrocarbons, PCBs, dioxins, furans
6	Wharf (100m northwest)	c1868-c1988	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
7	Cement works (80m southwest)	c1896	Heavy metals, arsenic, boron, free cyanide, nitrates, sulphates, sulphur, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
8	Iron works (40m west)	c1896-c1916	Heavy metals, arsenic, boron, free cyanide, nitrates, sulphates, sulphides, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
9	Wharf (45m west)	c1874-c1988	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
10	Engineering works (140m northwest)	c1916-present	Heavy metals, arsenic, boron, free cyanide, nitrate, sulphide, sulphate, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
11	Joinery (245m south)	c1951-c1952	Heavy metals, arsenic, boron, free cyanide, nitrates, sulphates, sulphides, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
12	Pumping station (40m north)	c1951-c1952	Heavy metals, arsenic, free cyanide, nitrates, ammonium, phosphates, sulphates, sulphides, asbestos, oil/fuel hydrocarbons, chlorinated aliphatic hydrocarbons, chlorinated aromatic hydrocarbons, PCBs, pathogens

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item ^{1,2}
13	Electrical substations (closest 30m north)	c1951-c1988	Oil, PCBs
14	Coach works (190m northwest)	c1952	Heavy metals, asbestos, TPHs, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons
15	Food processing factory (165m south)	c1952-c1988	Heavy metals, arsenic, free cyanide, nitrates, sulphates, sulphides, asbestos, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
16	Depot (40m north)	c1972-present	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds, heavy metals and asbestos

* refers to the main site.

On-site

- F.1.13 The earliest historical maps reviewed (1869) indicate that the southern part of the site, as well as the surrounding currently vacant area, was the location of a large distillery which included various process buildings, chimneys, tanks and, for a brief period, a gasometer.
- F.1.14 The Hammersmith Distillery (previously Haig Distillery) was established on the site (and on land further to the south) prior to 1869. A number of tanks and a gasometer were present on the site during its operation, including tanks of unknown contents in the northeast corner of the distillery, in the area of the proposed development site. Planning permission for the erection of a spirit tank farm was granted in 1954.
- F.1.15 Operation of the distillery ceased in 1959, after which the site was used to manufacture industrial chemicals including methylated spirits. This was subsequently halted due to discharges to the river. In the 1960s and 1970s, the former distillery was converted to a chemical storage site; the site was later transferred to the British Petroleum Company (BP). It is understood that various other smaller companies may have used the site from the 1970s onwards.
- F.1.16 Housing formerly occupied the northern part of the site boundary (fronting Chancellor Road) from the late 19th Century to the 1960s and the existing Hammersmith Pumping Station was constructed in the 1960s.
- F.1.17 In 1979 the council granted planning permission for installation for two 150 tonne carbon dioxide tanks, and in 1982 for the erection of a bunded diesel tank.

Off-site

- F.1.18 Within the 250m assessment area, the historical mapping shows that from the late 19th century through the twentieth century the area had been developed with a number of commercial and industrial works.
- F.1.19 As well as the wider distillery and related works which were present to the south (as described above), this included two wharves fronting the River Thames along the embankment, an iron works and cement works, a sugar refinery (saccharine works), engineering works, depot, a motor works and food processing factory.
- F.1.20 Presently only the engineering works and depot still exist. The food processing factory has been converted to bars/restaurants.
- F.1.21 The surrounding area remains predominantly residential.
- F.1.22 Directly to the northeast/east of the proposed development site on the opposite side of Distillery Road, the land was formerly occupied by terraced residential properties but, following bomb damage during WWII, was redeveloped into a park.
- F.1.23 In 2008, planning permission was granted for improvements to the park with a condition for placement of clean topsoil and turf across the park. The council report that elevated metals, TPH and PAHs were found within this area³.

Geology

- F.1.24 Data from the Thames Tideway Tunnel project ground investigation indicates the anticipated geological succession, as summarised in Vol 5 Table F.3 below.

Vol 5 Table F.3 Land quality – anticipated site geology

Geological unit/ strata	Description	Approximate depth below ground level (m)
Made Ground	Largely comprises sandy gravely silt with local gravels of brick, concrete and flint.	0.0 – 2.75
Alluvium	Soft and firm sandy slightly gravely clay with occasional shell fragments	2.75 – 3.25
River Terrace Deposits	Medium dense to dense sand and gravel (predominantly quartz sand and flint gravel).	3.25 – 7.75
London Clay	Slightly sandy and silty fissured clay.	7.5 – 40.85

Unexploded ordnance

- F.1.25 During both World Wars I and II, the London area was subject to bombing. In some cases bombs failed to detonate on impact. During construction works Unexploded Ordnance (UXO) are sometimes encountered and require safe disposal.

F.1.26 A desk based assessment for UXO threat has been undertaken by 6 Alpha Associates Limited at the Hammersmith Pumping Station site.⁴ The report reviewed information sources such as the Ministry of Defence (MoD), Public Records Office and the Port of London Authority (PLA).

F.1.27 Taking into account the findings of this study and known extent of the proposed works at the Hammersmith Pumping Station site, it was considered that there is an overall low/medium threat from UXO.

Thames Tideway Tunnel ground investigation data

F.1.28 This section summarises the ground investigation undertaken by the Thames Tideway Tunnel project.

F.1.29 One borehole (PR1117) was drilled at the proposed development site as part of the project-wide ground investigation, as shown on Vol 5 Figure F.1.2 (see separate volume of figures).

F.1.30 Vol 5 Figure F.1.2 (see separate volume of figures) also identifies a number of other boreholes excavated in vicinity of the site. However, these are not considered relevant, to the contamination status of the site, either due to their distance from the proposed combined sewer overflow (CSO) drop shaft location or because certain boreholes were excavated purely for geotechnical purposes.

Soil contamination testing

F.1.31 Four soil samples (comprising Made Ground, Alluvium and River Terrace Deposits) were taken from borehole PR1117 and sent for laboratory analysis.

F.1.32 The samples were tested for a wide variety of common contaminants including heavy metals and metalloids, PAHs, TPH, VOCs, PCBs, cyanide and phenols.

F.1.33 The testing recorded no contaminants above light industrial/ commercial human health screening values (Defra and EA, 2009)⁵, (Chartered institute of Environmental Health, 2009)⁶. No exceedances of more stringent residential screening values were found.

F.1.34 Refer to Volume 2 Environmental assessment methodology for full guidance on the benchmarks used.

Soil gas testing

F.1.35 Two rounds of ground gas monitoring of a standpipe installed in the alluvium in borehole PR1117 showed no detectable carbon dioxide or methane

Groundwater testing

F.1.36 Groundwater data shows exceedances of sodium and sulphate on-site, at borehole PR1117 and off-site for nitrate and PAHs, when compared against UK drinking water standards and Water Supply (Water Quality) Regulations (2000) .

F.1.37 The levels of contamination recorded are not considered to pose a risk to human health receptors.

F.1.38 Refer to Section 13 Water resources – groundwater of this volume for further information on groundwater quality on-site and in the surrounding area.

Third party ground investigation data

F.1.39 The site and immediate surroundings have been the subject of several intrusive site investigations.

F.1.40 The investigations centre on the wider Hammersmith Embankment site but some of the sampling locations encompass certain areas within the proposed Thames Tideway Tunnel site.

F.1.41 It should be noted that some of the reports are incomplete and due to their age and nature of the project for which they were commissioned, they utilise different soil and soil gas assessment criteria to those that are currently applicable. Whilst it has not been possible to determine the exact contaminant levels in comparison with current guidance and exploratory borehole location in each case, the documents provide a very good overview of the contamination status of the site and immediate surroundings.

F.1.42 Summaries of the following investigations are provided below

- a. Costain Limited (2000)
- b. WSP Environmental Limited (2002)
- c. Mott MacDonald Limited (2005)
- d. Mott MacDonald Limited (2007)
- e. Geo-environmental Services Limited (2011)

Costain Limited, 2000

F.1.43 A geo-environmental site assessment was undertaken by Costain Limited⁷ in 2000, as part of Project Brando site investigations at the Hammersmith Embankment site.

Exploratory holes

F.1.44 The intrusive investigation consisted of a combination of 30 boreholes and trial pits across the embankment. Those elements within the proposed Thames Tideway Tunnel site consist of WS5, TP17, TP21 and BH03 (BH03 is in the area of the proposed shaft site). Immediately adjacent to these are TP14, TP8, TP7 and TP3.

Soil analysis

F.1.45 Analysis from the samples taken at the site of the proposed Thames Tideway Tunnel site identified no elevated levels of contamination when compared against current Land Quality Management and Chartered Institute of Environmental Health (LQM), 2009:6 generic assessment criteria for commercial use, with the exception of lead and chromium.

F.1.46 Lead concentrations were recorded within WS5 (1.40mbgl) at 983 mg/kg in comparison with the recently withdrawn SGV of 750mg/kg.

- F.1.47 A lead concentration of 1126 mg/kg was recorded in TP7 at 0.90mbgl (this trial pit is located immediately adjacent to the proposed Thames Tideway Tunnel development site).
- F.1.48 Forty eight samples taken from Made Ground across the wider embankment site were tested for asbestos, 15.4% of these tested positive for fibres. This is considered to indicate a widespread but low level of asbestos contamination within surface or near surface material; no particular hotspots of asbestos contamination were identified. It is not possible to identify from the data whether any on-site exploratory holes contained asbestos.
- F.1.49 Notable observations of exploratory trial pits in and around the vicinity of the proposed Thames Tideway Tunnel site are as follows:
- TP7: Organic odour present within the Made Ground at a depth of 2.10-3.80mbgl
 - TP17: Debris such as plastic sheeting and metal motor oil can found within Made Ground at a depth of between 1.30 and 1.90mbgl
 - BH3: Water depth 5.20mbgl.
- F.1.50 The report concluded that although no particular pattern of contamination distribution could be established, the location of TP17 appeared more contaminated in general.

Groundwater analysis

- F.1.51 The investigation included testing of groundwater samples retrieved from borehole BH3 (on-site).
- F.1.52 Notable contaminants found above instrument detection limits were boron (0.23 ppm), sulphide (0.02 ppm) and thiocyanate (0.4 ppm).
- F.1.53 PAHs detected within BH3 were naphthalene (183ng/l), acenaphthene (83ng/l), fluorene (49ng/l), phenanthrene (64 ng/l) anthracene (14ng/l), fluoranthene (28ng/l) and pyrene (73ng/l). The EU drinking water standard (DWS) for PAHs is 0.1 ug/l (100ng/l).
- F.1.54 The Costain report concludes that within the wider Hammersmith Embankment site as a whole, no contaminants were detected within the groundwater samples taken.

WSP Environmental Ltd, 2002

- F.1.55 A phase II investigation at Hammersmith Embankment was undertaken by WSP Environmental Ltd in 2002⁸ following an initial environmental audit in 2001.

Exploratory holes

- F.1.56 The investigation consisted of 11 boreholes and 56 trial pits. One of these boreholes (BH10) and six of the trial pits (TP1-6) were located within the boundary of the proposed Thames Tideway Tunnel development site.
- F.1.57 The rationale for the location of BH10, TP4 and TP5 was that this was formerly the location of a wash pit adjacent to the pumping station. The presence of the wash pit was not identified during the investigation.

- F.1.58 Additionally, TP7, TP8 and TP9 located adjacent to the southeastern boundary of the proposed Thames Tideway Tunnel site targeted potentially contaminating infrastructure, namely the former location of an oil tank (TP7); further unspecified tanks (TP8) and the location of an above ground tank (TP9) that still existed at the time of the works.
- F.1.59 In the trial pits located within the proposed Thames Tideway Tunnel site, a notable observation of contamination was recorded in TP2 where solvent odour was detected within the Made Ground between 0.15-1.80mg/l.
- F.1.60 Within the immediate surrounds of the site, other trial pits dug during the Hammersmith Embankment Phase II identified the following notable details:
- a. TP8: Cylindrical shaped metal underground tank encountered at 0.4mbgl to 1.8mbgl. Perched water was encountered within the tank at 0.8mbgl which exhibited hydrocarbon sheen and odours
 - b. TP9: Possible hydrocarbon odour within the Made Ground at 1.0-1.75mbgl
 - c. TP10: Groundwater was encountered at 4mbgl and the Made Ground had some black hydrocarbon staining
 - d. TP19: Made Ground within TP19 observed as containing occasional black organic smelling sandy pockets at a depth of 3.10mbgl
 - e. TP60: Made Ground within TP60 at a depth of 0.10-0.70mbgl was recorded as having a slight hydrocarbon odour with a max photoionisation detector (PID) reading of 12.0 parts per million (ppm).
- F.1.61 Boreholes within the vicinity of the proposed development site recorded consistently elevated concentrations of carbon dioxide and locally elevated levels of methane between up to 3.7%.
- F.1.62 Groundwater levels across the whole Hammersmith Embankment investigation site vary from a general depth of 3.3-45mbgl adjacent to the river to 4.8-5.4mbgl in the central and eastern areas at a greater distance from the river.

Soil analysis

- F.1.63 No concentrations of the metals tested for were found above current assessment criteria for light industrial/commercial land use.
- F.1.64 Elevated concentrations of TPH present within the proposed Thames Tideway Tunnel site were recorded within TP2, TP4 and TP5 (at 2900mg/kg, 2380mg/kg and 2080mg/kg, respectively). It is not possible from these test results to ascertain whether the levels recorded would be elevated in comparison with current screening values.
- F.1.65 The report concluded that the identified hydrocarbon odours and staining observed in the trial pits represent isolated occurrences and appear confined to the Made Ground.
- F.1.66 Across the Hammersmith Embankment site, a suite of analysis was undertaken on Made Ground and natural soil samples. It was concluded

from the analysis that widespread contamination from heavy metals was not present at the site.

Groundwater analysis

- F.1.67 No concentrations of heavy metals or phytotoxic metals were elevated above Dutch values or contemporary DWS. In addition, results showed that the concentrations of TPH, VOCs and semi volatile organic compounds (SVOCs) in groundwater samples were below intervention values and/or the analytical detection limit.
- F.1.68 A sample of the perched groundwater within the underground tank structure found in TP8 recorded an elevated concentration of benzene (4300ug/l, above Dutch Intervention Value of 30ug/l).

Mott MacDonald Ltd, 2005

- F.1.69 In 2005, Mott MacDonald undertook a further assessment of the Hammersmith Embankment site as part of Project Brando⁹. Costain Ltd undertook the fieldwork element of this assessment.
- F.1.70 The investigation was limited to groundwater and gas monitoring in newly installed boreholes, only one of which was located on the proposed Thames Tideway Tunnel site.
- F.1.71 Gas and groundwater testing were undertaken for these samples. The report concluded that none of the seven groundwater samples tested from the River Terrace Deposits showed evidence of significant contamination from inorganic contaminants and only minor exceedances of saline environmental quality standard (EQS) values for arsenic and chromium were recorded.
- F.1.72 The gas monitoring round showed methane concentrations to be less than 0.1% and varying carbon dioxide concentrations between less than 0.1 and 9.3%.

Mott MacDonald Ltd, 2007

- F.1.73 In 2007, a further contamination risk assessment and remediation strategy was undertaken by Mott MacDonald Ltd on the Hammersmith Embankment area¹⁰.

Exploratory holes

- F.1.74 Fieldwork was undertaken by Costain Ltd in 2006 and consisted of seventeen boreholes and two test pits. The test pits are located within the boundary of the proposed Thames Tideway Tunnel site.
- F.1.75 Groundwater monitoring identified levels across the site to be between 4.06mbgl and 5.68mbgl.

Soil analysis

- F.1.76 Of the 18 soil tests undertaken on the Made Ground, results showed that widespread contamination was not evident.
- F.1.77 Hotspots of contamination in relation to arsenic and lead contamination were identified at 0.5mbgl; these hotspots are not located within the proposed Thames Tideway Tunnel site.

- F.1.78 No elevated TPH above current light industrial/commercial assessment criteria were recorded on site.
- F.1.79 Sixteen samples of soil comprising Made Ground and underlying natural deposits were tested for their concentration of leachable contaminants above their respective EQS or UK DWS.
- F.1.80 Asbestos was not identified in any of the 31 samples taken from the site during the 2006 ground investigation.

Gas monitoring

- F.1.81 Gas monitoring across Hammersmith Embankment showed that methane was below detection limits, with carbon dioxide concentrations varying between 0.6% and 5.2%.

Remedial Strategy

- F.1.82 In order to protect future residential occupants from the previously identified TPH contamination recorded during various phases of investigation, two remedial options were proposed.
- F.1.83 The proposed Option 1 remedial measure comprised the removal of the hotspots and Option 2 comprised the complete removal of Made Ground to 1.5m depth. These were only proposed in the areas identified for the residential development.
- F.1.84 Records detailing the successful completion of the remedial measures outlined above were not available to review. It is however understood that these were completed as GESL refer to the results of the validation testing within their later work (see next section).

Geo-Environmental Services Ltd, 2012

- F.1.85 Geo-environmental Services Ltd (GESL) produced a document in May 2012¹¹ which provided a review of investigations previously undertaken across the Hammersmith Embankment and proposed an additional ground investigation strategy. Within the Thames Tideway Tunnel development site, this comprised exploratory holes at the site of a feature labelled Tank A (former tanks central to the site) and at the former wash pit area.

Soil analysis

- F.1.86 Analysis of the soil testing undertaken during 2011 did not identify metals and TPH above residential SGVs/GACs.
- F.1.87 Concentrations of the PAH compound benzo(a)pyrene across Hammersmith Embankment were recorded below the current light/industrial or commercial assessment criteria.
- F.1.88 No elevated VOCs or naphthalene above threshold values were detected across Hammersmith Embankment.
- F.1.89 Within the 2012 report, GESL also provided a summary of the validation testing undertaken and documented in a completion report by Mott MacDonald Ltd in 2007. The report states that the completion report was not submitted for regulatory approval. The omission of the completion report from the LBHF planning portal supports this; however it is assumed

that at least a proportion of the remediation must have been carried out in order for the reported validation tests to have been undertaken.

Groundwater analysis

- F.1.90 During GESL's assessment, five samples of groundwater were recovered from monitoring wells, the results indicated a slightly elevated concentration of nickel at BH9 (59ug/l), when compared to the EQS for saltwater (50ug/l). This borehole is believed to be away from the proposed Thames Tideway Tunnel site.

Summary of third party data

Soils

- F.1.91 The investigations undertaken at and in the vicinity of the proposed Thames Tideway Tunnel development site have recorded contamination that is typical of Made Ground in older urban environments at the site.
- F.1.92 In general, contaminants have not been recorded above current light industrial/commercial land use screening values. However, concentrations of lead above the withdrawn SGV were identified on-site.
- F.1.93 Relatively minor elevated levels of TPH were also recorded although it is not possible to ascertain if these are above any current screening values, due to the type of test undertaken.
- F.1.94 Asbestos has also been recorded in the Hammersmith Embankment site in general - it is unclear whether these soils extend onto the proposed Thames Tideway Tunnel development site.
- F.1.95 It is also noted from the review of the investigations that remediation at the Hammersmith Embankment area has taken place, however the extent of which is located within the proposed Thames Tideway Tunnel site and extent of removal of underground infrastructure such as tanks and washpits is unclear.

Groundwater

- F.1.96 The investigations undertaken at the site and in the surrounding area show that the water quality of the upper aquifer reflects the poor water quality of an urban setting, with exceedences of metals and PAHs.
- F.1.97 No free phase or solvent contamination of the groundwater was identified by the assessments.

Other environmental records

- F.1.98 Details of environmental records (hazard and waste sites) in the vicinity of the site held by the Environment Agency (EA) and other bodies have been obtained from the Landmark Information Group and are presented in Vol 5 Table F.4. Pertinent records are discussed in further detail below.
- F.1.99 The location of these records is shown on Vol 5 Figure F.1.3 (see separate volume of figures).

Vol 5 Table F.4 Land quality – hazard and waste sites

Item	On-site	Within 250m of site boundary
Active integrated pollution prevention and control	0	0
Control of major accident hazard sites	0	0
Historical landfill site	0	0
LA pollution prevention and control	0	0
Licensed waste management facility	0	0
Notification of installations handling hazardous substances	0	0
Past potential contaminated industrial uses	Areas of past potential contaminated industrial uses are present on-site and within 250m.	
Pollution incident to controlled water*	0	1
Registered waste transfer site	0	0
Registered waste treatment or disposal site	0	1

* Does not include regular combined sewer overflow (CSO) discharges

- F.1.100 A number of past potential contaminated industrial uses have been identified on-site and within 250m of the Hammersmith Pumping Station site. The past on-site potential contaminated industrial use relates the presence of the pumping station and historically, the former presence of the distillery, methylated spirits manufacture, chemical storage and latterly a BP site, as shown on Vol 5 Figure F.1.1 (see separate volume of figures). Common contaminants associated with such land-uses are identified in Vol 5 Table F.2.
- F.1.101 Within the 250m assessment area, inspection of the data also shows the presence of a registered waste treatment or disposal site, located northeast of the site at the junction of Biscay Road and Distillery Lane. In addition to a single pollution incident to controlled water located within the River.

Thames Water operational records

- F.1.102 Thames Water records of contaminating substance storage at the Hammersmith Pumping Station site within the last five years were reviewed.
- F.1.103 No bulk storage of hydrocarbons or other potentially contaminating liquids are currently taking place at the site.
- F.1.104 No spillages of any potentially contaminating substances to ground were recorded.

Land quality data from local authority

- F.1.105 The LBHF were consulted with reference to data they may hold in respect of land quality within the specified 250m assessment area. Their response is given in full in Section F.2 and is summarised below.
- F.1.106 Hammersmith Distillery (previously Haig Distillery) was established on the site in 1859, (Plate F.3 within Section F.2 shows the location of the distillery in 1869). A number of tanks and a gasometer were present on the site during its operation, including tanks of unknown contents in the northeast corner of the distillery (in the area of the proposed development site). Planning permission for the erection of a spirit tank farm was granted in 1954.
- F.1.107 Operation of the distillery ceased in 1959, after which the site was used to manufacture industrial chemicals including methylated spirits. This was subsequently halted due to discharges to the river, but the site continued to be used for chemical storage as shown in Plate F.9 within Section F.2. The site was later transferred to BP.
- F.1.108 In 1979, the council granted planning permission for installation for two 150 tonne carbon dioxide tanks and in 1982 for the erection of a bunded diesel tank.
- F.1.109 Various planning applications have been submitted and approved for redevelopment of the former distillery site for mixed commercial and industrial use. Conditions regarding the investigation of contaminated land were placed on these applications, but were only discharged for the commercial area of the development. A recent application was submitted in 2011 and is currently pending.

Summary of contamination sources

- F.1.110 Following the review of the baseline data, the following sources of on-site contamination which may impact on the construction of the proposed development have been identified:
- a. historic contamination of underlying soils and groundwater as a result of former industrial use (distillery, chemical manufacturing and storage, and sewage pumping station) – this appears to be limited to relatively minor elevated concentrations of lead, and possibly asbestos and TPH locally.
 - b. ongoing usage as sewage pumping station – a possible source of pathogens and microbial contamination
 - c. potential for UXO.
- F.1.111 There are not considered to be any significant off-site sources of contamination which may impact on the construction of the proposed development.

F.2 Local authority consultation

London Borough of Hammersmith & Fulham

Public protection and safety
5th Floor Hammersmith Town Hall Extension, King Street, Hammersmith W6 9JU,
Tel: 020 8753 1084 Direct Dial: 020 753 3454
Fax: 020 8753 3922
Email: environmental.quality@lbhf.gov.uk
Web: www.lbhf.gov.uk



Dino Giordenelli
Mott MacDonald House
8-10 Sydenham Road
Croydon
CR0 2EE

13 April 2011

Our reference: 2011-00117 (Thames_Tunnel_Ham_Emb_Apr11).doc

Dear Dino,

Thames Tunnel – Hammersmith Pumping Station

I refer to your e-mail dated 31 March 2011 concerning environmental information for the above site.

To assist in the identification of contaminated land (as required by Part IIA of the Environmental Protection Act 1990) the Council has completed a preliminary review of historical land use in the borough. The information gathered as part of this review has indicated potentially contaminative land uses having occurred at and near to the site. Present and historical plans are enclosed showing the site in relation to surrounding areas and are discussed below.

There are fourteen areas of potential concern located at the subject site twenty three in the surrounding area. On-site areas of concern are discussed in detail in the following text whilst a general overview is provided of the off-site areas; the smaller sites in the area are briefly discussed in the 'Miscellaneous Site' sections below. These areas of concern have all been prioritised for further investigation under Part IIA. For your reference, these individual sites are highlighted on the attached OS Map Potentially Contaminated Land, the larger sites are numbered whilst the smaller sites are referred to collectively as 'Trade Directory' records; all highlighted sites are described in turn as follows:

On Site Potentially Contaminated Land

1. Queen Caroline Street Garage

This site is occupied by terraced properties on the 1869, 1896 and 1916 OS Maps. Council records indicate that a Garage was located at this site during the 1920s. The 1930s OS Map shows the site as having been developed and is occupied by a large structure and labelled as a Garage. The site was then developed into residential properties with communal gardens as well as a playground by at least 1951 as shown on the OS Map of that year.

2. Chancellors Road Pumping Station

The site comprises undeveloped rural land on the 1869 OS map before being occupied by three small unidentified structures by 1896 and five in 1916, as shown on the respective OS Maps. The 1930s OS Map depicts the site as having been redeveloped with a building in its south eastern half which is labelled as a Pumping Station. Ancillary buildings are shown in the northwest half of the site on the 1951 OS Map. The site is then labelled as a Depot on the 1972-1978 Plan and the Master Map. Planning records from 1992 (1992/00140/FUL) indicate that the site was operated as Thames Water Utilities' Main Drainage Depot at that time.

3. Queens Wharf

Council Records indicate that Rosser and Russell Ltd., an Engineering Company, was located at the site from 1774 until 1993. The company were accomplished in the history of Heating Ventilation and Hydraulic Engineering. The 1869 OS Map shows large structures occupying the west of the site, which is labelled as Chancellors Wharf, and terraced properties occupying the eastern half of the site. The 1896 OS Map shows the western portion of the site as having been redeveloped larger structures labelled as Queens Wharf. This Wharf is then labelled as an Engineering Works on the 1916 OS Map. The terraced properties in the northeast of the site are no longer present on the 1951 OS Map the Wharf is identified as a Works on the 1963-1967 OS Map. Council records indicate that planning permission was granted in July 1961 (1961/00448/HIST) to Rosser and Russell Ltd. to extend and redevelop this site including the erection of a basement. The Works at the site are shown to now cover the entire site on the 1972-1978 OS Map and the Master Map. Council records indicate that Rosser and Russell planned to move their Manufacturing processes from the site to the former Saccharine Factory to the south in the 1980s (see Point 6 below).

Council records indicate that the site is currently vacant and a recent application submitted to the Council (2011/00409/FUL) includes a limited environmental survey during which Fuel Storage Tanks were identified at the site. Council records indicate offices occupied the site after Rosser and Russell Ltd. vacated the premises in 1993 and that the site is currently vacant.

4. Hammersmith Iron Works/Riverside Studios

A Wharf is identified at the site on the 1869 OS Map with terraced properties within its northeast boundary. The site is identified as Kensington Vestry Wharf on the 1896 OS Map; this Map also identifies Hammersmith Iron Works at the site. Council records indicate that this Works merged with Gwyne Iron Works in 1903 who were known to manufactured Centrifugal Pumps for the Admiralty and then extended to Aero Engines. A large structure labelled as Hammersmith Iron Works is labelled at the site on the 1916 OS Map. Trade directory records indicate that Gwynes Engineering Co Ltd. operated at the site until at least 1927. Council records indicate that this site was used for filming purposes from 1939. The site, including the area of the former terraced properties in the northeast, is occupied by a large structure identified as Riverside Studios on the 1951 and on the consequent OS Maps provided.

5. Hammersmith Vestry/Chancellors Wharf:

Part of the Wharf discussed in point 6 above overlaps the north western boundary of this site on the 1869 OS Map. The OS Map 1896 depicts the site as being occupied by a number of structures identified as a Lime and Cement Works at Hammersmith Vestry Wharf; trade directory records indicate that Wiggins and Co. operated a Lime Merchants at this site until at least 1927. Council records indicate that a Pump House was established here for the Hammersmith Generating Station (See 13 below) and was used for piping Coal as a Slurry from here to the Station via underground 8-inch pipes along Chancellors Road; a Pump House is indicated in the southwest corner of the site on the 1951 OS Map. The 1930s OS Map shows the site to have been redeveloped with a number of Industrial structures and labelled as Hammersmith Borough Council Depot. Council records indicate that this Depot was used for the Storage and Transfer of Household Waste. The 1951 OS Map identifies the site as Chancellors Wharf and indicates the presence of a Pump House in the southwest corner of the site. The 1963-1967 OS Map identifies the site as a Borough Council Depot and Works. The site appears to have been redeveloped as depicted on the 1972-1978 OS Maps and is still identified as a Borough Council Depot on Chancellors Wharf.

Planning permission was granted in June of 1986 (1986/02040/FUL) for the redevelopment of this site into residential, commercial and Light Industrial properties. Although at the time of development, contaminated land was not a material planning consideration, contaminated land guidance existed and it would be expected that developers would have considered this. Anecdotal evidence held by the Council indicates that areas of the site were excavated down to six to eight metres below ground level due to stability issues in laying one or possible two main sewer lines.

6. Hammersmith Distillery

Council records indicate that this site was occupied by Brandenburgh House and its grounds from the 17th century until 1859 when the Haig Distillery was established on the northwest portion of the

grounds. The 1869 OS Map depicts a Distillery at the site with an associated Tank (of unspecified contents or capacity) and Gasometer as well as a structure in the site's northeast corner labelled with the number 9 (latterly identified as Tanks on the OS 1896 Plan). Council records indicate that a destructive fire burned the Grain Stores to the ground in November of 1895. The Distillery is labelled as Hammersmith Distillery on the 1896 OS Map which also shows these works to have expanded towards the southeast. The OS 1916 Plan shows additional Tanks (of unspecified contents or capacity) and Chimneys at the Hammersmith Distillery as well as terraced properties and associated roads to its northeast. The OS 1930s Map shows additional Tanks at the Distillery as well as additional development along the southeast boundary of the site. The 1951 OS Map shows the site to have additional Tanks, notably in the southwest corner as well as a Warehouse and Conveyor labelled at the site. Planning permission was granted in December 1954 for the erection of a Spirit Tank Farm at the site. Council records indicate that the Distillery ceased production in 1959, but that Industrial Chemicals were then produced there including Methylated Spirits, but that this was halted due to the discharge of waste products into the river. Records go on to state that the site continued undertaking research into Carbon Dioxide and was also used for Chemical Storage. Records also state that part of the site (unknown location or dates) was transferred to British Petroleum Company due to their interest in the Distillery Company's Chemical and Plastic interests. The site is identified as a Chemical Storage Depot on the 1972-1978 OS Map which also shows an Electricity Substation in the centre of the site, a Thames Water Authority Pumping Station along the north western boundary of the site and a Sugar Refinery in the southeast corner of the site. Council records indicate that the Distillers Company (Carbon Dioxide) were granted planning permission in November 1979 (1979/01812/FUL) for the installation of two 150 Tonne Carbon Dioxide Tanks with associated Pipework, Pump House and Tanker Loading Canopy and in September of 1982 (1982/01289/FUL) for the erection of a bunded Diesel Tank. I am not aware of when the Distillers Co. ceased to operate at the site entirely, however a number of planning applications were submitted and approved at the site for industrial uses throughout the 1980s by a variety of other applicants

Planning permission was granted in the 1970s for Warehousing and Industrial Uses and in the 1980s for an office park scheme. A series of planning applications were submitted and approved between then and the present for the redevelopment of the site for mixed use residential and commercial including the granting of permission in March of 2002 (2000/01545/FUL) for the redevelopment of the site with mixed residential and commercial properties. Planning conditions were placed on this application regarding the investigation of contaminated land. Conditions 19 and 20 (2006/00234/DET, 2006/03070/DET) regarding the site investigation in the commercial area of the development only were discharged, however Condition 21 requiring a risk assessment and remediation strategy for the site was not recommended for approval. The wording of these conditions is outdated; were a similar application considered today, more stringent conditions would be recommended to adequately address the issue of contaminated land to current standards and requirements.

An application was submitted to the Council in February 2011 for the redevelopment of this entire site for a mixed residential and commercial use. This application is currently pending consideration.

7. Manbre and Garton Sugar Refinery

This site is located adjacent to the southeast boundary of the Distillery and is shown as part of the Brandenburg House grounds on the 1869 OS Map. The Manbre Saccharine Works, associated structures including a Well are identified at the site on the 1896 OS Plan. Council records indicate that this Factory took part of the Brandenburg House grounds in 1870 and by 1876 the site was used to Refine Sugar and Glucose to produced Brewing Sugar. Records also indicate that powerful Coke Boiler fuelled Steam Wagons which were used to transport liquid sugar and glucose across the site. Records indicate that raw sugar was shipped from this site up the Thames until World War One when the company began pumping liquid glucose directly into the adjacent J. Lyons Jam Factory (see OS 1930s Map, later identified as a Preserved Food Factory on OS Map 1951). A Coal Yard is shown in the north

Planning records indicate that Manbre Sugars Ltd. were granted planning permission in May 1965 to erect a transport Maintenance Garage (1965/30115/HIST) and a replacement Wet Refinery and Sugar

Storage building (1965/30116/HIST) at this site. Further records indicate that the Sugar Factory was shut down in 1979 before being occupied by undefined works. Planning records indicate that an application was approved in February 1980 (1980/00210/FUL) for the erection of nine Industrial Units and two Warehouses for Rosser and Russell to move their Industrial Operations from Queens Wharf to this site. (See Points 3 above and 17 below for further information). Council records also indicate that Motor Vehicle Repair Works operated at Industrial units in the former Sugar Factory from at least the 2000s

8. Frank Banfield Park

The 1869 and 1896 OS Maps depict this site as being an undeveloped portion of the former Brandenburg House estate. Terraced properties and Streets are shown to occupy this site on the 1916 and 1930s OS Maps. Some redevelopment is shown in the southern portion of the site on the 1951 OS Map likely due to Bomb damage during World War II as indicated by Ruins in the area. The 1978 portion of the 1972-1978 OS Map shows this site as having been redeveloped as a park with markings indicative of elevated ground, or mounds, across the site.

Planning applications were approved in February 2003 (2002/01674/FR4) for landscaping and general park improvements. A Variation to this application was approved in August of 2008 (2007/02413/VAR) upon which a condition was placed requiring recommendations posed by WSP Environmental in their Phase II Environmental Assessment report, dated November 2002 are implemented including a minimum of 0.3m thickness of clean topsoil overlain by turf in areas where soils are removed. It is understood that elevated heavy metals, TPH and PAH were found at the site. I have no further information as to the implementation of these recommendations.

9. Brandenburg House (Lunatic Asylum)

A Lunatic Asylum was located here from at least as early as 1869 as shown on the OS Map of that year. The 1896 OS Map shows the location of Brandenburg House as being replaced by terraced property and the remainder of the site as relatively undeveloped. Terraced properties are shown on the site on the 1916, 1930s, 1951 and 1963-1967 OS Maps. The 1978 portion of the 1972-1978 OS Map and the Master Map show the western portion of the site as being occupied with a playground and Frank Banfield Park (See Point 8 above).

Miscellaneous Sites

(Described in a clockwise direction from the north) Trade directory records indicate that the following operated along Chancellors Road: a Carpenter operated at number 22 from at least as early as 1899 through at least 1912; a Builders and Contractors at 47 from at least as early as 1912; a Laundry at 60 from at least as early as 1896 through at least 1899; and a pump manufacturer at 62-64 from at least as early as 1931 through at least 1937. These records indicate that Crisp Road Carriage Builders operated at 23 Crisp Road from at least 1912 until at least 1924 and as a Motor Engineers from at least 1927.

Off Site Potentially Contaminated Land

10. Hammersmith Bridge Works

Trade directory records indicate that this property operated as a Garage since at least 1917. An unidentified Industrial Type Building is shown at the site on the 1930s OS Map. The site is identified as a Coach Work on the 1951 OS Map and as a Works on the 1963-1967 and 1972-1978 Maps. Planning permission was granted in December of 1983 (1983/02592/FUL) to redevelop the Motor Repair Workshop at this site into offices and residences. Council records indicate that Vehicle Re-spraying also took place at this location.

11. Ice Factory

The site is occupied by terraced properties and a public house on the 1869, 1896 and 1916 plans. The site is shown as having been redeveloped with an Ice Factory as labelled at the site on the 1930s OS Map. Two Tank like structures are shown on the site in the 1950s OS Map; I have no information as to the size of contents of these tanks. The 1963-1969 OS Map depicts the site as having been redeveloped with a housing estate.

12. Components Works

Council records indicate that a Works was located at the site from between 1915 through 1977. An Industrial Type building of unspecified use is shown at the site on the 1916 OS Map as well as a Mortuary. A Mortuary and Coroners Court is labelled at the site on the 1930s OS Map. A Pipe Factory and Transformers are also labelled at the site on the 1951 OS Map. The 1963-1967 OS Map depicts the Pipe Factory as occupying only the eastern portion of the Industrial building and an undefined Factory in the western portion; a Tank is also identified at the site. The Factories are labelled as Works on the 1972-1978 OS Map. Planning records indicate that Surrey Steel Components Ltd. operated at the site in 1986. The Master Map shows the site as having been redeveloped for commercial use.

13. Hammersmith Generating Station

Council records indicate that the Hammersmith Electricity Works, Electricity Generating Station, was located here from October 1897 and ceased operation in 1965. This site is labelled as Hammersmith Electricity Works on the 1930s OS Map where a Chimney and Tanks (of unspecified contents or size) are also shown. The site was then demolished and two Electricity Substations and an Undefined Works were present at the site as shown on the 1972-1978 OS Map. The Master Map shows the site as having been redeveloped for commercial use.

14. Hammersmith Studios

Workshops and later studios have been located at the site since at least 1896. Council records indicate that the site operated as a Repair Workshop of Baker's Ovens and Kilns in the late 1970's and early 1980s before being used as a Vehicle Hire office and Repair Workshop at least until 1990.

15. Lochaline Street Works:

Industrial Type Buildings of unknown use are shown at this site on that 1916 OS Map. Trade directory records indicate that an engineer operated here from at least as early as 1924. The site is identified as a Works on the 1972 OS Map and on the Master OS Plan.

16. Charing Cross Hospital

Council records indicate that during the Cholera epidemic of 1848-49, victims were housed here in wards and tents. These records go on to state that the Fulham Union Workhouse was erected here in 1850 and infirmaries operated here from this time even though the site was not officially named a Hospital until 1928. The workhouse was demolished in October of 1966 in preparation for the construction of Charing Cross Hospital.

17. J. Lyons and Co Food Factory

The portion of the Manbre and Garton Sugar Refinery discussed above (point 7) which extends off site was labelled as Pimlico Wheel and Motor Works on the 1916 OS Map before becoming part of the J. Lyons & Co Ltd. Works Department from at least the 1930s, part of a Preserved Food Factory (with associated Tank of unknown size or contents) and Joinery Works from at least the 1950s before being wholly encompassed by a Foodstuffs Factory by the 1970s. Council records indicate that liquid glucose was pumped directly from the Manbre works to this factory and that this co-operation extended to the preparation of ice-creams.

The site was redeveloped with a commercial and residential properties identified as Riverside House, Waterfront House and King Henry's Reach on the Master Map. Permission was granted for this redevelopment under 1989/01296/OUT. Although contaminated land was not a material planning consideration at the time of redevelopment, the Council holds records of a site investigation at the development area carried out by Terrasearch Ltd. in 1990. This investigation comprised limited analysis of shallow soils within the area and did not include groundwater or ground gas monitoring. I am unable to provide further information on this investigation and am not aware of any further investigation or actions undertaken at this site. This report has not been formally submitted through the planning process and, as a consequence, has neither been reviewed nor accepted by the Council.

18. Colwith Road Garages

A Garage is identified at this site on the 1930s OS Map and the site appears unchanged on the 1951 and 1972-1978 OS Maps. Planning records indicate that at least part of the site operated as a Builder's Yard and stores in the 1980s.

19. Engineering Works

Council records indicate that an Engineering Works was located at the site between the 1920s and 1950s and a Depot from the 1950s through the 1970s after which it became residential and commercial.

20. Petrol Station

Council records indicate that a Garage was located at this site from the 1920s through the early 2000s; an Electricity Substation existed at the site since the 1950s. The site was formerly operated by ESSO as a Petrol Station and is currently undergoing investigation in fulfilment of planning conditions placed on its permission to redevelop.

Miscellaneous Sites

The smaller highlighted sites identified on the Potentially Contaminated Land Map include Oil Dealers, a Printers, a Builders Yard, Dairies, Laundries, a Bedding Manufacturer, a Builder and Ironmonger, a Motor Spare Parts Manufacturer and an Ozone Preparation Company.

The Council can confirm that the property is not presently incurring remedial action under Part IIA of the Environmental Protection Act 1990. I can confirm that the property is not on the Council's Contaminated Land Register. However, please note that the absence of an entry in our register at present does not guarantee that the land is free from contamination or risk from harm.

Further information about past land uses may be gained from the Archive and Local History Centre located at 191 Talgarth Road, Hammersmith, London W6 8BJ (tel: 020 8741 5159). If you would like to visit the Centre then you will need to arrange an appointment by phone.

Yours sincerely,



Elizabeth Fonseca
Environmental Quality Manager

Enc: Site Plan
Historical Ordnance Survey Plans

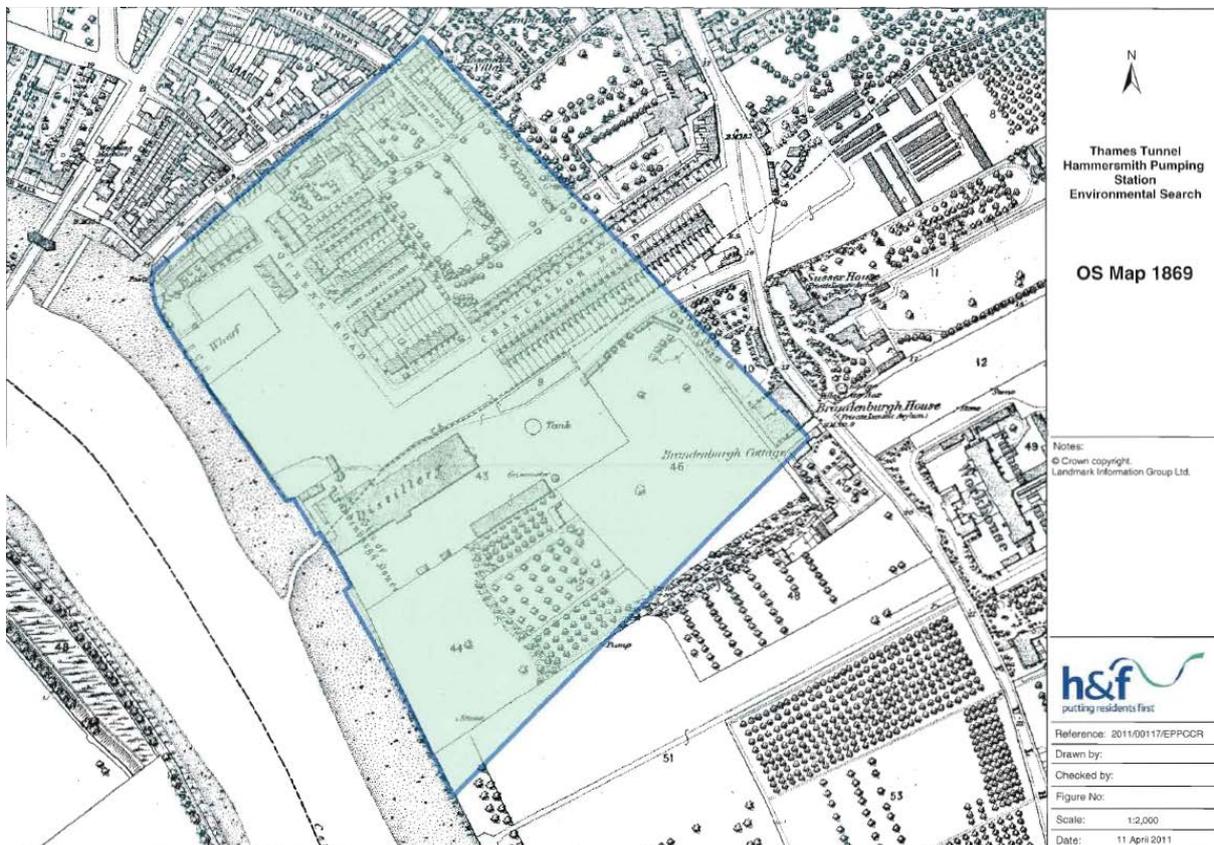
Vol 5 Plate F.1 Os Map – Potentially contaminated land



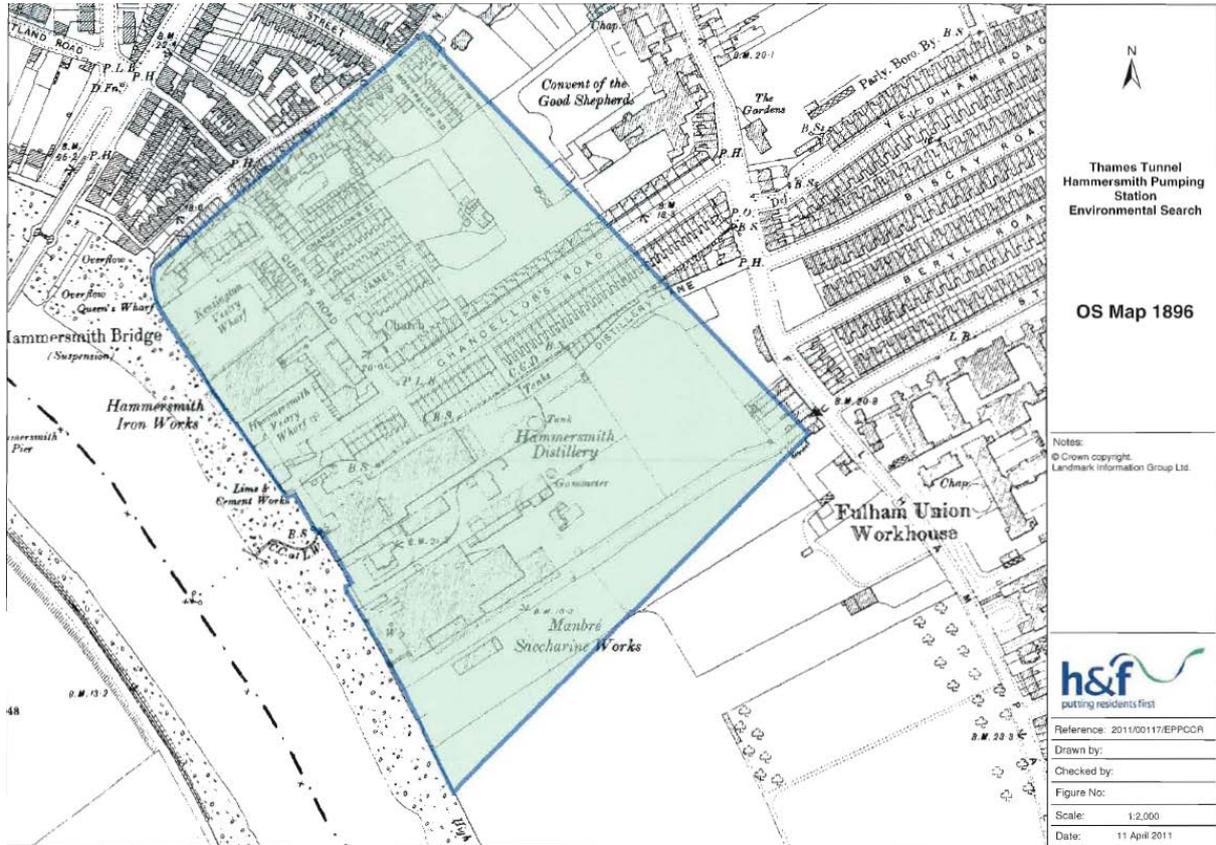
Vol 5 Plate F.2 OS Master Map



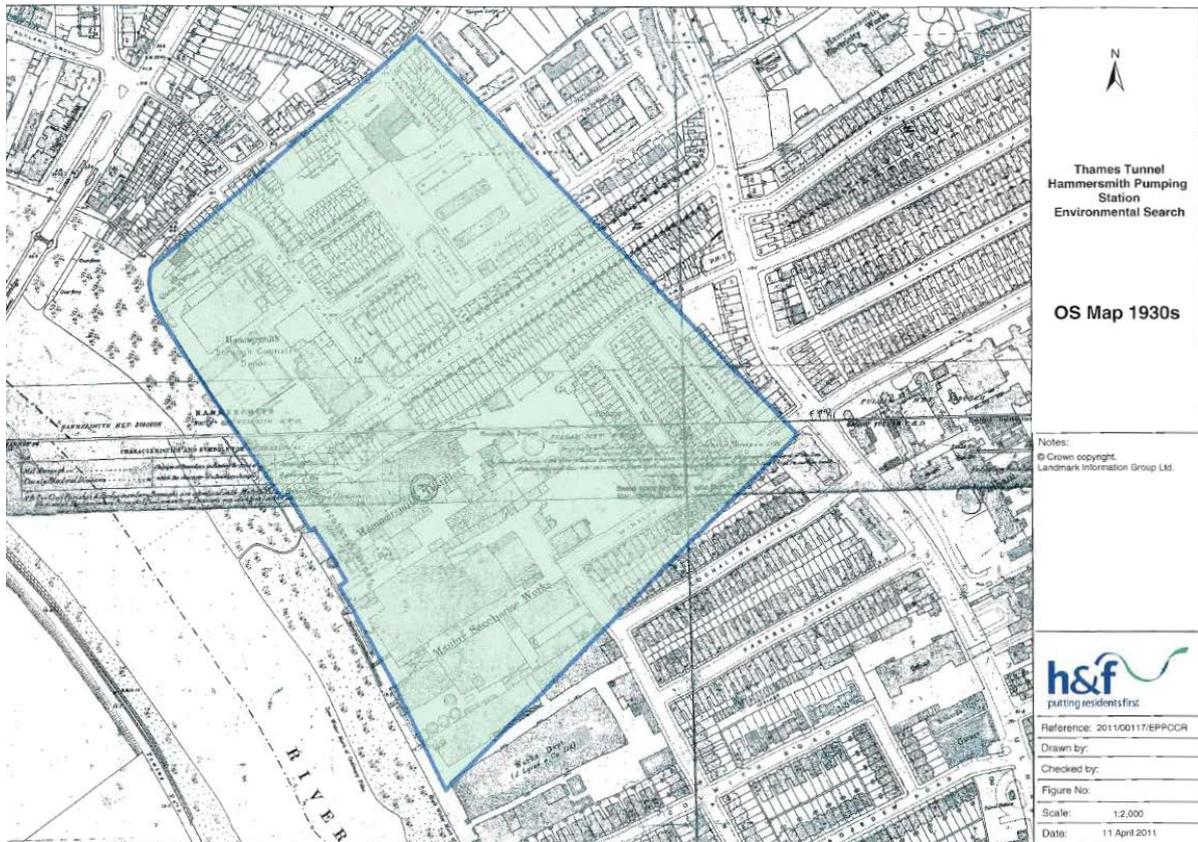
Vol 5 Plate F.3 OS Map 1869



Vol 5 Plate F.4 OS Map 1896



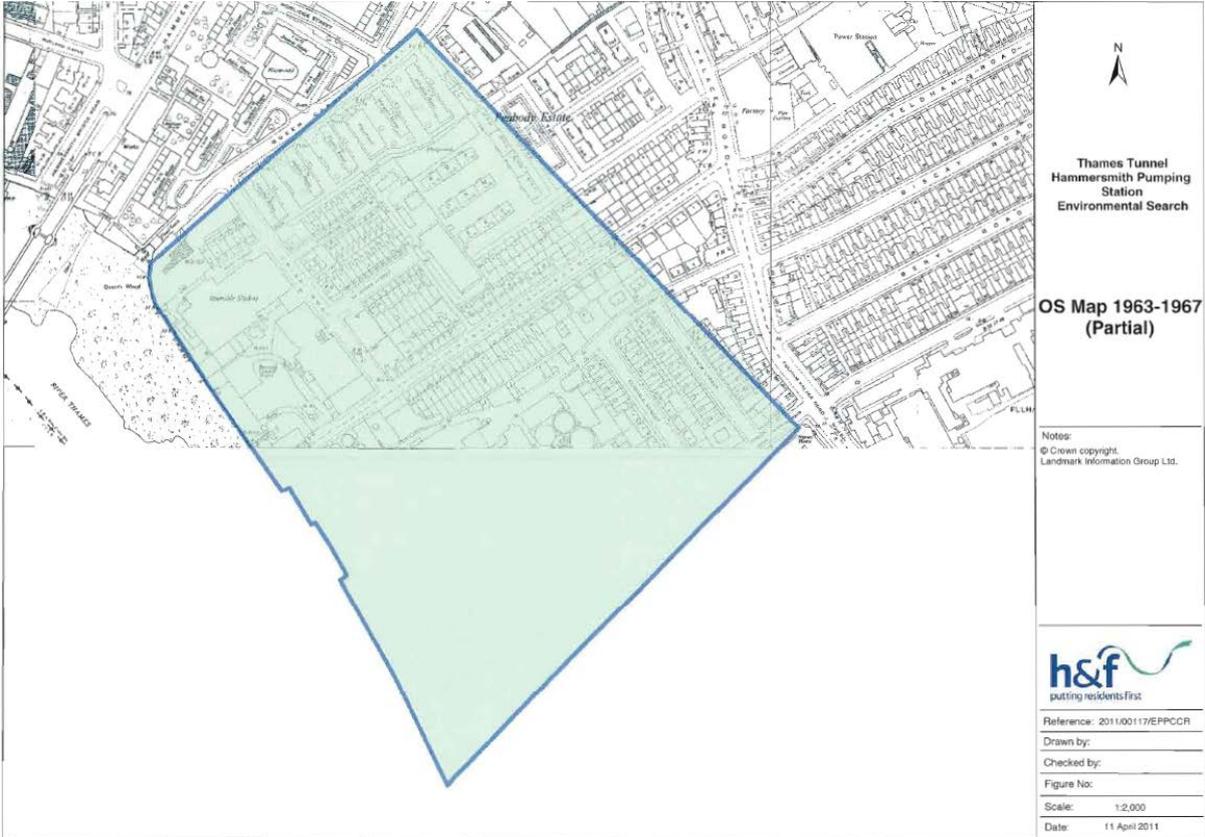
Vol 5 Plate F.6 OS Map 1930s



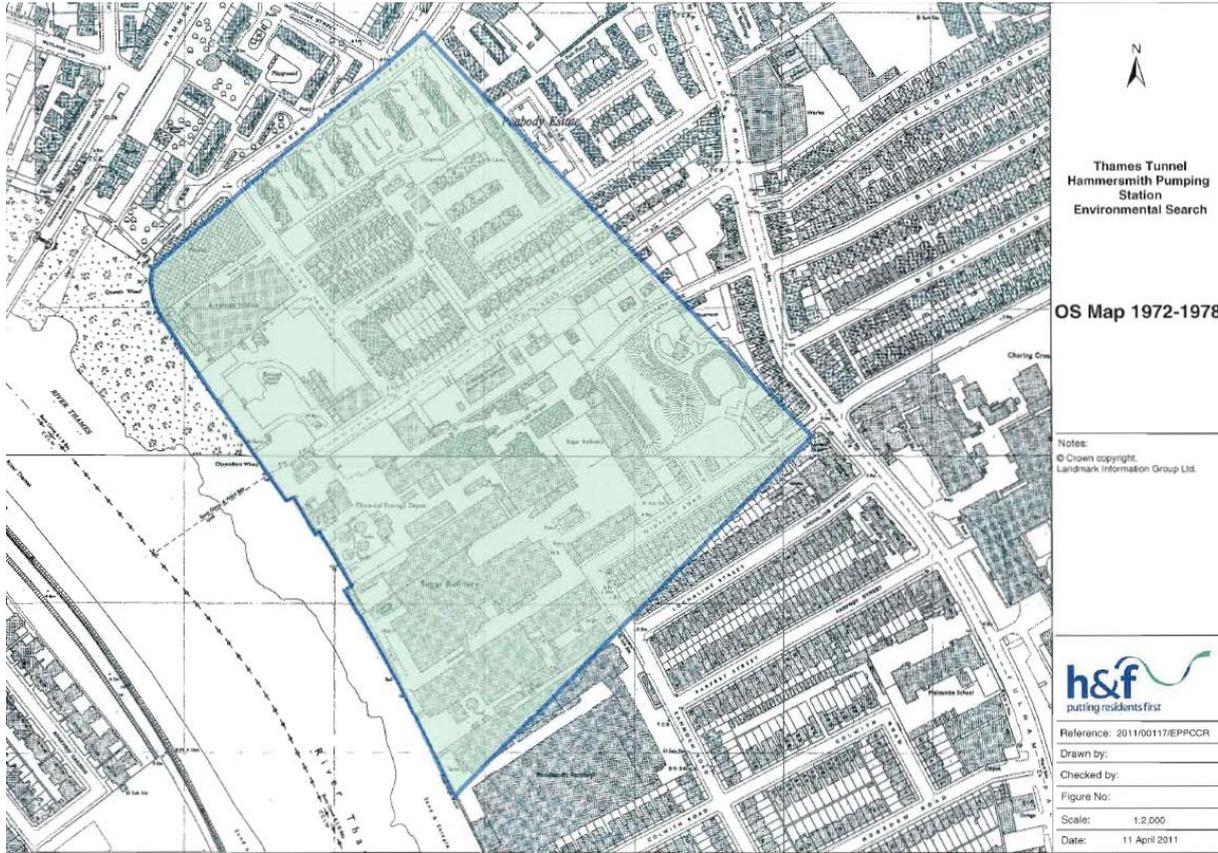
Vol 5 Plate F.7 OS Map 1951



Vol 5 Plate F.8 OS Map 1963-1967 (Partial)



Vol 5 Plate F.9 OS Map 1972-1978



F.3 Detailed Unexploded Ordnance (UXO) risk assessment – Hammersmith Pumping Station

Detailed Unexploded Ordnance (UXO) Risk Assessment

Study Site: Work Area PHF1X

Client Name: Thames Water

6 Alpha Project Number: P2278_R68_V1.0

Date: 7th February 2011

Originator: Gary Hubbard (7th February 2011)

Quality Review: Lee Gooderham (10th February 2011)

Released by: Simon Cooke (10th February 2011)

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EXECUTIVE SUMMARY

Study Site	<p>The Study Site is referred to as Work Area PHF1X.</p> <p>For the purposes of this study, a 50m-assessment radius will be applied to the work area to provide flexibility should it need to be relocated.</p>
Potential Threat Source	<p>The threat is predominately posed by Second World War (WWII) German High Explosive (HE) bombs and to a lesser extent, British Anti-Aircraft Artillery (AAA) projectiles used to defend against German bombing raids.</p>
Risk Pathway	<p>If Unexploded Ordnance (UXO) is encountered by a site investigation (or subsequent construction method) that generates significant kinetic energy (e.g. of the sort generated by cable percussion boreholes or drilling activities), then it could be initiated.</p>
Key Findings	<p>The final risk level has been determined by considering the following pertinent facts:</p> <ul style="list-style-type: none"> • The study site is located within an area of London that experienced relatively moderate levels of WWII bombing. • Bomb damage is consistently recorded across the region, and a number of buildings were damaged within the boundary of the study site. • Throughout WWII, “Hammersmith Distillery” and terrace residential properties occupied the site. Four of the residential buildings within the work site were seriously damaged. • As the site was occupied by commercial and residential properties during the war, it is highly likely that if any UXBs landed within the confines of this site, they would have been witnessed and dealt with accordingly. • In light of the potential risk on site and the ground conditions, 6 Alpha would recommend the “reactive” measures specified below.
Final Risk Level	LOW/MEDIUM
Risk Mitigation For All Works	<ol style="list-style-type: none"> 1. Hold documentary procedures that should be taken in the event of a suspicious find; 2. Brief all personnel involved with the intrusive works on the potential risk of an associated UXO discovery; 3. Engage an UXO Specialist to be “on-call” should a suspect item be discovered.

ASSESSMENT METHODOLOGY

Approach	<p>The UXO related risk on the site has been assessed using the process advocated by the Construction Industry Research & Information Association (CIRIA) best practice guide (UXO – A Guide for the Construction Industry) which has been endorsed by the Health & Safety Executive (HSE).</p> <p>Potential UXO hazards have been identified through investigation of Local and National archives covering the site, Ministry of Defence (MoD) archives, local historical groups, historical mapping and contemporaneous aerial photography, wherever it is available. Potential hazards have only been recorded if there is specific information that could reasonably place them within the boundaries of the site. Key source material has been cross-referenced within this document, whilst less significant data has been set aside, it is available upon request.</p> <p>The assessment of risk is a measure of <i>probability of encounter</i> and <i>consequence of encounter</i>; the former being a function of the identified hazard and proposed development methodology; the latter being a function of the type of hazard and the proximity of personnel to the hazard at the moment of encounter.</p> <p>Wherever a significant UXO risk has been identified, 6 Alpha will design and recommend methods of risk mitigation to “reasonably and sufficiently” reduce them, not only to an acceptable and tolerable level but also in accordance with the As Low As Reasonably Practicable (ALARP) principle. In this way we ensure that any risk mitigation solutions we design, delivers the Client the most cost effective solution.</p> <p>We believe that 6 Alpha’s holistic and intelligent application of the ALARP principle to UXO risk management is a critical and differentiating factor in our approach, because; it provides a transparent means for assessing the tolerability of risk; and it ensures that if the cost of reducing a risk outweighs the benefit, then the risk may be considered “tolerable”. This is considered especially pertinent, because the potential to reduce UXB risk to zero, is <i>de facto</i> unnecessary and prohibitively expensive.</p>
Important Notes	<p>Although this report is up to date and accurate, the databases are continually being populated as and when additional data becomes available. 6 Alpha have exercised all reasonable care, skill and due diligence in providing this service and producing this report.</p> <p>The assessment levels have been generated from historical data and third party sources. Wherever possible 6 Alpha have sought to verify the accuracy of all data, but cannot be accountable for inherent errors that may exist in third party data sets (e.g. National Archive or other library sources).</p> <p>The intention of this report is to provide the Client with a concise summary of the risks posed to the site investigation and construction works.</p> <p>The background risk has been established in the Threat & Preliminary Risk Assessment Report (<i>P1087_Version 3</i>).</p> <p>Although this document may be used in isolation, an overarching report is available that outlines the procedures, details and methodologies used to assess the UXO risk to this project.</p>

STAGE ONE – SITE LOCATION AND DESCRIPTION

Study Site	<p>The Study Site is referred to as Work Area PHF1X.</p> <p>For the purposes of this study, a 50m-assessment radius will be applied to the work area to provide flexibility should it need to be relocated. See Figure 1 for site location.</p>
Location Description	<p>The work area is situated on the boundary of Hammersmith and Fulham Metropolitan Boroughs. The site is boarded by Chancellors Road to the North, Distillery Road to the East and Winslow Road to the South. The western boundary is delineated by the River Thames. Thames Water Utilities Ltd occupies the buildings immediately to the north and residential properties occupy the northern perimeter of the site boundary. Buildings to the south of the work site have been demolished.</p> <p>The main site working area covers 8,520m² and appears to be a parcel of “waste ground” with no visible structures. See Figure 2 for current aerial photography.</p>
Proposed Works	<p>The following works will be conducted at this location, please note that this may not represent the full scheme but are those that may be presented with UXO Risk:</p> <ul style="list-style-type: none"> • Construction of a 25m internal diameter shaft, approximately 33m deep. It is anticipated that the shaft will be constructed using a sprayed concrete primary lining with a cast in-situ secondary lining. A pre-cast segmental lining could also be used as an alternative to the sprayed concrete. • Construction of a 2.2m internal diameter connection tunnel to Acton Storm Tanks. • A connection culvert between the existing pumping station inlet chamber and the shaft including two chambers along the route. • An above ground ventilation building including a 15m tall ventilation column. • Construction of a permanent hard standing area to facilitate the operation and two permanent vehicle access points of Chancellors Road.
Ground Conditions	<p>Thames Water have informed 6 Alpha that the ground conditions for this preferred site are expected to be:</p> <ul style="list-style-type: none"> • Made Ground (MG) – Ground Level to 2.75m below ground level (bgl); • Alluvium – 2.75m to 3.25m bgl; • River Terrace Deposits – 3.25m to 7.75m bgl; • London Clay – 7.75m bgl to not proven. <p>MG/fill may comprise of locally available materials (eg. Alluvium and Terrace Deposits together with waste materials such as building rubble, clinker or ash). It may also comprise a range of inert materials and/or domestic refuse. The presence of ferrous metal is not known (but is considered likely), as is the presence of red brick (both of which can interfere with magnetometry). However, all MG/fill It is likely to be heterogeneous and may also contain buried sub-structures and foundations.</p>

STAGE TWO – REVIEW OF HISTORICAL DATASETS

Sources of Information Consulted	<p>The following primary information sources have been used in order to establish the background UXO threat.</p> <ol style="list-style-type: none"> 1. London County Council (LCC) WWII Bomb Damage Mapping; 2. Home Office WWII Bomb Census Maps; 3. WWII & post-WWII Aerial Photography; 4. Official Abandoned Bomb Register; 5. National Archives in Kew; 6. 33 Engineer Regiment (Explosive Ordnance Disposal) at Carver Barracks, Wimbish. 	
WWII Historical Data	WWII Site Usage	During the WWII the site is shown to be occupied predominately by the Hammersmith Distillery on the banks of the River Thames, with a number of residential terraced properties being situated along the northern boundary.
	Bombing Targets	The River Thames, a major transportation route is located immediately to the west. Both vessels and wharfs were bombed. There are two further targets indicated to the northeast; these are Hammersmith Station and Hammersmith Electricity works, they are both located within 400m of the study site.
	HE Bomb Strikes (Figure 3)	There are no HE bomb strikes recorded within the work area. However, there is one HE bomb strike recorded within the assessment buffer to the north. A further three bomb strikes are noted in the immediate area. There is also a V1 strike recorded approximately 60m to the northeast.
	WWII HE Bomb Density (Figure 4)	The site is covered by two administrative districts. Hammersmith Metropolitan Borough recorded 132 HE bombs per 1,000 acres and Fulham Metropolitan Borough recorded 239 HE bombs per 1,000 acres.
	WWII Bomb Damage (Figure 5)	<p>There is limited damage recorded within the work area, this damage is confined to the northeastern corner where residential properties are described as “seriously damaged; doubtful if repairable”. Within the assessment buffer there is significant damage to residential properties both in the north and east, this ranges from “total destruction” to “general blast damage”. Much of this damage may be attributed to the V1 strike to the north.</p> <p>It is possible that damage occurred to the commercial property on site, but many businesses appointed the own Air Raid Precaution officers and kept internal records of bomb damage, these were not recorded on the LCC bomb damage maps.</p>
	Abandoned Bombs	There are no abandoned bombs recorded at this location.

STAGE THREE – DATA ANALYSIS

<p>Is there a reason to suspect that the immediate area was a bombing target during WWII?</p>	<p>Yes, areas situated close to the River Thames provided the Luftwaffe with numerous bombing targets; this included both industrial targets and shipping.</p>
<p>Is there firm evidence that ordnance landed on site?</p>	<p>There is no evidence of HE bomb strikes within the work site. However, there is one HE bomb strike recorded to the north within the assessment buffer.</p>
<p>Would an UXB entry hole have been observed and reported during WWII?</p>	<p>The Hammersmith Distillery Company occupied the site during the war and it is highly likely that if any UXBs landed within the confines of this site they would have been witnessed, recorded and then dealt with accordingly.</p>
<p>Was the ground undeveloped during WWII?</p>	<p>No, the majority of the site was developed and occupied by the Hammersmith Distillery with a number of residential properties to the northeast.</p>
<p>Is there any reason to suspect that Live Firing or military training may have occurred at this location?</p>	<p>There is no evidence to support that live firing took place on the site.</p>
<p>Is there any reason to suspect that other activities on site may have resulted in ordnance and / or explosives being present?</p>	<p>No, there is no evidence to support other activities on site involved ordnance or explosives of any type.</p>
<p>Would previous earthwork have removed the potential for UXO to be present?</p>	<p>Unlikely, there has been no significant development on site other than the removal of structures post WWII.</p>

STAGE FOUR – RISK ASSESSMENT

Threat Items	The threat is predominately posed by Second World War (WWII) German High Explosive (HE) bombs and to a lesser extent, British Anti-Aircraft Artillery (AAA) projectiles used to defend against German bombing raids.
Maximum Penetration	After reviewing the site-specific geotechnical data, the maximum Bomb Penetration Depth (BPD) of a 500kg German bomb is assessed to be 6.5m below ground level (m bgl).
Risk Pathway	Given the type of munitions that may be present on site, all types of aggressive intrusive engineering activities may generate a significant risk pathway.
Consequence	<p>Consequences of a UXB initiation include:</p> <ol style="list-style-type: none"> 1. Kill and/or critically injure personnel; 2. Severe damage to plant and equipment; 3. Blast damage to nearby buildings; 4. Rupture and damage underground services. <p>Consequences of UXO discovery include:</p> <ol style="list-style-type: none"> 1. Delay the project; 2. Disruption to local community/infrastructure; 3. Incurring of additional costs.

UXO RISK CALCULATION

Activity	Probability (SHxEM=P)	Consequence (DxPSR=C)	Risk Rating (Px C=RR)
Enabling Works	1x1=1	3x2=6	1x6=6
Shaft Installation	1x2=2	2x2=4	2x4=8
Open Excavations	1x2=2	2x2=4	2x4=8

Abbreviations – Site History (SH), Engineering Methodology (EM), Probability (P), Depth (D), Consequence (C), Proximity to Sensitive Receptors (PSR) and Risk Rating (RR).

STAGE FIVE – RECOMMENDED RISK MITIGATION MEASURES WITH RESULTING RISK RATING

<p>If a geophysical survey is required are the ground conditions an issue?</p>	<p>Non-Intrusive Methods of Mitigation – Not possible, as any magnetometer results would be affected by Ferro-magnetic contamination within the fill material. Moreover any UXBs are expected to be out of range given the thickness of the fill material.</p> <p>Intrusive Methods of Mitigation – It is likely that intrusive magnetometry would be limited on this site.</p>
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MITIGATION MEASURES TO REDUCE RISK TO ‘ALARP’

Activity	Risk Mitigation Measures	Final Risk Rating (Post Mitigation)
All Works	<ol style="list-style-type: none"> 1. Hold documentary procedures that should be taken in the event of a suspicious find; 2. Brief all personnel involved with the intrusive works on the types of UXO that might be encountered and the potential risks of an associated UXO discovery, as well as the actions to be taken in all cases; 3. Engage an UXO Specialist to be “on-call” should a suspect item be discovered. 	<p>LOW = ALARP</p>

This assessment has been conducted based on the information provide by the Client, should the proposed works change then 6 Alpha should be re-engaged to refine this risk assessment.

Report Figures

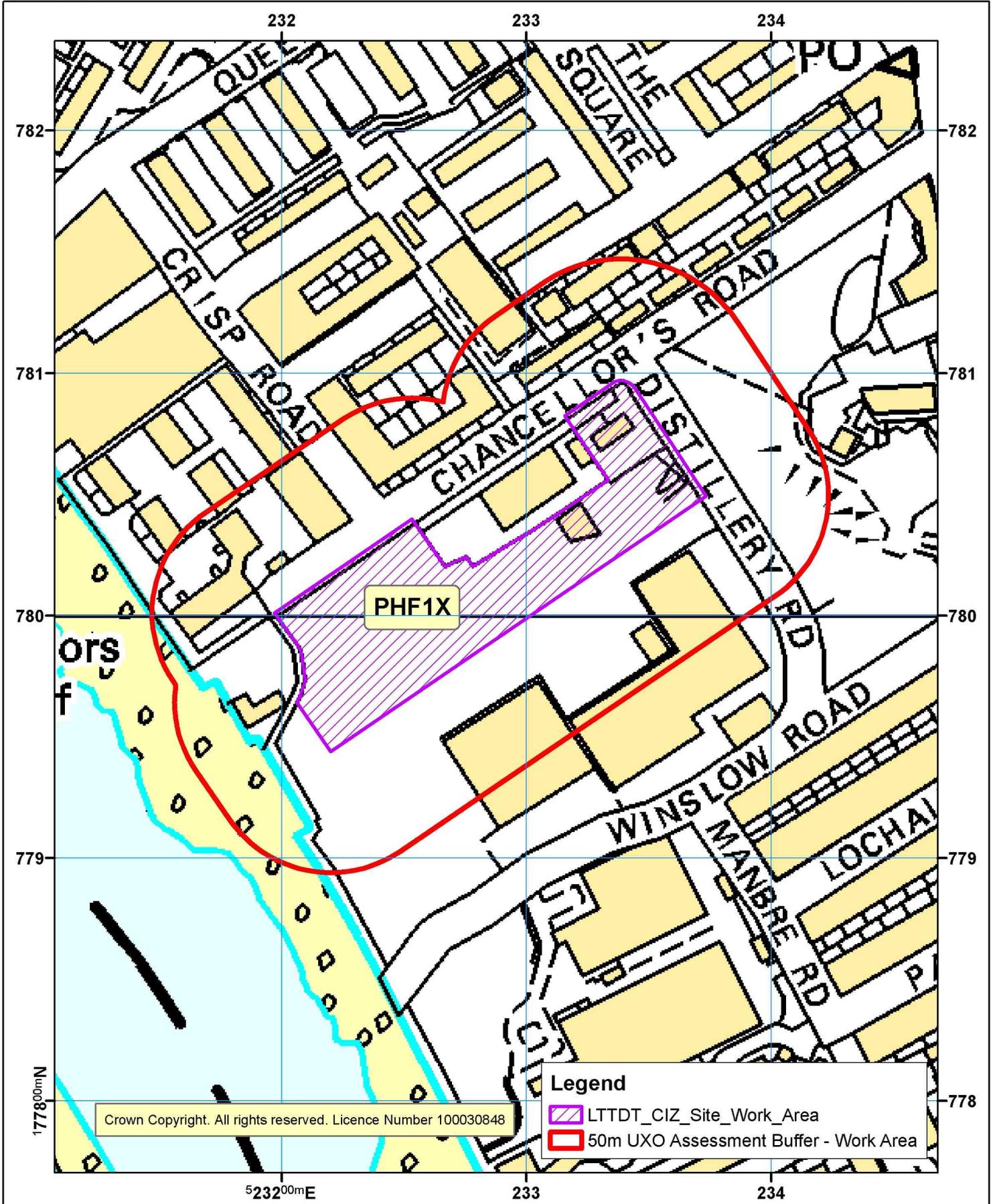
Figure One

Location of the Proposed Works

Thames Tideway Tunnel - Work Area PHF1X. Work Area Locations

Figure 1

British National Grid



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Checked by: Lee Gooderham

Date: 4th January 2011

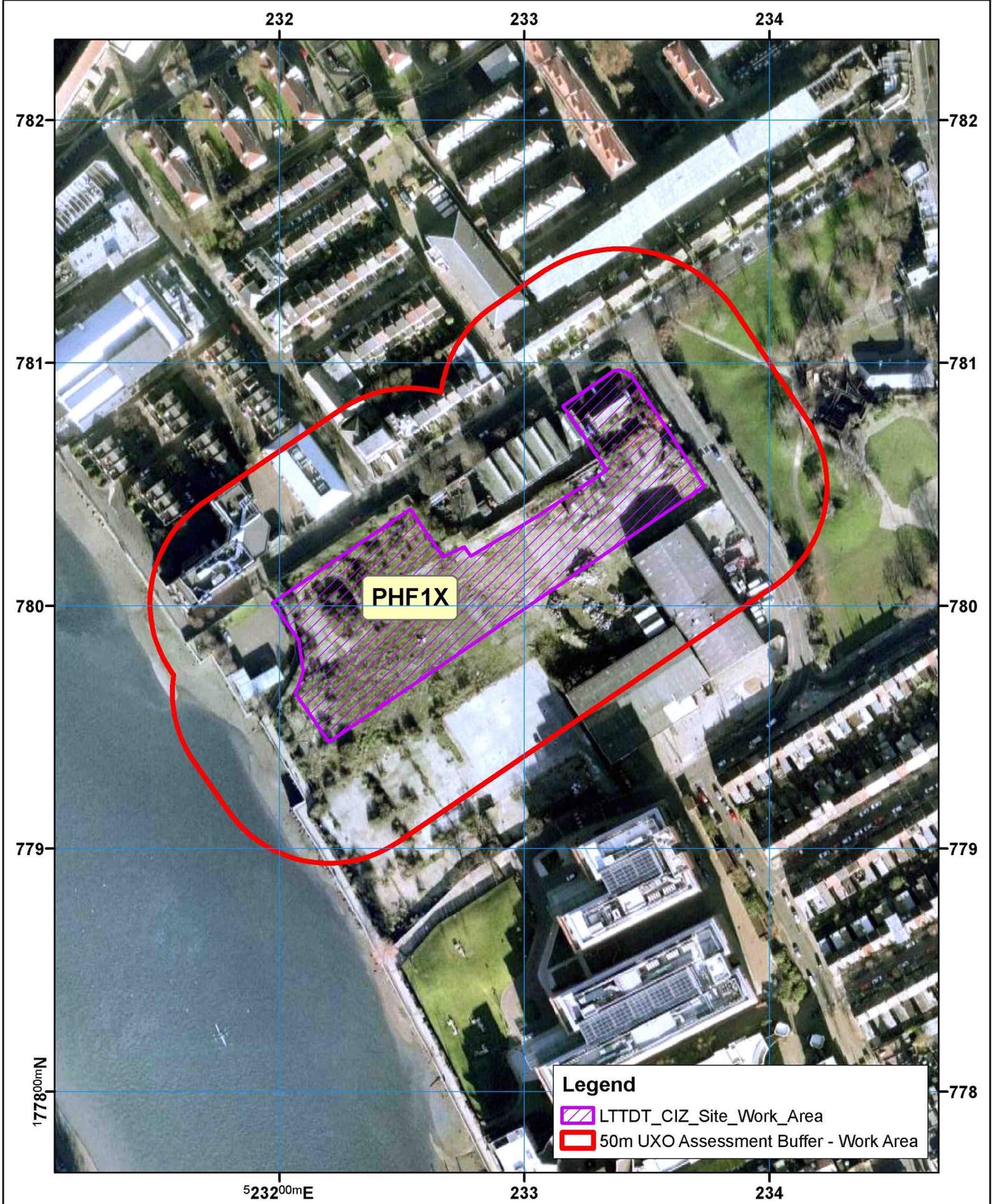
Figure Two

Current Aerial Photography

Thames Tideway Tunnel - Work Area PHF1X Current Aerial Photograph

Figure 2

British National Grid



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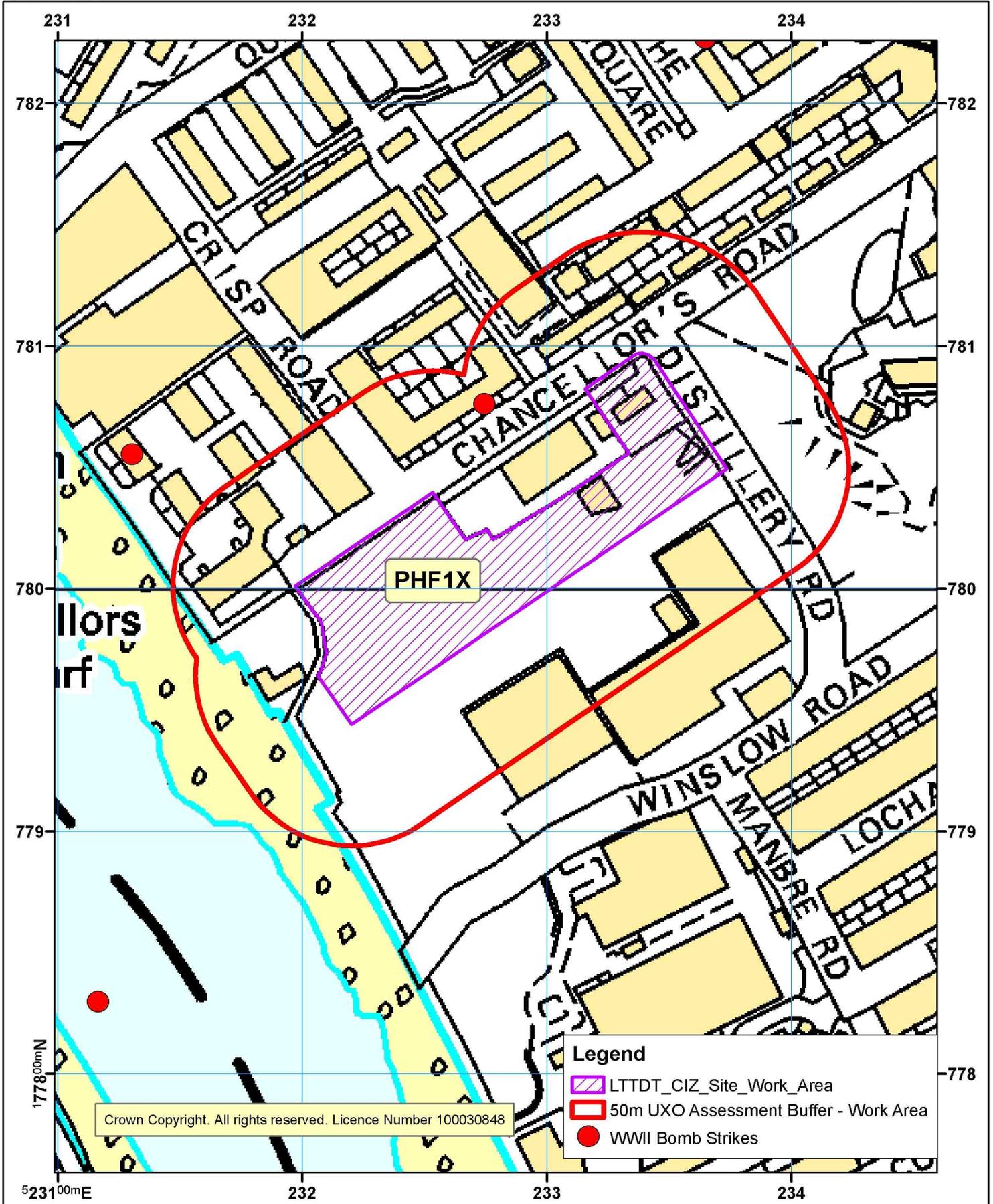
Figure Three

WWII High Explosive Bomb Strikes

Thames Tideway Tunnel - Work Area PHF1X Location of WWII High Explosive Bombs

Figure 3

British National Grid



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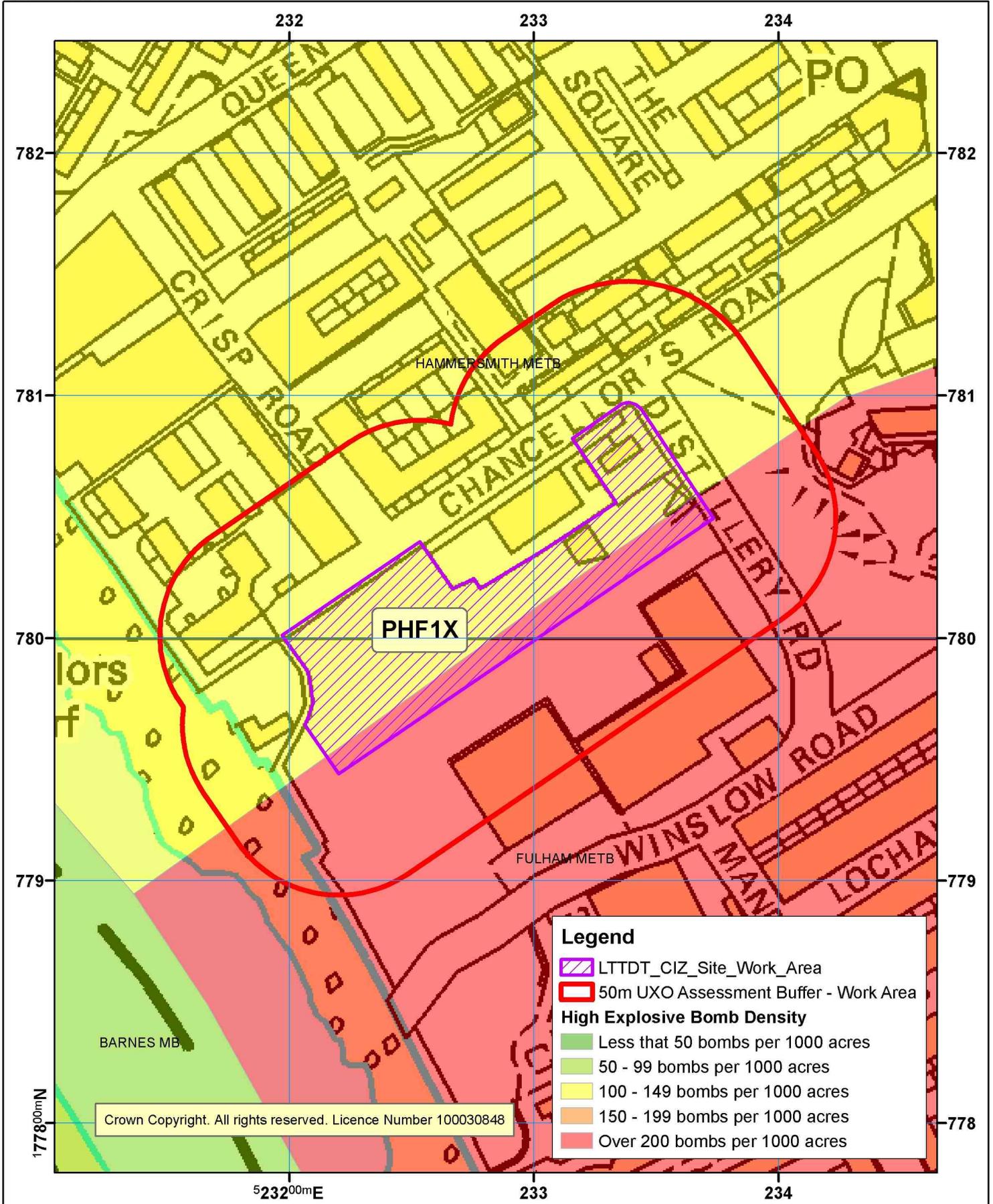
Figure Four

WWII High Explosive Bomb Density

Thames Tideway Tunnel - Work Area PHF1X WWII High Explosive Bomb Density

Figure 4

British National Grid



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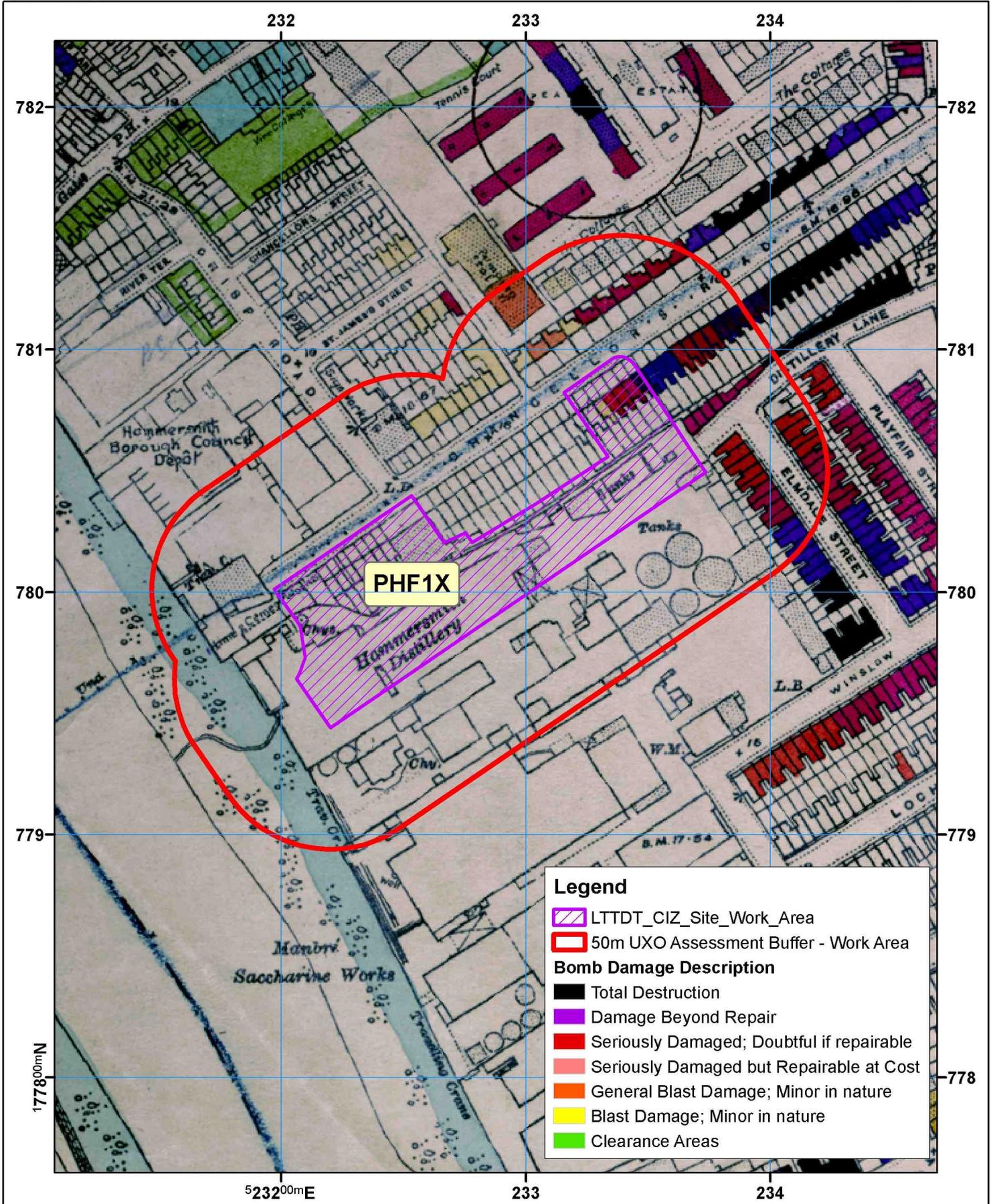
Figure Five

London County Council Bomb Damage Mapping

Thames Tideway Tunnel - Work Area PHF1X London County Council Bomb Damage Mapping

Figure 5

British National Grid



Legend

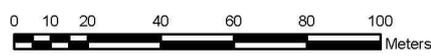
- LTTDT_CIZ_Site_Work_Area
- 50m UXO Assessment Buffer - Work Area

Bomb Damage Description

- Total Destruction
- Damage Beyond Repair
- Seriously Damaged; Doubtful if repairable
- Seriously Damaged but Repairable at Cost
- General Blast Damage; Minor in nature
- Blast Damage; Minor in nature
- Clearance Areas



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References

- ¹ Department for the Environment, Food and Rural Affairs and The Environment Agency, *CLR8: Potential Contaminants for the assessment of land*, Environment Agency (2002).
- ² Department of the Environment, Industry Profiles (various), available from <http://www.environment-agency.gov.uk/research/planning/33708.aspx>, accessed 25th March 2011.
- ³ London Borough of Hammersmith and Fulham consultation response
- ⁴ 6 Alpha Associates Limited. *Detailed Unexploded Ordnance Risk Assessments. Study site: Work area PHF1X - Hammersmith Pumping Station* (7th February 2011)
- ⁵ Defra and EA. *Soil Guideline Values* (2009).
- ⁶ Land Quality Management/Chartered institute of Environmental Health. *Generic Assessment Criteria for Human Health Risk Assessment*, 2nd Edition (2009).
- ⁷ Costain Limited, 2000, Ground Investigation Project Brando, Hammersmith, Geo-environmental Site Assessment.
- ⁸ WSP Environmental Ltd, 2002, Environmental Assessment, Phase 2, Hammersmith Embankment London.
- ⁹ Mott MacDonald, 2005. Project Brando Contamination Risk Assessment and Remediation Strategy
- ¹⁰ Mott MacDonald Ltd, 2007, Hammersmith Embankment Contamination Risk Assessment and Remediation Strategy.
- ¹¹ Geo-environmental Services Ltd, 2012, Review of investigations for the site at Distillery Road for St George (Central London) Ltd

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Thames Tideway Tunnel
Thames Water Utilities Limited



Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.05**

Volume 5: Hammersmith Pumping Station appendices

Appendix G: Noise and vibration

APFP Regulations 2009: Regulation **5(2)(a)**

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**Thames
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Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 5 Hammersmith Pumping Station appendices

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Appendix G: Noise and vibration

G.1 Baseline noise survey

Introduction

- G.1.1 As described in Volume 2 Environmental assessment methodology, the main purpose of the noise survey has been to determine representative ambient and background noise levels at a number of different types of noise sensitive receptor.
- G.1.2 The nearest identified noise sensitive receptors to Hammersmith Pumping Station are the two storey residential dwellings on Chancellor's Road located north of the proposed development, to the east is Frank Banfield Park beyond which are the rear façades of three-storey mixed residential and commercial premises facing Fulham Palace Road. To the south are two storey residential dwellings on Winslow Road and to the southwest on the opposite bank of the Thames in LB of Richmond upon Thames are three storey properties at River View Gardens. Additionally, planning approval has been granted for a new residential development to the southwest (and partly within) the area of the proposed worksite, known as Fulham Reach. The development proposals indicate several buildings located close to the boundary of the development and therefore this development has been included in the assessment.

Survey methodology

- G.1.3 The London Borough of Hammersmith and Fulham has been consulted regarding the noise assessment and monitoring locations, prior to completing the surveys. A response has not been received (see Vol 5 Section 9.3).
- G.1.4 An initial baseline noise survey was completed on 7th December, 2011 and additional data was collected on 19th January, 2012 and 25th to 27th March, 2012. These surveys comprised short term attended measurements taken during the daytime, evening and night time. Continuous unattended overnight monitoring was also completed at one location.
- G.1.5 Short term attended monitoring was completed at all measurement locations. Measurements were undertaken during the interpeak periods of 10:00-12:00, 14:00-16:00, 20:00-22:00 and 00:00-04:00 on a typical weekday, and 14:00-18:00 and 00:00-04:00 on a typical weekend day so that the baseline data is representative of the quieter periods where any disturbance from construction would be most noticeable.
- G.1.6 Vol 5 Table G.1 describes the survey equipment that was used to collect the baseline data at the site.

Vol 5 Table G.1 Noise – survey equipment

Item	Type	Manufacturer	Serial Number(s)	Laboratory Calibration Date
Initial baseline survey: 7 th December, 2011				
Hand-held analyser(s)	2250	Brüel & Kjær	2626232 2626233	15/02/2010*
½ “ microphone(s)	4189	Brüel & Kjær	2621211 2621212	15/02/2010*
B&K sound calibrator(s)	4231	Brüel & Kjær	2619374 2619375	21/02/2011* 21/01/2010*
Additional baseline survey: 19 th January, 2012				
Hand-held analyser(s)	2250	Brüel & Kjær	2659069	11/03/2011**
½ “ microphone(s)	4189	Brüel & Kjær	2650595	10/03/2011**
B&K sound calibrator(s)	4231	Brüel & Kjær	2062513	09/11/2011**
Additional baseline survey: 25 th -27 th March, 2012				
Hand-held analyser(s)	2250	Brüel & Kjær	2626232 2626233	23/01/2012* 23/01/2012*
½ “ microphone(s)	4189	Brüel & Kjær	2621211 2621212	20/01/2012* 20/01/2012*
B&K sound calibrator(s)	4231	Brüel & Kjær	2619374	20/01/2012*

*Hand-held analyser(s) and ½ “ microphone(s) valid for two years from the date listed, calibrator(s) valid for one year from the date listed

**Hand-held analyser(s), ½ “ microphone(s) and calibrator(s) valid for one year from the date listed

G.1.7 Prior to and on completion of the surveys, the sound level meters and microphone calibration was checked using a Brüel and Kjær sound level meter calibrator. On-site calibration checks were performed before and after all measurements with no significant deviation being observed. The sound level meters and calibrators have valid laboratory calibration certificates.

G.1.8 The sound level meters were tripod-mounted with the microphone approximately 1.3m above ground level. A windshield was fitted over the

Environmental Statement

microphone at all times during the survey period to minimise the effects of any wind induced noise.

- G.1.9 For the attended measurements, the sound level meters were tripod-mounted with the microphone approximately 1.3m above ground level. A windshield was fitted over the microphone at all times during the survey period to minimise the effects of any wind induced noise.
- G.1.10 For the unattended measurement, the environmental case used for the continuous data logging was locked to avoid any potential tampering. The microphone was tripod-mounted approximately 1.3m above ground level. A windshield with bird spikes was fitted over the microphone at all times during the survey period to minimise the effects of any wind induced noise, and also to prevent birds from perching on the equipment.
- G.1.11 The prevailing weather conditions observed during the baseline surveys are described in Vol 5 Table G.2.

Vol 5 Table G.2 Noise – weather conditions during baseline noise surveys

Wind Speed (ms ⁻¹)	Wind Direction	Temperature (°C)	Precipitation?	Description
Initial baseline survey – 7 th December, 2011 (daytime, 10:00-12:00)				
Maximum: 3.1-8.4 Average: 0.7-2.8	Westerly	9-10	No	Dry, sunny and breezy
Initial baseline survey – 7 th December, 2011 (daytime, 14:00-16:00)				
Maximum: 3.6-7.0 Average: 1.0-2.3	W; WNW	8-10	No	Dry, sunny and breezy
Initial baseline survey – 7 th December, 2011 (evening, 20:00-22:00)				
Maximum: 1.5-2.9 Average: 0.3-1.1	W; WSW	5-7	No	Dry and clear, with occasional light breeze
Additional baseline survey – 19 th January, 2012 (evening, 20:00-22:00)				
Maximum: 3.3-4.9 Average: 0.9-1.6	Westerly	8	No	Dry, clear and breezy
Additional baseline survey - 25 th March, 2012 (daytime, 14:00-18:00)				

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Wind Speed (ms ⁻¹)	Wind Direction	Temperature (°C)	Precipitation?	Description
Maximum: 0.5-3.7 Average: 0-1.7	E, NE	14-18	No	Sunny, warm, clear and breezy
Additional baseline survey - 26 th March, 2012 (night-time, 00:00-04:00)				
Maximum: 0.6-3.5 Average: 0-1.6	E, ENE	5-8	No	Clear and dry. Occasional light breeze
Additional baseline survey - 27 th March, 2012 (night-time, 00:00-04:00)				
Maximum: 0-2.7 Average: 0-1	N,NE	8-11	No	Clear, dry and calm

Measurement locations

G.1.12 Vol 5 Table G.3 details the measurement locations which are also presented in Vol 5 Figure G.1 Noise – measurement locations (see separate volume of figures), and shown in Vol 5 Plate G.1 to Vol 5 Plate G.4.

Vol 5 Table G.3 Noise – measurement locations

Measurement location number	Description	Co-ordinates	
		X	Y
HAM01	On public footpath adjacent to Chancellor's Road	523190	178001
HAM02	On public footpath adjacent to Chancellor's Road, in front of residential dwellings	523244	178047
HAM03	On public footpath within Frank Banfield Park	523409	178083
HAM04	On public footpath adjacent to Winslow Road, in front of residential dwellings	523381	177927

Results

G.1.13 The range of values for each of the parameters collected during the baseline surveys are summarised in Vol 5 Table G.4 to Vol 5 Table G.7.

Vol 5 Table G.4 Noise – sampled noise survey results - HAM01

Location Detail: HAM01, on public footpath adjacent to Chancellor’s Road						
Measurement period	Noise level (dB(A) free-field)			Averaged ambient noise level, dBL_{Aeq,15min}		dBL_{Aeq,15min} (rounded to nearest 5dB)
	L_{AFmax}	L_{A90,15min}	L_{Aeq,15min}	Free field	Façade	Façade
Daytime (10.00-12.00, 14.00-16.00)	89	51	59-61	60	63*	65
Evening (20.00-22.00)	71	45	50-53	52	55*	55
Night (00.00-04.00)	58	40	41-45	43	46*	45
Weekend day (14.00-18.00)	77	44	52-53	52	55*	55
Weekend night (00.00-04.00)	61	42	42-45	43	46*	45

* An approximation of the averaged ambient façade noise level has been obtained by adding 3dB to the calculated averaged ambient free-field level

Vol 5 Table G.5 Noise – sampled noise survey results - HAM02

Location Detail: HAM02, on public footpath adjacent to Chancellor’s Road, in front of residential dwellings						
Measurement period	Noise level (dB(A) free-field)			Averaged ambient noise level, dBL_{Aeq,15min}		dBL_{Aeq,15min} (rounded to nearest 5dB)
	L_{AFmax}	L_{A90,15min}	L_{Aeq,15min}	Free field	Façade	Façade
Daytime (10.00-12.00, 14.00-16.00)	99	52	61-80	70	73*	75
Evening (20.00-22.00)	81	46	55-57	53	56*	55
Night (00.00-04.00)	75	39	40-50	47	50*	50
Weekend day (14.00-18.00)	82	45	56-57	56	59*	60
Weekend night (00.00-04.00)	76	40	44-53	50	53*	55

** An approximation of the averaged ambient façade noise level has been obtained by adding 3dB to the calculated averaged ambient free-field level*

Vol 5 Table G.6 Noise – sampled noise survey results - HAM03

Location Detail: HAM03, on public footpath within Frank Banfield Park						
Measurement period	Noise level (dB(A) free-field)			Averaged ambient noise level, dBL _{Aeq,15min}		dBL _{Aeq,15min} (rounded to nearest 5dB)
	L _{AFmax}	L _{A90,15min}	L _{Aeq,15min}	Free field	Façade	Façade
Daytime (10.00-12.00, 14.00-16.00)	79	55	59-60	59	62*	60
Evening (20.00-22.00)	71	50	52-53	53	56*	55
Night (00.00-04.00)						
Weekend day (14.00-18.00)	88	51	58-61	60	63*	65
Weekend night (00.00-04.00)						

* An approximation of the averaged ambient façade noise level has been obtained by adding 3dB to the calculated averaged ambient free-field level

Vol 5 Table G.7 continuously logged noise survey results - HAM03

Location Detail: HAM03, on public footpath within Frank Banfield Park							
Day	Period	Period noise level (dB(A) free-field)			Period noise level (dB(A) façade)		
		L _{AFmax}	L _{A90}	L _{Aeq}	L _{AFmax}	L _{A90}	L _{Aeq}
Weekday	22.00-07.00*	70	39	44	73	42	47
Sunday	21.00-07.00*	67	38	43	70	41	46

*The data presented in this row is deemed to be representative of the reference period. The continuous monitor only collected data from 00:00 through 04:00.

Vol 5 Table G.8 Noise – sampled noise survey results - HAM04

Location Detail: HAM04, on public footpath adjacent to Winslow Road, in front of residential dwellings						
Measurement period	Noise level (dB(A) (façade))			Averaged ambient noise level, dBL _{Aeq,15min}		dBL _{Aeq,15min} (rounded to nearest 5dB)
	L _{AFmax}	L _{A90,15min}	L _{Aeq,15min}	Free field	Façade	Façade
Daytime (10.00-12.00, 14.00-16.00)	92	57	60-70	62*	65	65
Evening (20.00-22.00)	91	48	51-63	57*	60	60
Night (00.00-04.00)	78	37	42-50	44*	47	45
Weekend day (14.00-18.00)	94	46	54-66	59*	62	60
Weekend night (00.00-04.00)	69	39	41-45	41*	44	45

* An approximation of the averaged ambient free-field level has been obtained by subtracting 3dB from the calculated averaged ambient façade noise level

Plates of noise measurement locations

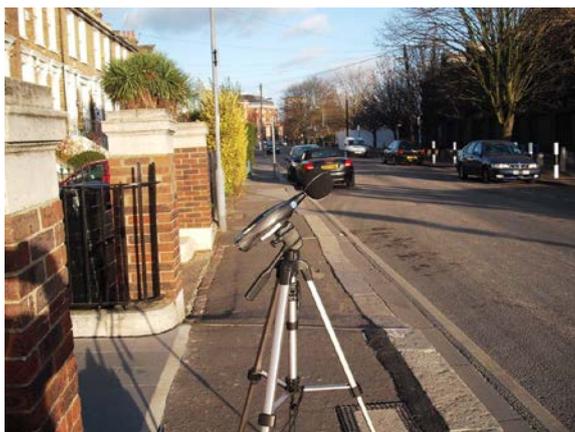
G.1.14 The following plates (Vol 5 Plate G.1 to Vol 5 Plate G.4) illustrate the noise measurement locations.

Vol 5 Plate G.1 Noise measurement location HAM01



Note: On public footpath at the end of Chancellor's Road, looking southwest towards River Thames

Vol 5 Plate G.2 Noise measurement location HAM02



Note: On public footpath along Chancellor's Road, in front of residential dwellings, looking northeast

Vol 5 Plate G.3 Noise measurement location HAM03



Note: On public footpath within Frank Banfield Park, looking north

Vol 5 Plate G.4 Noise measurement location HAM04



Note: On public footpath along Winslow Road, in front of residential dwellings looking southwest

G.2 Construction noise prediction results

- G.2.1 The construction noise prediction methodology follows the methodology provided in Volume 2 Environmental assessment methodology.
- G.2.2 The assessment has been carried out based on a typical construction programme which has been used to calculate the average monthly noise levels.
- G.2.3 Construction plant assumptions used in the assessment are presented in Vol 5 Table G.9.
- G.2.4 Time histories of the predicted daytime construction noise levels across the programme of construction works are shown in Vol 5 Plate G.5 to Vol 5 Plate G.14.

Vol 5 Table G.9 Noise – typical construction plant schedule.

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
Hoarding General site equipment NOT applicable during this phase	Excavator digging post holes for hoarding	1	98	30	BS5228-1: Table C.2, Item 7	Tracked excavator,
	Nail guns for erection of hoarding	2	101	10	BS5228-1: Table C.4, Item 95	Handheld cordless nail gun, 15 to 50 mm nails
	Hand-held percussive breaker	1	111	15	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker,
	Compressor 250cfm	1	93	15	BS5228-1: Table C.5, Item 5	Compressor for hand-held pneumatic breaker, 1 t
	Generator 35kVA	1	94	100	BS5228-1: Table C.4, Item 78	Diesel generator,
	Circular saw cutting timber	1	107	10	BS5228-1: Table D.7, Item 72	Hand-held electric circular saw,
	Cutting equipment (diamond saw)	1	108	10	BS5228-1: Table C.4, Item 93	Angle grinder (grinding steel), 4.7 kg
	Waste collection via skip or tipper lorry	1	106	5	BS5228-1: Table C.8, Item 21	Skip wagon,
	Oxyacetelene cutting equipment	1	93	10	BS5228-1: Table C.3, Item 35	Hand-held gas cutter, 230 bar
	Oxyacetelene cutting equipment	1	93	10	BS5228-1: Table C.3, Item 35	Hand-held gas cutter, 230 bar
Site set up and general site	Compressor 250cfm	1	93	50	BS5228-1: Table D.5,	Compressor for hand-

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Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
					Item 5	held pneumatic breaker,
	Generator - 200 kVA	1	94	100	BS5228-1: Table C.4, Item 78	Diesel generator,
	Cutting equipment (diamond saw)	2	108	10	BS5228-1: Table C.4, Item 93	Angle grinder (grinding steel), 4.7 kg
	Telescopic Handler/FLT	1	99	30	BS5228-1: Table C.2, Item 35	Telescopic handler, 10 t
	Wheel wash	1	91	20	BS5228-1: Table C.3, Item 13	Water jet pump,
	Hiab lorry/crane	1	105	5	BS5228-1: Table C.4, Item 53	Lorry with lifting boom, 6 t
	Water settling/treatment	1	104	100	Measured	Dirty water plant
	Dewatering Pump	1	96	100	BS5228-1: Table C.4, Item 88	Water pump,
	JCB with hydraulic breaker	1	116	25	BS5228-1: Table C.5, Item 1	Backhoe mounted hydraulic breaker,
	Fuel delivery vehicle	1	104	5	BS5228-1: Table C.4, Item 15	Fuel tanker lorry,
	Well drilling Rig	1	107	50	Manufacturer	BauerBBA well drilling rig,
Demolition	Service Crane 25T mobile Crane	1	98	30	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
General site equipment also applicable	22T Excavator c/w hydraulic hammer	1	118	30	BS5228-1: Table C.1, Item 9	Breaker mounted on excavator, 15 t, 1650 kg

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Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
during this phase						breaker
	Site dumper	1	104	30	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	Pneumatic breaker	1	111	20	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker,
	Concrete crusher	1	112	80	BS5228-1: Table C.1, Item 15	Tracked crusher,
	Vibrating rollers	2	101	50	BS5228-1: Table C.2, Item 38	Roller, 18 t
Piling for shaft/culvert support	100t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	25 tonne mobile crane	1	98	50	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	Vibratory piling rig	1	116	80	BS5228-1: Table C.3, Item 8	Vibratory piling rig, 52 t
Shaft sinking and connection tunnel drive by SCL	Concrete deliveries (aggitating)	1	99	80	BS5228-1: Table C.4, Item 19	Cement mixer truck (idling),
	Concrete deliveries (discharging)	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
General site equipment also applicable	Waste collection via skip or tipper lorry	1	106	10	BS5228-1: Table C.8, Item 21	Skip wagon,
	100t crawler crane	1	103	80	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t

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Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
during this phase	25t mobile crane	1	98	20	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	Pneumatic breakers	4	111	20	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker,
	Vent fans	1	100	100	Measured	Ventilation fans,
	400 cfm compressor	1	93	50	BS5228-1: Table D.5, Item 5	Compressor for hand-held pneumatic breaker,
	25t excavator	1	105	50	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t
	100t crawler crane	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
Shaft secondary lining General site equipment also applicable during this phase	Concrete pump	2	95	20	BS5228-1: Table C.4, Item 24	Concrete pump + cement mixer truck (discharging), 8 t / 350 bar
	Concrete deliveries (discharging)	1	91	20	BS5228-1: Table C.4, Item 35	Vibratory tamper,
	Service Crane 40T mobile Crane	1	98	25	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	Hand tools (e.g. drills and wrenches)	4	95	80	Estimated	Impact wrench and compressor,
Culvert and chamber works	Service crane - 100T mobile crane	1	95	50	BS5228-1: Table C.4, Item 14	Wheeled backhoe loader, 9 t
	25t excavator	1	105	50	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t

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Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment	
General site equipment also applicable during this phase					Item 19		
	Fixed and portable concrete vibrators	2	106	20	BS5228-1: Table C.4, Item 33	Poker vibrator,	
	Concrete deliveries (discharging)	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),	
	Concrete boom pump	1	108	20	BS5228-1: Table C.4, Item 29	Truck mounted concrete pump + boom arm, 26 t	
	Dumper	1	104	50	BS5228-1: Table C.4, Item 3	Dumper, 7 t	
	Hand tools (e.g. drills and wrenches)	4	95	80	Estimated	Impact wrench and compressor,	
	Landscaping General site equipment NOT applicable during this phase	25t excavator	1	105	50	BS5228-1: Table C.2, Item 25	Tracked excavator, 14 t
		Dumper	1	104	70	BS5228-1: Table C.4, Item 3	Dumper, 7 t
		Telescopic Handler/FLT	1	99	30	BS5228-1: Table C.2, Item 35	Telescopic handler, 10 t
		Hiab lorry/crane	1	105	5	BS5228-1: Table C.4, Item 53	Lorry with lifting boom, 6 t
Compressor for hand-held breaker		1	102	10	BS5228-1: Table C.1, Item 8	Hydraulic breaker power pack, 63 kg/ 138 bar	
Hand-held percussive breaker		1	111	10	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker,	

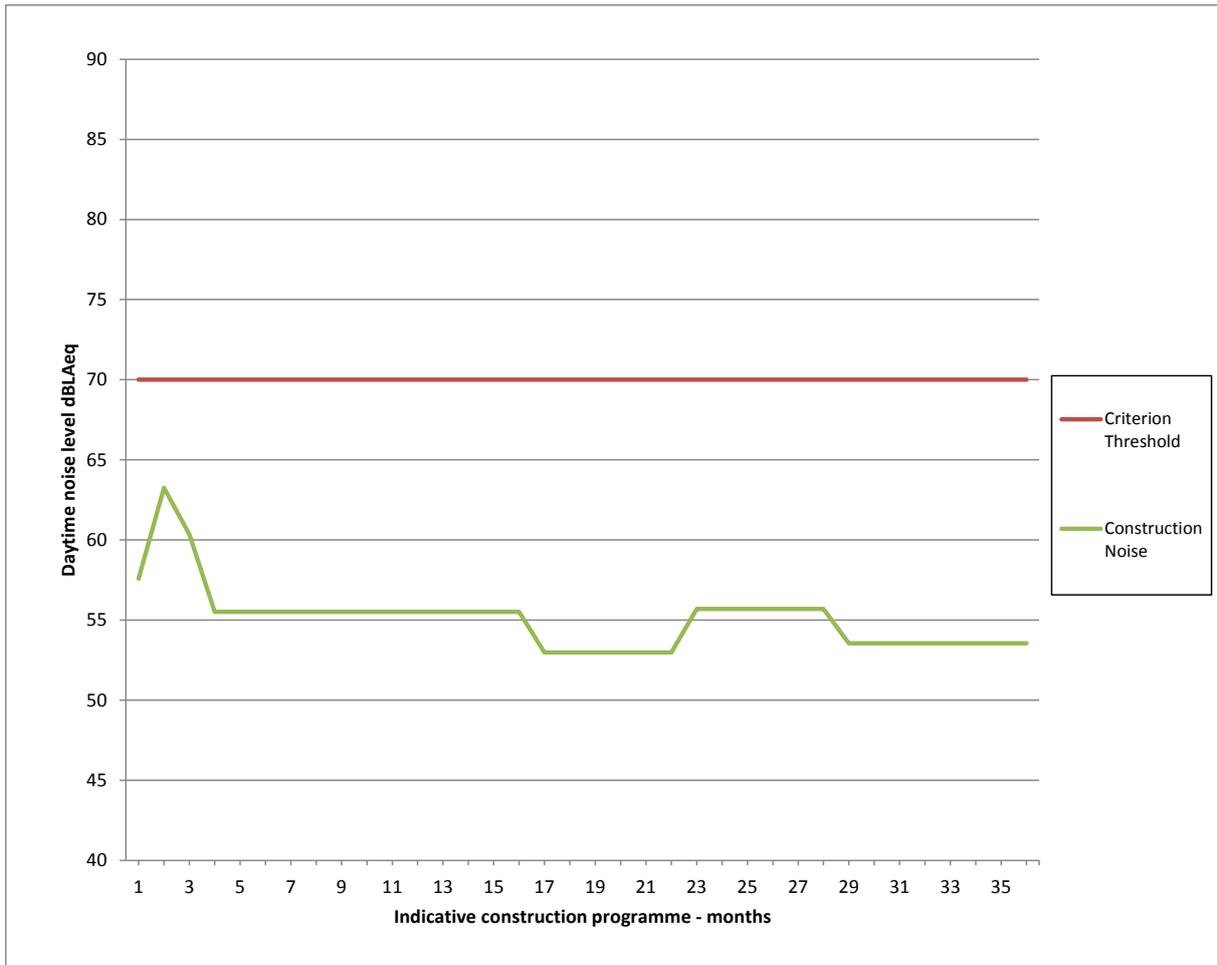
Environmental Statement

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
	Plate compactors	2	108	10	BS5228-1: Table C.2, Item 41	Vibratory plate (petrol),
	Vibrating rollers	1	101	20	BS5228-1: Table C.2, Item 38	Roller, 18 t

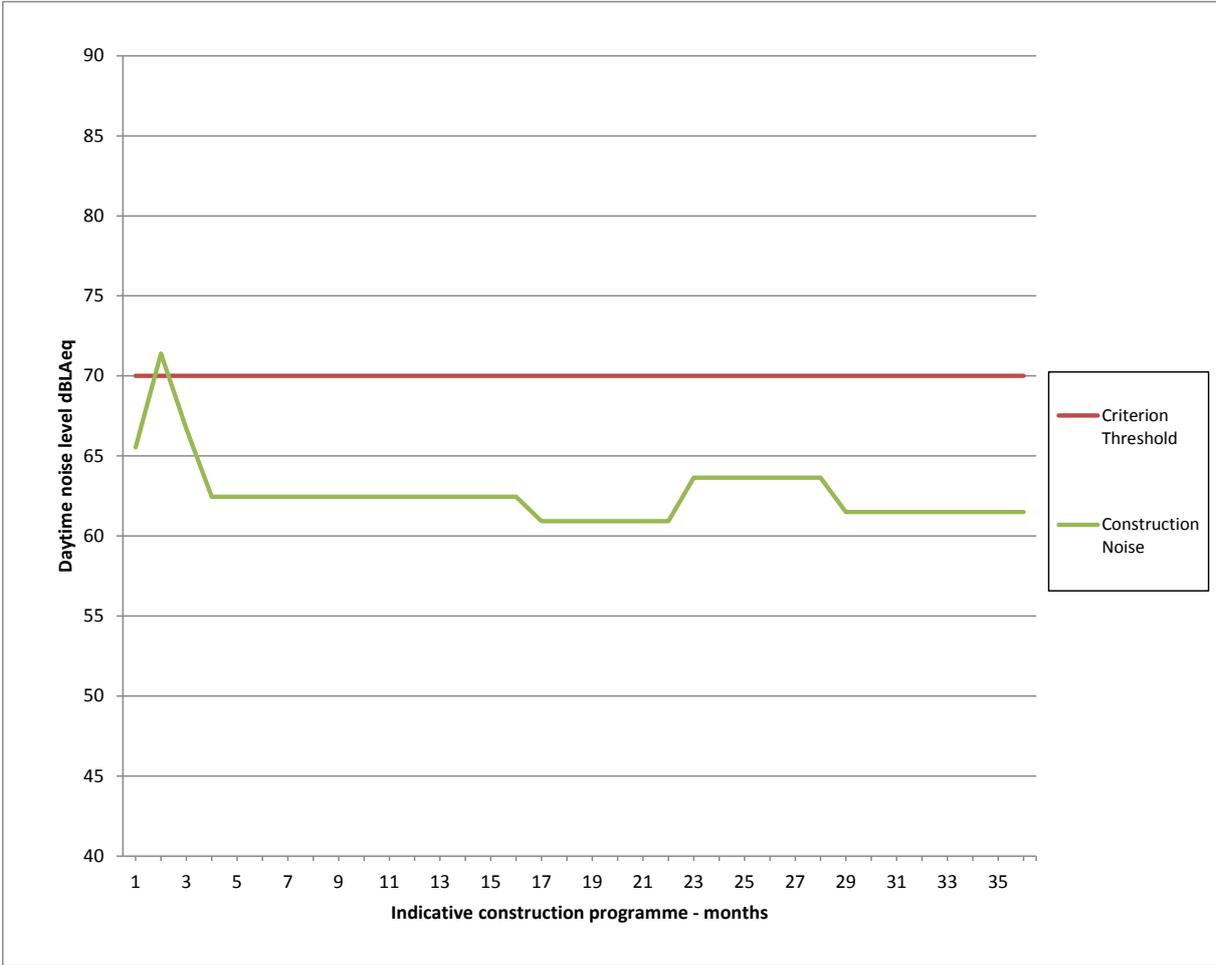
Note: This schedule provides an illustration of typical plant that could be used in the construction of the Thames Tideway Tunnel at this site. The appointed Contractor must comply with section 6 of the CoCP but may vary the method and plant to be used. This schedule therefore represents the most reasonable assumption for the assessment that can be made at this stage.

G.2.5 The predicted construction noise over time at each receptor is shown in the figures below. It should be noted that these representations are for the worst-case scenarios for noise exposure at the upper floors. For comparison with the construction noise, the figures also show either the potential significance criterion threshold for residential receptors, or the ambient noise level. This comparison is discussed in the main assessment text. The night time noise levels have also been assessed for the short period of night time works, these results are described in the main assessment text and not presented here.

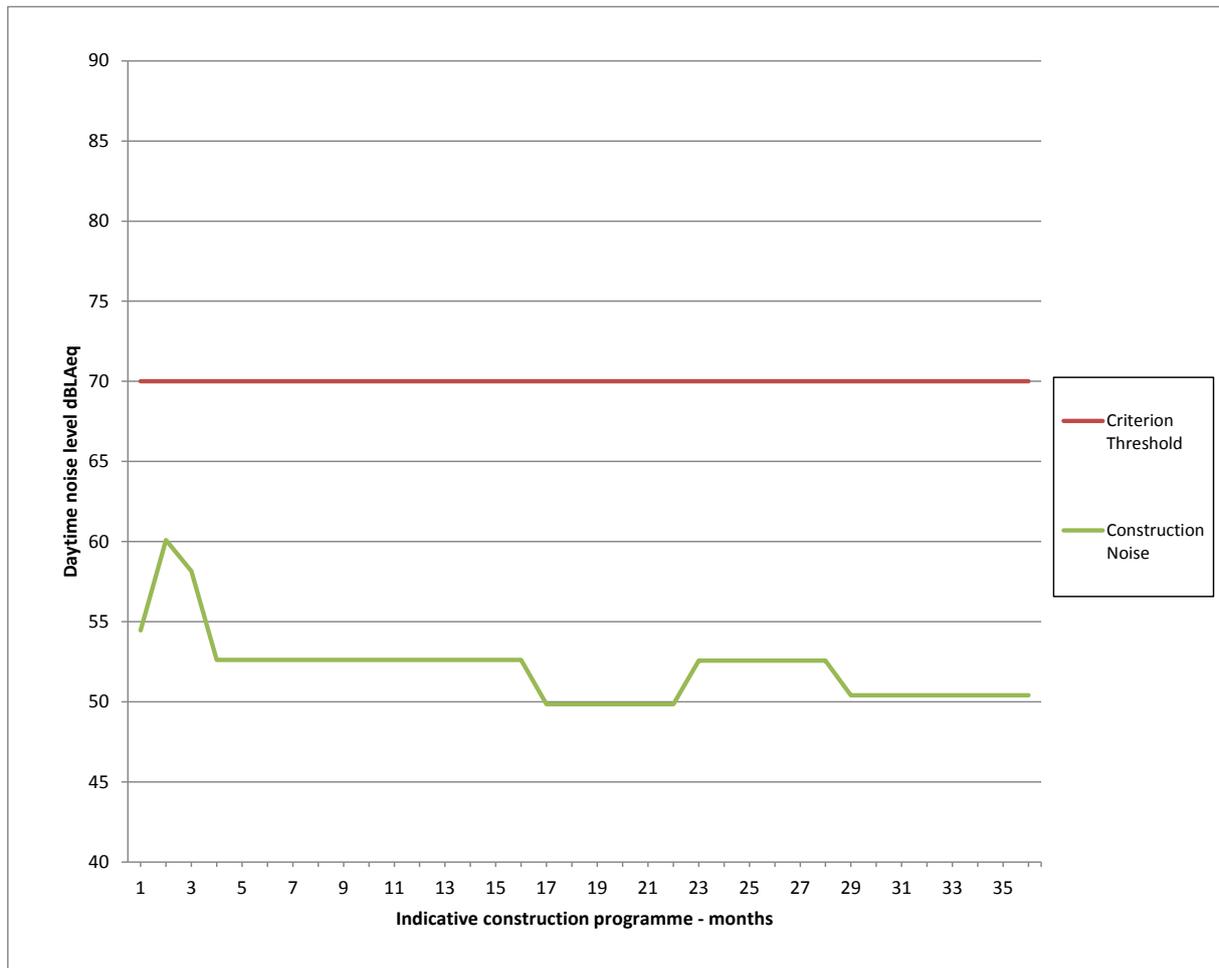
Vol 5 Plate G.5 Average monthly daytime noise level over duration of construction – 48-64 Chancellor’s Road (HA1)



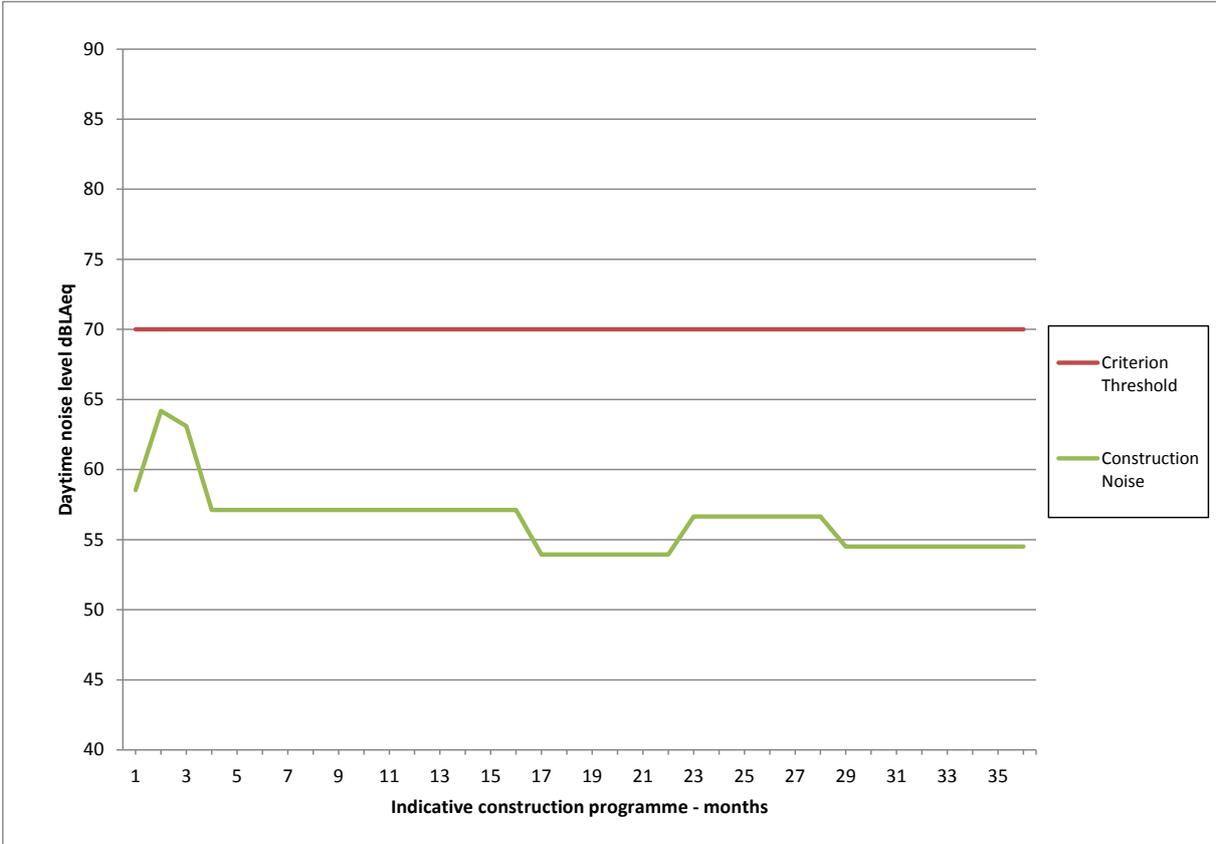
Vol 5 Plate G.6 Average monthly daytime noise level over duration of construction – 28-44 Chancellor’s Road (HA2)



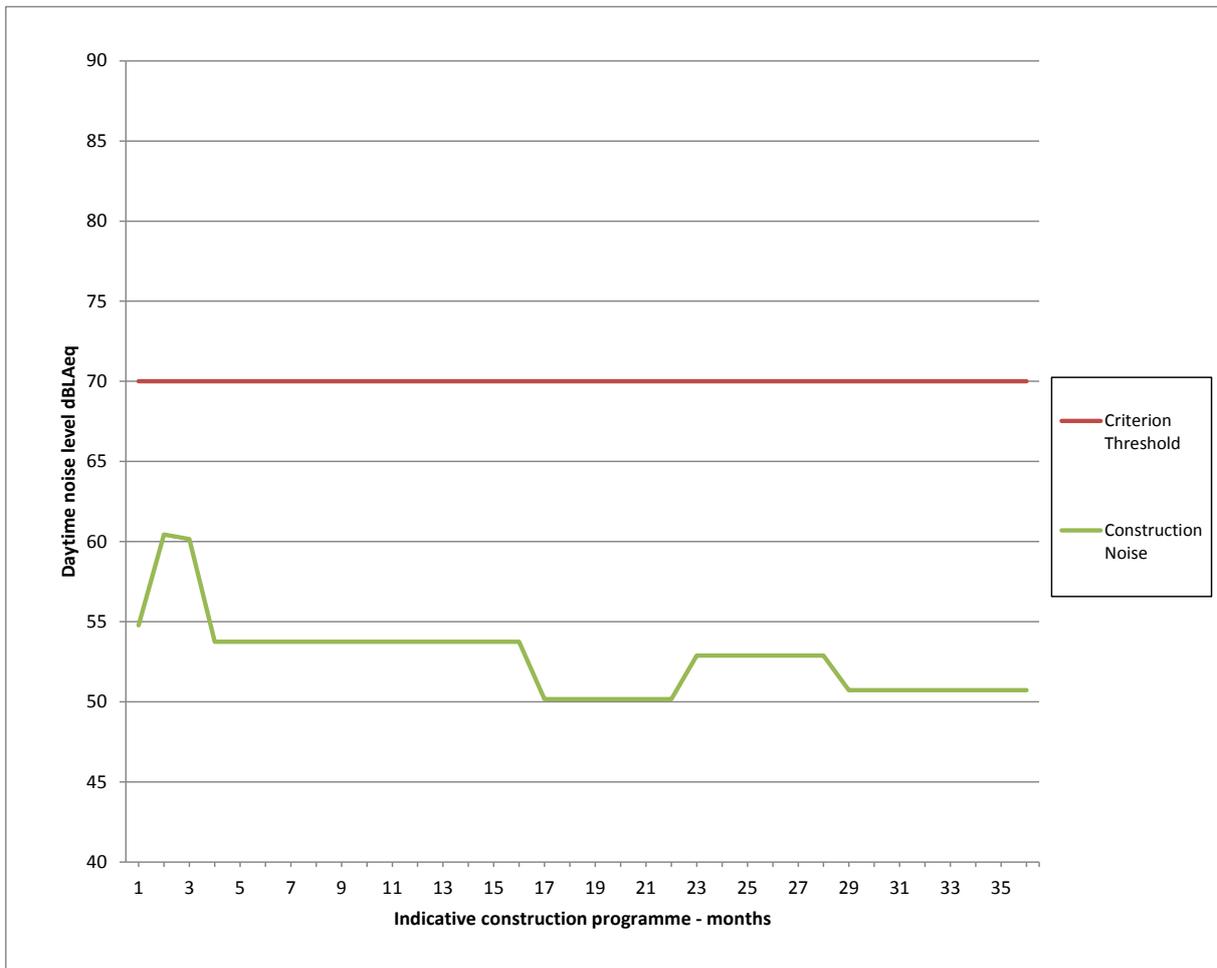
Vol 5 Plate G.7 Average monthly daytime noise level over duration of construction – 82-104 Fulham Palace Road (HA3)



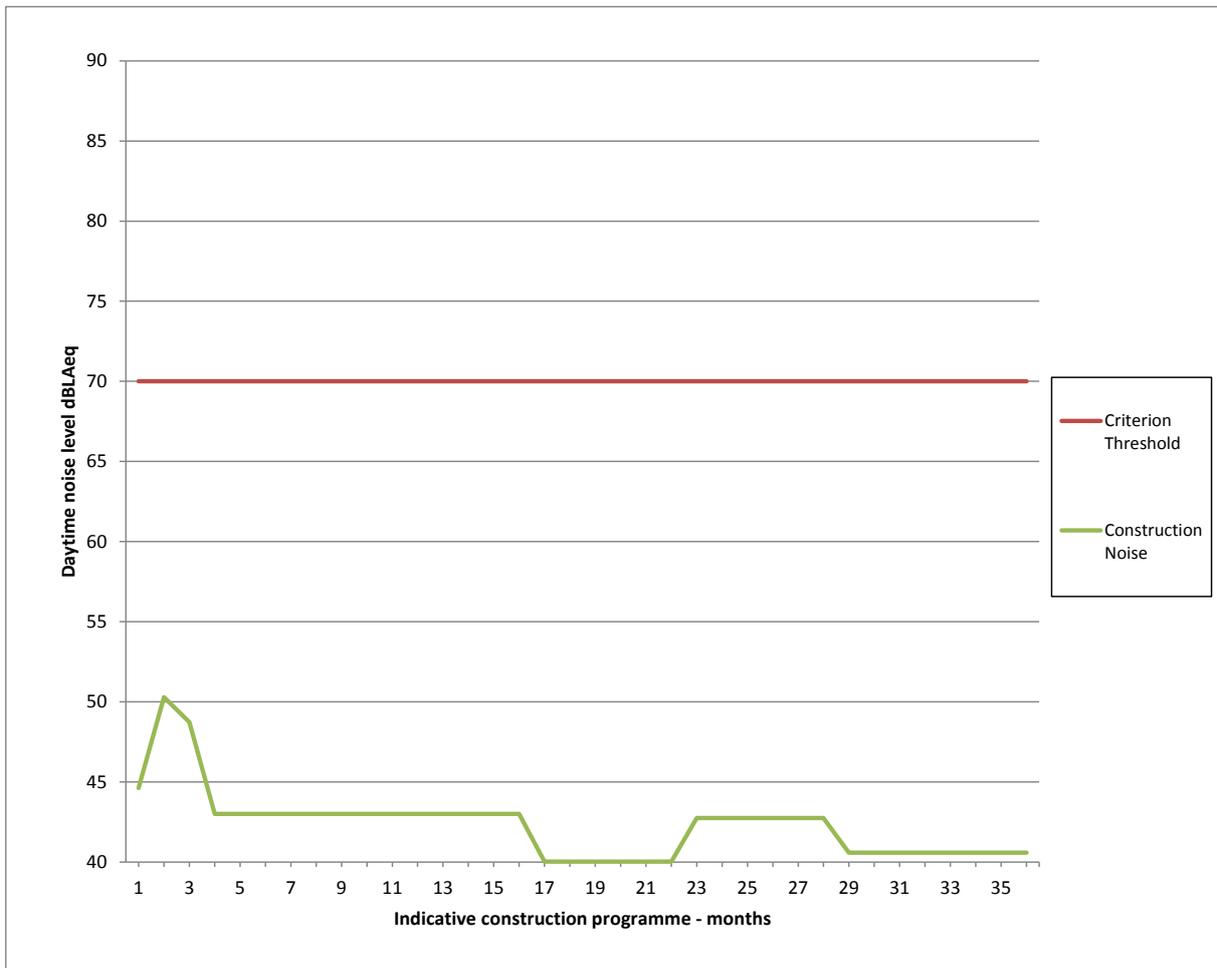
Vol 5 Plate G.8 Average monthly daytime noise level over duration of construction – 11 Winslow Road (HA4)



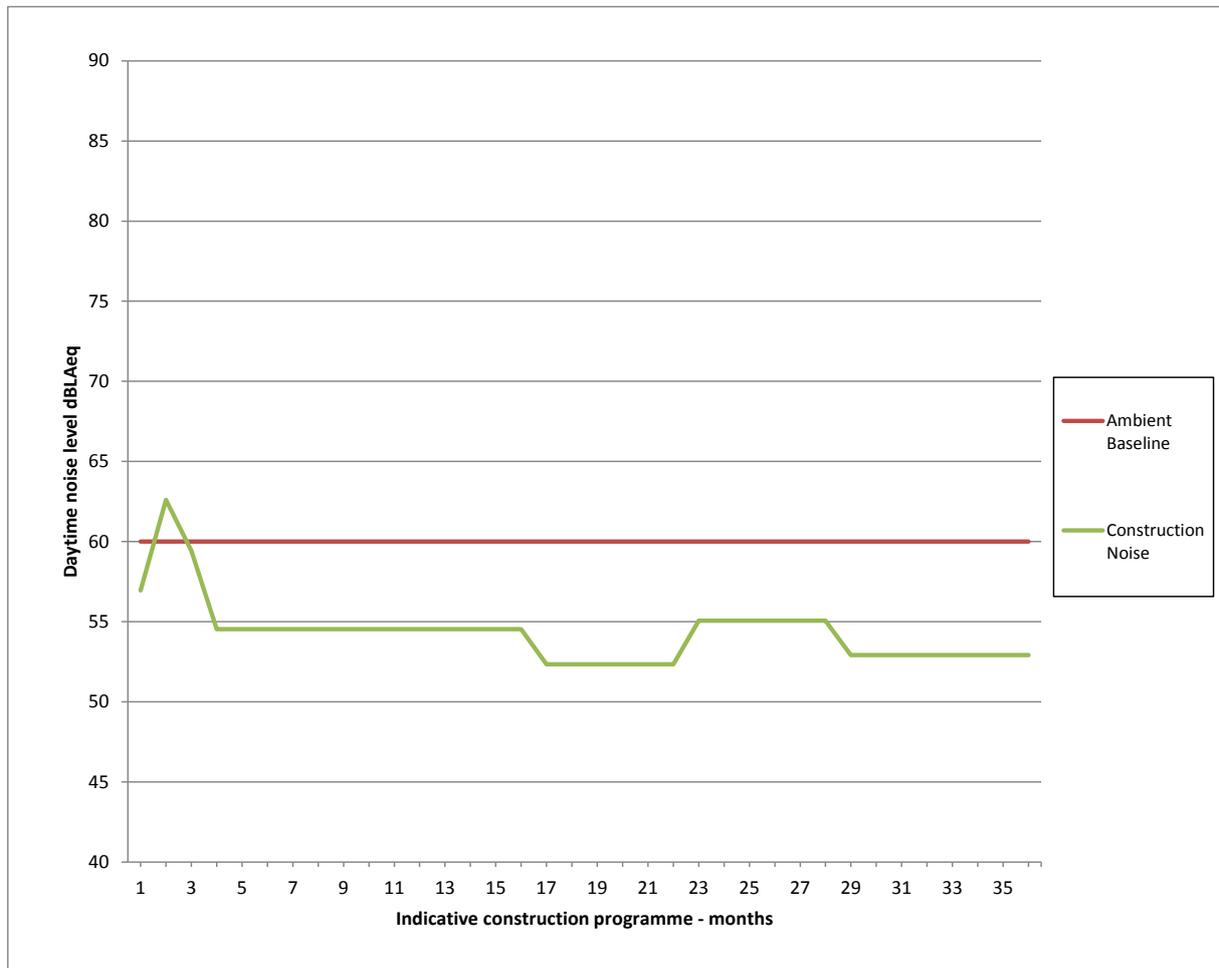
Vol 5 Plate G.9 Average monthly daytime noise level over duration of construction – 43 Winslow Road (HA5)



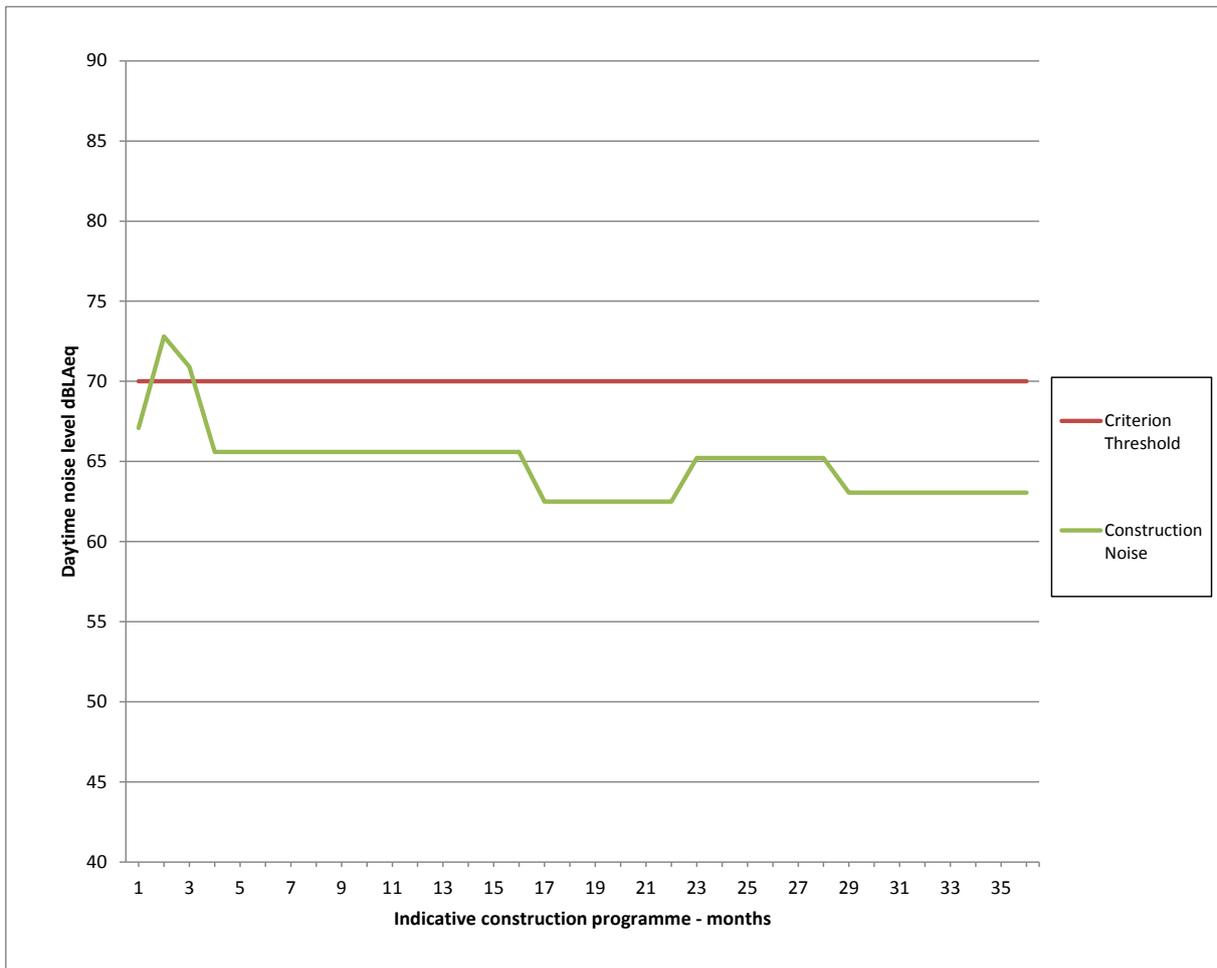
Vol 5 Plate G.10 Average monthly daytime noise level over duration of construction - 106-111 Riverview Gardens (HA6)



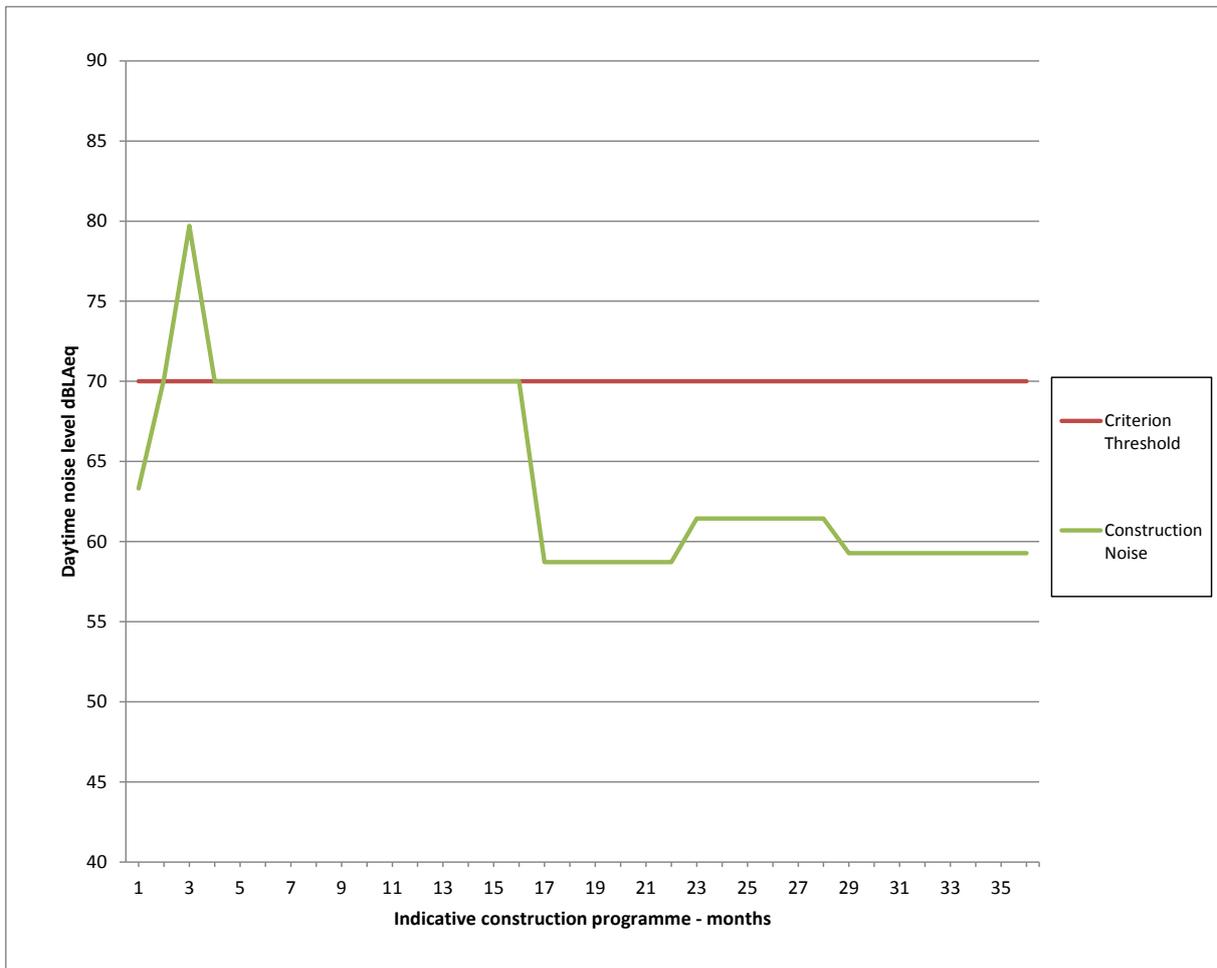
Vol 5 Plate G.11 Average monthly daytime noise level over duration of construction – Frank Banfield Park (HA7)



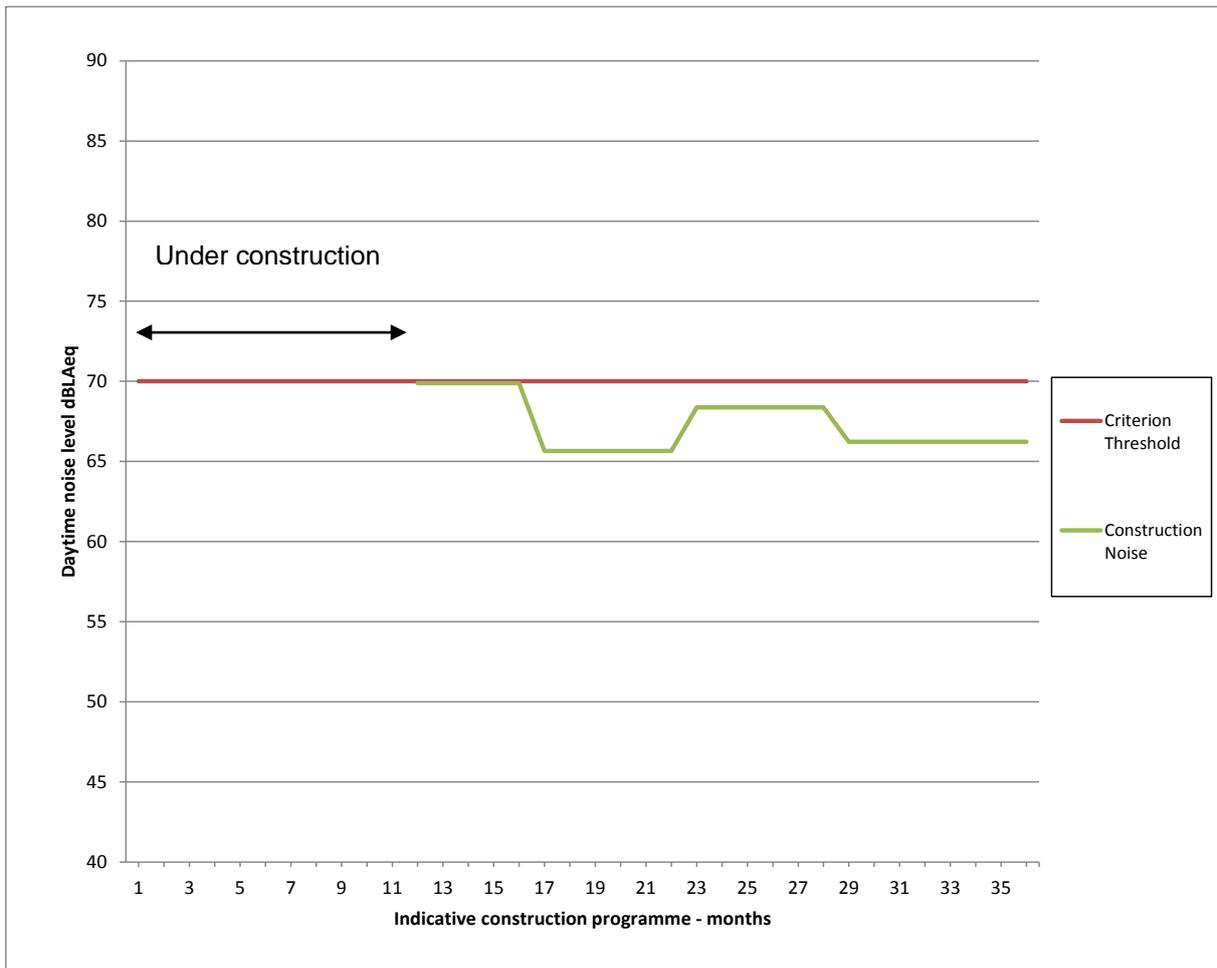
Vol 5 Plate G.12 Average monthly daytime noise level over duration of construction – Fulham Reach Phase 1 Block A (HA8)



Vol 5 Plate G.13 Average monthly daytime noise level over duration of construction - Fulham Reach Phase 2 Block B (HA9)



Vol 5 Plate G.14 Average monthly daytime noise level over duration of construction - Fulham Reach Block F (HA11)



References

ⁱ BRITISH STANDARDS INSTITUTION, *BS 5228 Code of Practice for Noise and Vibration Control on Open Construction Sites*, British Standards Institution (2009)

Thames Tideway Tunnel
Thames Water Utilities Limited



Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.05**

Volume 5: Hammersmith Pumping Station appendices

Appendix H: Socio-economics

APFP Regulations 2009: Regulation **5(2)(a)**

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Volume 5 Appendices: Hammersmith Pumping Station site assessment

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Appendix H: Socio-economics

H.1 Baseline community profile

- H.1.1 The community profile is based on both Output Area (OA) and local authority level data from the Office of National Statistics (ONS). The data have been obtained from four sources: Census 2001ⁱ (the last census for which data are availableⁱ), Department of Communities and Local Government Deprivation Indices 2010², London Public Health Observatory 2012³, and the Network of Public Health Observatories 2011⁴ (see Volume 2 Methodology). Data is grouped according to those ‘protected characteristics’ⁱⁱ or groups which are relevant for consideration in relation to this socio-economic impact assessment. This baseline community profile provides context for this socio-economic assessment.
- H.1.2 On the basis of likely impacts on receptors identified in this socio-economic assessment, the community profile examines the ‘immediate area’ surrounding the construction site (ie, within an assessment area of 250mⁱⁱⁱ), the ‘wider local area’ (ie, within an assessment area of 1km^{iv}) and the overall borough level (which in this case is the London Borough [LB] of Hammersmith and Fulham).
- H.1.3 The main protected characteristic groups concentrated^v within the immediate area surrounding the proposed construction site are:
- persons aged over 65 years old
 - persons suffering from a long term limiting illness
 - households that do not own cars
 - persons suffering from income deprivation.
- H.1.4 The main protected characteristic groups concentrated within the wider local area surrounding the proposed construction site are:
- persons aged over 65 years old
 - persons belonging to the ‘Other’ ethnic group
 - persons suffering from a long term limiting illness.

Resident population

- H.1.5 The resident population was approximately 2,700 within 250m of the site and approximately 29,275 within 1km at the time of the last census.

ⁱ Census 2001. This type of data for the 2011 Census had not been released at the time of the assessment.

ⁱⁱ The Equalities Act 2010 defines ‘protected characteristics’ as: age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex, and sexual orientation. Of these characteristics, age, disability, race and religion are relevant for consideration in relation to this socio-economic impact assessment.

ⁱⁱⁱ The statistics presented for the study area within 250m of the site include only that area on the same side of the River Thames as the proposed development.

^{iv} The statistics presented for the study area within 1km of the site include both sides of the River Thames.

^v In this instance, ‘concentrated’ refers to the occurrence of a particular protected characteristic group, the proportion of which is notably higher than borough wide proportions.

Gender and age

- H.1.6 Of the total population within 250m of the site 53.1% of residents are female, broadly in line with the proportion of females within 1km (52.2%) and the LB of Hammersmith and Fulham (52.2%). At a Greater London level, there is also a slight predominance of females (51.6%).
- H.1.7 Vol 5 Table H.1 outlines age breakdown by assessment area, it illustrates that within 250m, the proportion of under 16 year olds (16.1%) is slightly higher than within 1km (14.7%), and broadly in line with the borough wide level (16.5%). Within all of the above assessment areas, the proportions of under 16 year olds are all somewhat lower than the Greater London average (20.2%).
- H.1.8 Within 250m, the percentage of over 65 year olds (13.1%) is broadly in line with the proportions of over 65 year olds within 1km (12.0%) and at a Greater London level (12.4%). The proportion of over 65 year olds at a borough wide level (10.5%) is slightly lower than within the above assessment areas. This information is presented in Vol 5 Table H.1 below.

Vol 5 Table H.1 Socio-economics - age breakdown by assessment area

Age group	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (LB of Hammersmith and Fulham)	Greater London
Under 16 years old	16.1%	14.7%	16.5%	20.2%
Over 65 years old	13.1%	12.0%	10.5%	12.4%

Ethnicity

- H.1.9 Vol 5 Table H.2 outlines ethnicity by assessment area, showing that within 250m of the site White residents make up 78.8% of the population, with Black and Minority Ethnic (BME) groups comprising the remaining 21.2% of residents. The proportion of White residents within 250m (78.8%) is broadly in line with the proportion within 1km (79.9%) and at a borough wide level (77.8%). The Greater London proportion of White residents is slightly lower (71.2%).
- H.1.10 Within 250m, the proportion of Black residents (11.0%) is broadly in line with the LB of Hammersmith and Fulham (11.1%) and Greater London averages (10.9%). The proportion of Asian residents within 250m (4.2%) is broadly in line with the proportions within 1km (4.7%) and at a borough wide level (4.5%) and considerably lower than the Greater London average (12.1%).

Vol 5 Table H.2 Socio-economics - ethnicity by assessment area

Ethnicity	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (LB of Hammersmith and Fulham)	Greater London
White	78.8%	79.9%	77.8%	71.2%
BME	21.2%	20.1%	22.2%	28.8%
Asian	4.2%	4.7%	4.5%	12.1%
Black	11.0%	8.7%	11.1%	10.9%
Other	2.3%	3.2%	2.8%	2.7%
Mixed	3.8%	3.5%	3.8%	3.2%

Note: The figure for BME data presented in Table H.2 is the sum of data for Asian, Black, Other and Mixed ethnicities.

Religion and belief

- H.1.11 Residents identifying themselves as Christians are the predominant religious group within 250m (62.4%), 1km (63.2%) and within the LB of Hammersmith and Fulham (63.6%), slightly higher than the Greater London average (58.2%).
- H.1.12 Muslims are the second most predominant religious group within 250m (6.7%), broadly in line with the LB of Hammersmith and Fulham (6.8%) and slightly higher than within 1km (5.8%). The proportion of Muslims at the Greater London level (8.5%) is somewhat higher than within all of the above assessment areas.
- H.1.13 Almost 30% of residents within 250m do not follow a religion (28.3%). This is slightly higher than the proportion within 1km (27.4%) and higher still than the Greater London proportion (24.3%).

Health indicators

- H.1.14 Vol 5 Table H.3 outlines health indicators by assessment area, noting that the proportion of residents suffering from a long term or limiting illness within 250m of the site (17.1%) is slightly higher than within 1km (15.4%) the LB of Hammersmith and Fulham (14.7%) and Greater London (15.5%).
- H.1.15 The proportion of residents who claim disability living allowance within 250m (4.3%) is broadly in line with the proportion of claimants within the LB of Hammersmith and Fulham (4.4%) and Greater London (4.5%) and slightly higher than within 1km (4.0%).

Vol 5 Table H.3 Socio-economics - health indicators by assessment area

Health indicator	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (LB of Hammersmith and Fulham)	Greater London
Long term limiting sick	17.1%	15.4%	14.7%	15.5%
Disability living allowance	4.3%	4.0%	4.4%	4.5%

- H.1.16 Levels of adult obesity in the LB of Hammersmith and Fulham fall within the lowest quintile (ie, the lowest being the best) of all London boroughs. By contrast, the levels of child obesity measured at a borough level fall within the second highest quintile of all London boroughs.
- H.1.17 Despite high levels of child obesity, data available for the LB of Hammersmith and Fulham overall indicates that adults and children within the borough have amongst the highest rates of physical activity (ie, they fall within the highest and therefore the best quintile) of all London boroughs.
- H.1.18 Death rates by heart disease within the Middle Layer Super Output Area (MSOA)^{vi} in which the site is located are in the lowest quintile (ie, the lowest being the best) relative to Greater London. Respiratory disease, heart disease and cancer are more prevalent and fall within the second lowest quintile and deaths by strokes fall within the middle quintile relative to Greater London.
- H.1.19 Female life expectancy falls within the highest quintile (ie, the highest being the best) in the MSOA, relative to Greater London. Male life expectancy falls in the middle quintile relative to Greater London. Average life expectancy for female residents in the LB of Hammersmith and Fulham ranges from 84.9 to 93.1 years old and for male residents ranges from 81.9 to 83.2 years old.

Lifestyle and deprivation indicators

- H.1.20 Table H.4 outlines lifestyle and income deprivation indicators by assessment area, showing that the proportion of households within 250m of the site that do not own cars (58.8%) is somewhat higher than within 1km (47.7%) and at a borough wide level (48.6%), and considerably higher than the Greater London average (37.5%).

^{vi} MSOAs are areas determined by the Office of National Statistics (ONS) to collect local area statistics. MSOAs have a minimum size of 5,000 residents and 2,000 households. MSOAs have an average population size of 7,200 residents.

H.1.21 Levels of deprivation^{vii} measured by income within 250m (38.6%) are somewhat higher proportionately than levels recorded at a borough wide (31.7%) and Greater London level (30.8%), and moderately higher than within 1km (23.0%).

H.1.22 It is notable that within 250m, no overall deprivation is recorded. Within 1km however, overall deprivation (12.3%) is considerably lower than the borough wide (24.6%) and Greater London levels (24.5%).

Vol 5 Table H.4 Socio-economics - lifestyle and income deprivation levels by assessment area

Indicator	Assessment area			
	Immediate area (250m)	Wider local area (1km)	Borough wide (LB of Hammersmith and Fulham)	Greater London
No car households	58.8%	47.7%	48.6%	37.5%
Income	38.6%	23.0%	31.7%	30.8%
Overall	0.0%	12.3%	24.6%	24.5%

^{vii} Income deprivation and overall deprivation in this instance both refer to the percentage of the population which fall within the top 20% of deprived areas nationally. Percentages therefore refer to the proportion of residents within each assessment area who fall within the highest quintile of deprivation within England.

H.2 Baseline economic profile

- H.2.1 This section presents a profile of the economy local to the proposed construction site at Hammersmith Pumping Station.
- H.2.2 Data are presented for the geographical area within a radius or 'catchment' of approximately 250m from the boundary of the Limits of land to be acquired or used (LLAU) of the project site. Data are also provided at the overall borough level (which in this case is the London Borough [LB] of Hammersmith and Fulham) and for Greater London.
- H.2.3 Data are sourced from Experian's National Business Database (2012)⁶ which draws primarily on regularly updated records from Companies House^{viii}.

Employment and businesses

- H.2.4 Within approximately 250m of the site there are approximately 5,200 jobs.^{ix} Vol 5 Table H.5^x below illustrates the breakdown of employment by sector based on the UK Standard Industrial Classification (SIC) 2007⁷. It presents data for those sectors which account for more than 5% of total employment within 250m. It can be seen that:
- Information and Communication accounts for 19% of employment within 250m, somewhat more than within the LB of Hammersmith and Fulham (14%) and almost three times than within Greater London (7%).
 - Arts, Entertainment and Recreation accounts for 19% of employment within 250m, over four times more than within the LB of Hammersmith and Fulham (4%) and over six times more than within Greater London (3%).
 - Professional, Scientific and Technical Activities account for 14% of employment within 250m, somewhat more than within the LB of Hammersmith and Fulham (10%) and Greater London (11%).
 - Administrative and Support Service Activities account for 13% of employment within 250m, considerably more than within both the LB of Hammersmith and Fulham (7%) and Greater London (8%).
 - Real Estate Activities account for 7% of employment within 250m, which is over double that within both the LB of Hammersmith and Fulham (3%) and Greater London (3%).

^{viii} Information on employees and businesses reflects aggregated data for seven digit post-code units falling wholly or partially within a 250m boundary of the LLAU. This includes post code units on the opposite side of the River Thames, if relevant. Please refer to Volume 2 Appendix H for further details.

^{ix} Employees data reflect a head count of workers on-site rather than Full Time Equivalent (FTE) jobs. While employee figures are mostly based on actual reported data, a proportion is based on modelled data.

^x Data in tables rounded to nearest whole percentage and do not always sum due to rounding.

- f. Accommodation and Food Services Activities account for 5% of employment within 250m, somewhat lower than within both the LB of Hammersmith and Fulham (8%) and Greater London (8%).

Vol 5 Table H.5 Socio-economics – employment by top six sectors (2012)

Sector (Standard Industrial Code 2007)	Assessment area		
	Immediate area (250m)	Borough wide (LB of Hammersmith and Fulham)	Greater London
Information and Communication	19%	14%	7%
Arts, Entertainment and Recreation	19%	4%	3%
Professional, Scientific and Technical Activities	14%	10%	11%
Administrative and Support Service Activities	13%	7%	8%
Real Estate Activities	7%	3%	3%
Accommodation and Food Service Activities	5%	8%	8%
Other (including unclassified)	23%	54%	60%

H.2.5 Within approximately 250m of the site there are approximately 420 businesses (defined here as business locations^{xi}). The split of businesses by sector within 250m generally reflects the breakdown of employment by sector set out in Vol 5 Table H.5 with a relatively high proportion of businesses engaged in Administrative and Support Service Activities (13%), Information and Communication Activities (12%), Professional, Scientific and Technical Activities (12%) Accommodation and Food Service Activities (7%). However Arts, Entertainment and Recreation only accounts for 5% of businesses, while generating 19% of employment.

H.2.6 Vol 5 Table H.6 below illustrates the size of businesses in terms of the number of employees at each business location / unit. At all geographical levels, businesses within the smallest size band (one to nine employees) account for the majority. Within approximately 250m, 84% of businesses have one to nine employees on site, compared to 87% within the LB of Hammersmith and Fulham and 88% within Greater London. Overall, the size banding profile of businesses within 250m of the site is similar to the LB of Hammersmith and Fulham and Greater London.

H.2.7 For the sectors accounting for the greatest proportions of jobs and businesses within approximately 250m, the size banding of businesses follows a broadly similar pattern. The Administrative and Support Services, Information and Communication, and Professional, Scientific

^{xi} This count relates to business 'locations' or 'units'; an enterprise may have a number of business locations / units. It includes private sector, public sector and voluntary sector / charitable entities.

and Technical Activities and Arts, Entertainment and Recreation sectors each have between 10% and 14% of businesses employing ten to 24 employees and, also, between 10% and 14% employing 25 or more employees.

H.2.8 Within the Information and Communication sector, 8% of businesses employ 100 to 249 employees, and in the Arts, Entertainment and Recreation sector 5% of businesses employ over 250 employees; both proportions being considerably higher respectively compared to the average for each of the three geographical levels. This indicates that the leading employment sectors are helped to achieve that position due to the presence of some larger companies

Vol 5 Table H.6 Socio-economics - businesses by size band (number of employees)

Assessment area / sector	Size band (number of employees)					
	1-9	10-24	25-49	50-99	100-249	250+
Immediate area (250m)	84%	10%	3%	1%	2%	1%
<i>Administrative and Support Services</i>	75%	14%	5%	2%	4%	0%
<i>Information and Communication</i>	76%	10%	4%	2%	8%	0%
<i>Professional, Scientific and Technical Activities</i>	78%	12%	4%	4%	0%	2%
<i>Accommodation and Food Services Activities</i>	74%	26%	0%	0%	0%	0%
<i>Arts, Entertainment and Recreation</i>	85%	10%	0%	0%	0%	5%
Borough wide (LB of Hammersmith and Fulham)	87%	9%	2%	1%	1%	0%
Greater London	88%	8%	2%	1%	1%	0%

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- ⁶ Experian. *National Business Database* (Database of employment and enterprise statistics). Accessed: September 2012.
- ⁷ Office of National Statistics. *UK Standard Industrial Classification of Economic Activities 2007 (SIC 2007)*, 2009. Available at: <http://www.ons.gov.uk/ons/guide-method/classifications/current-standard-classifications/index.html>. Accessed 5/9/12.

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Thames Tideway Tunnel
Thames Water Utilities Limited



Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.05**

Volume 5: Hammersmith Pumping Station appendices

Appendix I: Townscape and visual

APFP Regulations 2009: Regulation **5(2)(a)**

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Appendix I: Townscape and visual

I.1 Introduction

- I.1.1 Construction and operational effects assessments at this site for this topic do not require the provision of any supporting information, so this appendix is intentionally empty.

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Thames Tideway Tunnel
Thames Water Utilities Limited



Application for Development Consent

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Appendix J: Transport

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Appendix J: Transport

J.1 Introduction

- J.1.1 Construction and operational effects assessments at this site for this topic do not require the provision of any supporting information, so this appendix is intentionally empty.

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Appendix K: Water resources - groundwater

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Appendix K: Water resources – groundwater

K.1 Geology

K.1.1 A summary of the geology succession anticipated to be encountered at the Hammersmith Pumping Station site is shown in Vol 5 Table K.1 below.

Vol 5 Table K.1 Groundwater – anticipated geological succession

Period	Series	Group	Formation
Quaternary	Holocene	Superficial deposits	Made Ground
			Alluvium
	Pleistocene		River Terrace Deposits
Palaeogene	Eocene	Thames	London Clay

K.1.2 The superficial and solid geology in the vicinity of the site, as published by the British Geological Survey (BGS)¹, is shown in Vol 5 Figure 13.4.1 and Vol 5 Figure 13.4.2 respectively (see separate volume of figures).

K.1.3 The ground investigation undertaken for the Thames Tunnel project has involved drilling boreholes both on the banks and within the main river channel for the purposes of understanding the geology and hydrogeology within the assessment area. The depths and thicknesses of geological layers are based on ground investigation boreholes drilled on site; these are boreholes PR1117 and SA1118. In addition borehole SA1119, located approximately 300m northwest of the CSO site, and two overwater boreholes, SR5001 and SR5018, located approximately 200m west, have been used to assess the lateral continuity of the site geology. The locations of boreholes around the site are shown in Vol 5 Figure 13.4.1 (see separate volume of figures). The depths and thicknesses of geological layers encountered are summarised in Vol 5 Table K.2 below.

Vol 5 Table K.2 Groundwater – anticipated ground conditions

Formation	Top elevation* (mATD)**	Depth below ground level (m)	Thickness (m)
Made Ground	104.96	0	2.75
Alluvium	102.21	2.75	0.5
River Terrace Deposits	101.71	3.25	4.5
London Clay			
B	97.21	7.75	18.3
A3ii	78.91	26.05	9.8
A3i	69.11	35.85	5.0

Formation	Top elevation* (mATD)**	Depth below ground level (m)	Thickness (m)
A2	64.11	40.85	Not proven

* Based on an assumed ground level of 104.96mATD.

** mATD = metres above tunnel datum. A commonly used term for sub-surface construction projects, which defines height above a temporary datum set at – 100mAOD (metres above Ordnance Datum).

- K.1.4 The CSO shaft and base slab at the Hammersmith Pumping Station site would extend down to approximately 72.47mATD and 70.47mATD respectively and would pass through the Made Ground, Alluvium, River Terrace Deposits and into the London Clay Formation, units B and A3ii.
- K.1.5 The Hammersmith connection tunnel would be constructed within the London Clay Formation, unit A3ii.
- K.1.6 The interception chamber and culvert approximately 14.53m, as assumed for the purpose of this assessment, would extend down to 90mATD into the London Clay Formation, unit B.
- K.1.7 The Made Ground, containing gravelly sand, sandy gravel or sandy, gravelly clay with cobbles, concrete, brick and flint, is expected to be 2.75m thick at the site.
- K.1.8 The Alluvium is comprised of slightly gravelly, slightly sandy silty clay and is expected to be 0.5m thick at the site.
- K.1.9 The River Terrace Deposits are formed of extensive alluvial sand and gravel deposits laid down in river terraces by a braided river system of approximately 5km width, in river terraces since the Anglian glaciation. The River Terrace Deposits are expected to be 4.5m thick at the site.
- K.1.10 The London Clay is comprised of firm to very stiff clay, slightly sandy and slightly gravelly in places and fissured in places. The London Clay is divided into sub-units referred from oldest to youngest as A to E, with some of these sub-units dividing further, for example A2, A3i-iii, B in decreasing age order. The on site boreholes were terminated after penetrating up to c.33m of London Clay Formation, the depth of which was not proven.

K.2 Hydrogeology

- K.2.1 A summary of the hydrogeological conditions anticipated to be encountered at the Hammersmith Pumping Station site is shown in Vol 5 Table K.3 below.

Vol 5 Table K.3 Groundwater – anticipated hydrogeological units

Group	Formation	Hydrogeology
Superficial deposits	Made ground Alluvium	Hydraulic continuity with upper aquifer

Group	Formation	Hydrogeology
	River Terrace Deposits	Upper aquifer
Thames	London Clay Formation	Aquiclude ⁱ

- K.2.2 The Made Ground and Alluvium overlie the River Terrace Deposits or upper aquifer. The ground investigation boreholes drilled on site indicate that these superficial deposits were drilled dry.
- K.2.3 The upper aquifer (River Terrace Deposits) is defined by the Environment Agency (EA) as a secondary A aquifer. These deposits are described as “permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These were previously known as minor aquifers”.²
- K.2.4 The lower aquifer, comprising of the Upnor Formation, the Thanet Sands and the Chalk, is not expected to be encountered by the Thames Tunnel project at the Hammersmith Pumping Station site.
- K.2.5 The CSO shaft would pass through the upper aquifer and into the London Clay Formation (B and A3ii sub divisions). This is generally acknowledged as an aquiclude between the upper and lower aquifers. Any groundwater present is likely to consist of localised seepages and/or minor flows, with the exception of unit A3ii which is regarded as the most porous section of this formation. It is anticipated that below the River Terrace Deposits the shaft would be excavated in predominantly dry London Clay Formation with the exception of minor seepage at various horizons, namely silt or claystone horizons.

K.3 Groundwater level monitoring

- K.3.1 Groundwater level monitoring was undertaken at a number of ground investigation boreholes across the assessment area with a few exceptions. In addition, the EA has a regional network of monitoring boreholes, mainly within the lower aquifer, across London which records are available dating back over 50 years.
- K.3.2 Information on groundwater levels for this assessment was collected from one of the two on site ground investigation boreholes (PR1117) and one off site borehole (SA1119). These boreholes have response zonesⁱⁱ³ and monitor groundwater levels in the River Terrace Deposits. The response zone depths, the monitored strata and the frequency of monitoring are detailed in Vol 5 Table K.4. The manual dip data collected from these monitoring boreholes is shown in Vol 5 Table K.5.

ⁱ Aquiclude – a geological formation through which virtually no water moves (EA website, 2012).

ⁱⁱ Response zone – the section of a borehole that is open to the host strata (EA, 2006).

Vol 5 Table K.4 Groundwater – monitoring boreholes

Borehole (location)	Response zone (mATD)	Strata	Monitoring type and frequency
PR1117 (on site)	101.6-99.06	River Terrace Deposits	Monthly manual dips
SA1119 (200m northwest)	100.66–97.96	River Terrace Deposits	Monthly manual dips
SA1120 (600m northwest)	102.08-96.68	River Terrace Deposits	Monthly dips and logger

Vol 5 Table K.5 Groundwater – summary level data

Borehole	Period of record	Maximum Month Year		Minimum Month Year		Average over period of record	
		mbgl	mATD	mbgl	mATD	mbgl	mATD
PR1117	20/10/2009 - 16/12/2010	5.32 (October 2010)	99.74 (October 2010)	5.61 (August 2010)	99.44 (August 2010)	5.51	99.54
SA1119	20/10/2009 – 02/08/2012	5.01 (January 2011)	99.85 (January 2011)	5.36 (March 2012)	99.50 (March 2012)	5.25	99.61
SA1120	02/07/2009 – 02/08/2012	3.96 (Mar 2010)	101.12 (Mar 2010)	4.75 (Feb 2012)	100.33 (Feb 2012)	4.40	100.68

K.3.3 The recorded water levels in the River Terrace Deposits at PR1117 range from 99.44mATD to 99.74mATD. These water levels consistently remain below the top of this formation, which is at 101.71mATD, indicating that this formation is not fully saturated at this location. The water levels show seasonal variation.

K.3.4 The recorded water levels in the River Terrace Deposits at SA1119 range from 99.5mATD to 99.85mATD. These water levels consistently remain below the top of this formation, which is at 101.71mATD, indicating that this formation is not fully saturated at this location. The water levels show seasonal variation.

K.3.5 The recorded water levels in the River Terrace Deposits at SA1120 range from 100.33mATD to 101.12mATD. These water levels consistently remain below the top of this formation, which is at 101.71mATD, indicating that this formation is not fully saturated at this location. The water levels show seasonal variation.

- K.3.6 A plot of the groundwater levels within the River Terrace Deposits in the vicinity of the site is shown in Vol 5 Figure 13.4.3 (see separate volume of figures). The two monitoring wells close to the site are parallel and in close proximity to the River Thames and as such it is difficult to determine the direction of groundwater flow. However it is expected that the direction of groundwater movement is to the southeast towards the River Thames in these shallow deposits.
- K.3.7 There are no EA groundwater level monitoring boreholes sufficiently close enough to provide representative water level in the upper aquifer.

K.4 Groundwater abstractions and protected rights

Groundwater licensing policy

- K.4.1 The London Catchment Abstraction Management Strategy (CAMS), (EA, 2006)⁴ does not identify a condition status for the upper aquifer.
- K.4.2 The status of the lower aquifer is not relevant to this assessment as the construction would not reach to this depth at the Hammersmith Pumping Station site.
- K.4.3 No dewatering of the upper or lower aquifers is anticipated at the Acton Storm Tanks site. Any water entering the excavation from either the superficial deposits or from minor seepages through silt layers in the London Clay Formation would be pumped to the River Thames via appropriate settlement tanks.

Licensed abstractions

- K.4.4 The EA licenses abstractions from groundwater within London for all sources in excess of 20m³/d. Groundwater abstractions within 1km around the site have been identified.
- K.4.5 The nearest licensed abstraction from the River Terrace Deposits or upper aquifer is at a distance of approximately 1.6km to the west of the site, close by the River Thames (see Vol 5 Table K.6). The licensed abstraction source (28/39/39/137) is held by Fuller Smith & Turner Ltd and is used for industrial, commercial and public service purposes. A capture zone for this source, estimated using licence information and appropriate aquifer properties, the boundaries of which remain at approximately 1.4km from the Hammersmith Pumping Station site.
- K.4.6 The licensed abstractions from the lower aquifer (Chalk) would be unaffected due to construction taking place entirely within the upper aquifer and the London Clay.
- K.4.7 There are no known unlicensed groundwater abstractions within a 1km of the site.

Vol 5 Table K.6 Groundwater – licensed abstractions

Licence number	Licence holder	Purpose	Aquifer	Licensed volume [m³/annum]
28/39/39/0137	Fuller Smith & Turner LTD	Industrial, commercial and public services	River terrace gravels	82,000

K.5 Groundwater source protection zones

K.5.1 The EA defines source protection zones (SPZ) (which are designated to safeguard groundwater resources from potentially polluting activities) around all major public water supply abstractions sources and large licensed private abstractions.

K.5.2 There are no SPZs delineated within the vicinity of site. The nearest of these lies about 4km to the east.

K.6 Environmental designations

K.6.1 A Site of Special Scientific Interest (SSSI) is designated at Barn Elms Wetland Centre located 0.6km to the south of the site on the other side of the River Thames. To the south of the SSSI approximately 1.3km from the site are a series of playing fields, which are a Grade 2 Site of Borough Importance (and Site of Nature Conservation Interest).

K.7 Groundwater quality and land quality assessment

K.7.1 Historical mapping at the Hammersmith Pumping Station site indicates the on site presence of a distillery in c1874-c1952 and chemical storage in c1972-c1983 (Vol 5 Section 8). Land quality may impact on groundwater quality through the creation or promotion of preferential pathways for existing contamination during construction of the proposed development.

K.7.2 The groundwater quality data presented in Vol 5 Table K.7 has been sourced from the ground investigation and monitoring works undertaken as part of the Thames Tunnel project and includes data from monitoring boreholes located on site (PR1117) and off site (SA1119 and SA1120) (for locations see Vol 5 Figure 13.4.1 in separate volume of figures). Any exceedances of the UK drinking water standards⁵ or relevant Environmental Quality Standards (EQS)⁶ are shaded in blue in this table.

K.7.3 The data shows exceedances of the relevant standards for sodium and sulphate on site at PR1117 and for nitrate and polycyclic aromatic hydrocarbons (PAH's) off site at SA1119 and SA1120.

K.7.4 The EA monitors groundwater quality at number of points across London, mainly the Chalk and Lower London Tertiaries (Lambeth Group) (EA, 2006). The water quality information provided from this network is not

relevant to the site, where construction would take place entirely with the London Clay.

- K.7.5 The land quality data from the ground investigation boreholes used in the groundwater quality assessment show several exceedances of the human health screening values⁷ (soil guideline values designed to be protective of human health) within the River Terrace Deposits. Further detail is provided in the land quality assessment (see Vol 5 Appendix F).

Vol 5 Table K.7 Groundwater – groundwater quality results

Source of data*					SI	SI	SI	SI
Name					PR1117	SA1119	SA1120	
Hydrogeological unit**					ALV	RTD	RTD	
Distance from site					0m	266m	650m	
Chemical	Value	Units	Source		2009	2009	2009	
1,1,1 - Trichloroethane	100	ug/l	SW Regs 98		-	-	-	
1,1,2 - Trichloroethane	400	ug/l	SW Regs 98		-	-	-	
1,2 - Dichloroethane {Ethylene Dichloride}	3	ug/l	WS Regs 20		-	-	-	
2,4 - Dichlorophenol	20	ug/l	WFD 2010		<0.1	<0.1	<0.1	
2,4 - Dimethylphenol {2,4-Xylenol}	-	ug/l	-		<0.1	<0.1	<0.1	
2,4,6 - Trichlorophenol	-	ug/l	-		<0.1	<0.1	<0.1	
2,6 - Dichlorophenol	-	ug/l	-		<0.1	<0.1	<0.1	
4 - Chloro - 3- Methylphenol {P-Chloro-M-Cresol}	40	ug/l	WFD 2010		<0.1	<0.1	<0.1	
Acenaphthene	-	ug/l	-		<0.01	<0.01	0.23	
Acenaphthylene	-	ug/l	-		<0.01	<0.01	<0.01	
Aliphatics >C10-C12	-	ug/l	-		1	1	<1	
Aliphatics >C12-C16 (Aqueous)	-	ug/l	-		2	3	<1	
Aliphatics >C16-C21 (Aqueous)	-	ug/l	-		5	6	2	
Aliphatics >C21-C35 (Aqueous)	-	ug/l	-		25	14	19	
Aliphatics >C6-C8	-	ug/l	-		<0.1	<0.1	<0.1	
Aliphatics >C8-C10	-	ug/l	-		<0.1	<0.1	<0.1	
Aliphatics C5-C6	-	ug/l	-		<0.1	<0.1	<0.1	
Alkalinity (Carbonate)	-	mg/l as CaCO3	-		-	-	-	
Alkalinity Ph 4.5 - As CaCO3	-	mg/l as CaCO3	-		200	230	280	
Aluminium Total	200	ug/l as Al	DWS 2010		-	-	-	
Ammonia - As N	0.4	mg/l as N	WS Regs 20		-	-	-	
Ammoniacal nitrogen	-	mg/l	-		0.24	0.3	3.6	

Environmental Statement

Source of data*						SI	SI	SI	SI
Name						PR1117	SA1119	SA1120	
Hydrogeological unit**						ALV	RTD	RTD	
Distance from site						0m	266m	650m	
Chemical	Value	Units	Source			2009	2009	2009	
Anthracene	0.1	ug/l	SW WFD			<0.01	<0.01	<0.01	
Aromatics >C7-C8	50	ug/l	WFD 2010			<0.1	<0.1	<0.1	
Aromatics >EC10-EC12	-	ug/l	-			8	3	<1	
Aromatics >EC12-EC16 (Aqueous)	-	ug/l	-			9	4	<1	
Aromatics >EC16-EC21 (Aqueous)	-	ug/l	-			10	32	5	
Aromatics >EC21-EC35 (Aqueous)	-	ug/l	-			20	41	12	
Aromatics >EC8-EC10	-	ug/l	-			<0.1	<0.1	<0.1	
Aromatics C6-C7	1	ug/l	DWS 2010			<0.1	<0.1	<0.1	
Arsenic Total	10	ug/l as As	DWS 2010			<1	1	10	
Atrazine { }	0.100000001	ug/l	DWS 2010			-	-	-	
Bentazone	0.100000001	ug/l	DWS 2010			-	-	-	
Benzene	1	ug/l	DWS 2010			<1	<1	<1	
Benzo (a) anthracene	-	ug/l	-			<0.01	<0.01	<0.01	
Benzo[a]Pyrene	0.01	ug/l	DWS 2010			<0.01	<0.01	<0.01	
Benzo[b]Fluoranthene	0.03	ug/l	WFD D 10			<0.01	<0.01	<0.01	
Benzo[g,h,i]Perylene	0.002	ug/l	WFD D 10			<0.01	<0.01	<0.01	
Benzo[k]Fluoranthene	0.03	ug/l	WFD D 10			<0.01	<0.01	<0.01	
Boron Total	1000	ug/l as B	DWS 2010			480	<100	170	
Bromate	10	ug/l as BrO3	DWS 2010			-	-	-	
Cadmium Total	5	ug/l as Cd	DWS 2010			<2	<2	<2	
Calcium Total	250	mg/l as Ca	DWS 2010			-	-	-	
Carbendazim / Benomyl	0.100000001	ug/l	FW List II			-	-	-	
Carbetamide	-	ug/l	-			-	-	-	
Carbon tetrachloride	3	ug/l	DWS 2010			-	-	-	
Chemical oxygen demand	-	mg/l	-			-	-	<10	
Chlorfenvinphos	0.100000001	ug/l	DWS 2010			-	-	-	

Environmental Statement

Source of data*					SI	SI	SI	SI
Name					PR1117	SA1119	SA1120	
Hydrogeological unit**					ALV	RTD	RTD	
Distance from site					0m	266m	650m	
Chemical	Value	Units	Source	SI	2009	2009	2009	
Chloride	250	mg/l as Cl	DWS 2010	140	90	51		
Chloroform	100	ug/l	WS Regs 20	-	-	-		
Chlortoluron	2	ug/l	FW List II	-	-	-		
Chromium Total	50	ug/l as Cr	DWS 2010	<5	<5	<5		
Chrysene	-	ug/l	-	<0.01	<0.01	<0.01		
Clopyralid	-	ug/l	-	-	-	-		
Conductivity @ 20°C	2500	uS/cm	WS Regs 20	1460	454	781		
Copper Total	2000	ug/l as Cu	DWS 2010	<2	3	<2		
Cresols	-	ug/l	-	<0.1	<0.1	<0.1		
Cyanazine	0.100000001	ug/l	DWS 2010	-	-	-		
Cyanide (Free)	50	ug/l as CN	DWS 2010	<20	<20	<20		
Cyanide (Total)	50	ug/l as CN	DWS 2010	<40	<40	<40		
Cypermethrin	1E-04	ug/l	WFD 2010	-	-	-		
Dalapon	-	ug/l	-	-	-	-		
Diazinon	0.100000001	ug/l	DWS 2010	-	-	-		
Dibenz-[A,H]-Anthracene	-	ug/l	-	<0.01	<0.01	<0.01		
Dichloromethane	20	ug/l	WFD 2010	-	-	-		
Dichlorprop	0.100000001	ug/l	DWS 2010	-	-	-		
Diuron	0.100000001	ug/l	DWS 2010	-	-	-		
Ethylbenzene	-	ug/l	-	<1	<0.01	<1		
Fluoranthene	0.200000003	ug/l	EEC MAC	0.01	<0.01	0.02		
Fluorene	-	ug/l	-	<0.01	<0.01	<0.01		
Fluoride	1.5	mg/l as F	DWS 2010	-	-	-		
Glyphosate	-	ug/l	-	-	-	-		

Environmental Statement

Source of data*				SI	SI	SI	SI
Name				PR1117	SA1119	SA1120	
Hydrogeological unit**				ALV	RTD	RTD	
Distance from site				0m	266m	650m	
Chemical	Value	Units	Source	2009	2009	2009	
Indeno-[1,2,3-Cd]-Pyrene	0.002	ug/l	WFD D 10	<0.01	<0.01	<0.01	
Isoproturon (Diip1,3Dithiolan-2-Ylidenemalonate)	0.100000001	ug/l	DWS 2010	-	-	-	
Lead Total	10	ug/l	WS Regs 20	<4	<4	<4	
Magnesium Total	50	mg/l as Mg	EEC MAC	9	10	11	
MCPA {2-methyl-4-chlorophenoxyacetic acid }	0.100000001	ug/l	DWS 2010	-	-	-	
Mecoprop { }	0.100000001	ug/l	DWS 2010	-	-	-	
Mercury Total	1	ug/l Hg	WS Regs 20	<0.05	<0.05	<0.05	
Metazachlor	-	ug/l	-	-	-	-	
MTBE {Methyl Tert-Butyl Ether}	-	ug/l	-	<1	<1	<1	
Multi Residual Scan	-	ug/l	-	-	-	-	
Naphthalene	1.200000048	ug/l	WFD D 10	<0.01	<0.01	<0.01	
Nickel Total	20	ug/l as Ni	DWS 2010	<10	<10	<10	
Nitrate - N	11.300000019	mg/l as N	WS Regs 20	<0.1	34	2.1	
Permethrin (Cis + Trans)	0.01	ug/l	WFD D 10	-	-	-	
pH	10	pH units	DWS 2010	8.1	7.7	7.3	
Phenanthrene	-	ug/l	-	0.02	<0.01	<0.01	
Phenol	0.5	ug/l	EEC MAC	<0.1	<0.1	<0.1	
Phenol (Pentachlorophenol (PCP))	-	ug/l	-	-	-	-	
Phenols Total For SWAD (7 Compounds)	-	ug/l	-	-	-	-	
Polynuclear Aromatic Hydrocarbons (Total)	0.100000001	ug/l	DWS 2010	<0.2	<0.2	0.47	
Potassium Total	-	mg/l as K	-	-	-	-	
Propazine	0.100000001	ug/l	DWS 2010	-	-	-	
Propetamphos	0.100000001	ug/l	DWS 2010	-	-	-	

Environmental Statement

Source of data*				SI	SI	SI	SI
Name				PR1117	SA1119	SA1120	SA1120
Hydrogeological unit**				ALV	RTD	RTD	RTD
Distance from site				0m	266m	650m	650m
Chemical	Value	Units	Source	2009	2009	2009	2009
Pyrene	-	ug/l	-	0.05	<0.01	0.21	0.21
Selenium	10	ug/l as Se	DWS 2010	<3	<3	<3	<3
Simazine	0.100000001	ug/l	DWS 2010	-	-	-	-
Sodium Total	200	mg/l as Na	DWS 2010	250	54	53	53
Sulphate	250	mg/l as SO4	DWS 2010	300	89	30	30
Sulphide	-	ug/l	-	<250	<10	<10	<10
Terbutryn	0.100000001	ug/l	DWS 2010	-	-	-	-
Tetrachloroethylene	-	ug/l	-	-	-	-	-
Toluene (Methylbenzene)	50	ug/l	WFD 2010	<1	<1	<1	<1
Total Aliphatic TPH	-	ug/l	-	33	24	23	23
Total Aromatic TPH	-	ug/l	-	48	79	17	17
Total Chemical Oxygen Demand	-	mg/l	-	16	<10	-	-
Trichloroethene (Trichloroethylene)	10	ug/l	DWS 2010	-	-	-	-
Trietazine	-	ug/l	-	-	-	-	-
Trifluralin	0.100000001	ug/l	DWS 2010	-	-	-	-
Turbidity	1	FTU	WS Regs 20	-	-	-	-
Xylene (Meta & Para){1,3+1,4-Dimethylbenzene}	30	ug/l	WFD 2010	<1	<1	<1	<1
Zinc Total	50	ug/l as Zn	DWS 2010	<1	14	2	2
Notes:							
	xx	GAC1 exceedance					
	' - '	Not tested					
	' < '	Less than MDL					

* Origin of data: SI – Groundwater quality data collected during site investigation works by Thames Tunnel project (2009-2011), TT – Groundwater quality data collected during ongoing monitoring works by Thames Tunnel project (2009-2012)

** Hydrogeological unit: RTD – River Terrace Deposits, ALV – Alluvium

K.8 Groundwater status

- K.8.1 The EC Water Framework Directive (WFD) requires the status of groundwater management units (groundwater bodies) within each river basin to be determined as 'good' or 'poor' by 2015. For groundwater there are two separate classifications for groundwater bodies; chemical status and quantitative status. The WFD aims to achieve good status by 2015, or, where this is not possible and subject to the criteria set out in the Directive, the WFD aims to achieve good status by 2021 or 2027.
- K.8.2 The Thames River Basin Management Plan (RBMP)⁸ shows no groundwater body designation for either the upper or lower aquifers within the area in which the Hammersmith Pumping Station site is located; therefore no baseline assessment of quantitative or chemical status is available.
- K.8.3 The baseline assessment for groundwater status classification for the nearby Greenwich Chalk and Tertiaries (consisting of the Lambeth Group, Thanet Sands, Blackheath Formation and Chalk Formation) shows poor quantitative status and poor quality status for 2009. The predicted quantitative and chemical quality was poor for 2015 due to treatment or improvement being disproportionately expensive or technically infeasible.
- K.8.4 The baseline assessment for groundwater status classification for the nearby Lower Thames Gravels is good quantitative status and poor quality status for 2009. The predicted chemical quality was poor for 2015 due to treatment or improvement being disproportionately expensive or technically infeasible.
- K.8.5 Only eight out of forty-six groundwater bodies within the Thames River basin district are at good status overall; this is not expected to change by 2015 (EA, 2009)⁸.
- K.8.6 The Thames Tunnel project would prevent deterioration of the current and predicted status of groundwater and would adhere to the key actions identified in the RBMP to achieve good status by 2021 or 2027, as follows (EA, 2009)⁸:
- a. Adhere to the Communities and Local Government (CLG) Planning Policy Guidance Statement 23 (PPS23) on controlling pollution of groundwater that may arise from development of land.
 - b. Prevent input of nitrates to groundwater body.
 - c. Prevent inputs to and mitigate potential mobilisation of copper, other metals and hazardous substances in groundwater.
 - d. Prevent and mitigate potential inflow of river water to groundwater due to dewatering/ abstraction by implementing working methods to protect surface and groundwater from impacts, including changes to flow, by producing site-specific water management plans and by monitoring where required.
 - e. Prevent direct discharges of pollutants to groundwater.

K.9 Data sources

K.9.1 A list of data used for the Hammersmith Pumping Station site assessment is given in Table K.8 below.

Vol 5 Table K.8 Groundwater – desk based baseline data sources

Source	Data	Date received	Notes
BGS	British Geological Survey (BGS) 1:50,000 scale digital geological data	February 2009	
EA	Licensed groundwater abstraction boreholes, their ownership and purpose	December 2010, February 2011 and March 2012	Licensed abstraction rates, aquifer, and status (active or dormant)
LB's*	Unlicensed groundwater abstraction boreholes and their details	June 2009	Contacted 14 London Boroughs along tunnel alignment
EA	Designated source protection zones	December 2010	
EA	Groundwater level records for EA observation boreholes	September 2009, June 2011, December 2011 and October 2012	
EA	Groundwater quality results for EA observation boreholes	August 2009 and May 2011	
EA	Ground Source Heat Pump (GSHP) schemes and their details	December 2010 and March 2012	
Thames Tunnel project	Ground Investigation (2009) borehole logs, construction details, monitoring regime and available water level records and water quality results from 2009 to 2012	Last updated September 2012	Final ES
Thames Tunnel project	Groundwater monitoring strategy	Draft strategy Feb 2012	
Thames Tunnel project	Land quality data	February 2011	
Individual licence holders	Letters sent out to 30 licence holders	December 2011	

* LBs – London Boroughs

References

- ¹ British Geological Survey. *British geology onshore digital maps 1:50 000 scale*. Received from Thames Tunnel project (February 2009).
- ² Environment Agency. *Environment Agency website*. Available at: <http://www.environment-agency.gov.uk/homeandleisure/117020.aspx>. Accessed April 2012
- ³ Environment Agency. *Guidance on the design and installation of groundwater quality monitoring points Science Report SC020093* (2006). Available at: <http://publications.environment-agency.gov.uk/PDF/SCHO0106BKCT-E-E.pdf>. Accessed April 2012.
- ⁴ Environment Agency. *The London Catchment Abstraction Management Strategy (CAMS)*. Final Strategy Document (2006). Available at: <http://publications.environment-agency.gov.uk/PDF/GETH0406BKRM-E-E.pdf>. Accessed April 2012.
- ⁵ *The Water Supply (Water Quality) Regulations* (2000). Available at: <http://www.legislation.gov.uk/uksi/2000/3184/contents/made>. Accessed April 2012.
- ⁶ *River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Direction 2010*. Available at: <http://www.defra.gov.uk/environment/quality/water/legislation/water-framework-directive/>. Accessed April 2012.
- ⁷ Environment Agency. *Soil Guideline Value Reports* (2009). Available at: <http://www.environment-agency.gov.uk/research/planning/64015.aspx>. Accessed April 2012.
- ⁸ Environment Agency. *River Basin Management Plan, Thames River Basin District* (December 2009). Available at: <http://publications.environment-agency.gov.uk/PDF/GETH0910BSWA-E-E.pdf>. Accessed April 2012.

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Thames Tideway Tunnel
Thames Water Utilities Limited



Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.05**

Volume 5: Hammersmith Pumping Station appendices

Appendix L: Water resources - surface water

APFP Regulations 2009: Regulation **5(2)(a)**

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Appendix L: Water resources – surface water

L.1 Introduction

- L.1.1 Construction and operational effects assessments at this site for this topic do not require the provision of any supporting information, so this appendix is intentionally empty.

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Thames Tideway Tunnel
Thames Water Utilities Limited



Application for Development Consent

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Appendix M: Water resources - flood risk

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Appendix M: Water resources – flood risk

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Appendix M: Water resources – flood risk

M.1 Policy considerations

- M.1.1 The relevant planning document that would be used to assess the proposals is the National Policy Statement (NPS) for Waste Water (DEFRA, 2012)¹ which was published in February 2012.
- M.1.2 The Waste Water NPS considers the Thames Tideway Tunnel project as ‘nationally significant waste water infrastructure.’
- M.1.3 General policy documents (eg, the NPS) have been reviewed within Volume 2 Environmental assessment methodology. A summary of local and regional policy relevant to flood risk at Hammersmith Pumping Station is provided below

Local policy

Strategic Flood Risk Assessment

- M.1.4 The site lies within the London Borough (LB) of Hammersmith and Fulham. The borough has produced a Strategic Flood Risk Assessment (SFRA) (JBA, 2010)² which outlines the main flood sources to the borough through a review of existing information. Key sources of flood risk in the borough are from surface water and sewer, and the residual risk associated with the failure of the Thames tidal defences.
- M.1.5 The SFRA confirms that the Thames Tidal Defence network reduces the annual probability of flooding from the River Thames to less than 0.1%. The risk of flooding is a residual risk associated with a breach in the defences.
- M.1.6 According to the SFRA:
- a. The site is within the Environment Agency (EA) Flood Zone 3.
 - b. There have been ‘between 51-100’ sewer flooding incidences recorded by Thames Water in the last 10 years in the vicinity of the site.
 - c. The site is within the Rapid Inundation Zone (RIZ) and carries a high residual risk from both breaching and overtopping of flood defences.
 - d. The residual risk at the site, in the event of a breach in the local defence wall or overtopping as a result of a failure of the Thames Barrier, is high.
 - e. The existing flood defence near the site is in fair condition and is identified as a likely breach location.
 - f. The site is situated within an area identified as having increased risk of surface water flooding, with records of properties flooding nearby in 2007.
 - g. The site is identified as a proposed future development site.

M.1.7 The SFRA promotes the use of Sustainable Drainage Systems (SuDS) suitable to specific site locations within the borough, depending on underlying geology.

Surface Water Management Plan

M.1.8 The LB of Hammersmith and Fulham, in partnership with the Greater London Authority (GLA), Thames Water and the EA has produced a Surface Water Management Plan (SWMP) (Halcrow and MWH, 2011)³ as part of the Drain London project. The SWMP sets out the preferred surface water management strategy for the borough.

M.1.9 The SWMP has not been made available to inform this study.

Regional policy

Thames Estuary 2100

M.1.10 The site lies within the Hammersmith policy unit which has been assigned the P5 flood risk management policy within the Thames Estuary 2100 (TE2100) Plan (EA, 2012)⁴, meaning that further action needs to be taken to reduce flood risk beyond that required to keep pace with climate change.

M.1.11 The TE2100 Plan identifies the local sources of flood risk at this location as including:

- a. tidal and fluvial from the River Thames
- b. heavy rainfall and urban drainage sources
- c. a risk of groundwater flooding from superficial strata which is possibly connected to high water levels in the River Thames.

M.1.12 Defences from these sources include:

- h. the Thames Barrier and secondary tidal defences along the River Thames frontage (both making up the Thames Tidal Defences)
- d. combined sewer overflows (CSOs) for mitigation of urban drainage
- e. flood forecasting and warning.

M.1.13 The TE2100 Plan seeks to promote, where possible, defence improvements that ensure views are maintained and impacts to river access/views are minimised. Where defence raising in the future to manage the consequences of climate change is not possible, secondary defences and floodplain management should be introduced. There is also a vision to increase flood risk awareness within the area.

M.1.14 Further investigation is required into flood risk from pluvial and groundwater sources. These form part of the TE2100 Action Plan.

London Regional Flood Risk Appraisal

M.1.15 For the reach between Hammersmith Bridge and the Thames Barrier (City Reach) the London Regional Flood Risk Appraisal (RFRA) (GLA, 2009)⁵ encourages small scale set back of development from the river walls where possible. The aim is to enable modification, raising and maintenance of defences in a sustainable, environmentally acceptable and

cost effective way. Development should be designed in such a way as to take opportunities to reduce flood risk and include resilience.

- M.1.16 There is particular concern surrounding confluences of tributaries into the River Thames and the interactions between tidal and fluvial flows in the future due to climate change. This should be taken into consideration during the re-development process.
- M.1.17 The RFRA indicates that SuDS should be included within developments to reduce surface water discharge.

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References

¹ Department of Environment, Food and Rural Affairs (Defra), *National Planning Policy for Waste Water*. (February 2012)

² JBA and Entec UK Ltd. *London Borough of Kensington and Chelsea and London Borough of Hammersmith and Fulham Strategic Flood Risk Assessment Final Report*. (Jun 2010).

³ Halcrow and MWH. *LB Hammersmith and Fulham Surface Water Management Plan Final Report*. (Jul 2011).

⁴ Environment Agency. *Thames Estuary 2100 Plan*. (November 2012).

⁵ Greater London Authority. *London Regional Flood Risk Appraisal*. (Oct 2009).

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Thames Tideway Tunnel
Thames Water Utilities Limited



Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.05**

Volume 5: Hammersmith Pumping Station appendices

Appendix N: Development schedule

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Appendix N: Development schedule

N.1 Summary

N.1.1 The assessments undertaken for this site take account of other relevant development projects within the vicinity of the site which are under construction, permitted but not yet implemented or submitted but not yet determined. In order to identify the relevant developments for consideration, the Planning Inspectorate, local planning authorities and the Greater London Authority have been consulted on the methodology (see Volume 2) and asked to assist in identifying and verifying the development projects included in the assessment. A schedule is provided in Vol 5 Table N.1 of the resulting development projects, a description of what is proposed and assumptions on phasing. Longer term development projects may be included under both base case, with construction preceding that of the Thames Tideway Tunnel site, and cumulative with construction or operation occurring at the same time as a given Thames Tideway Tunnel site.

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Vol 5 Table N.1 Development schedule for Hammersmith Pumping Station

Category types:

- a. Under construction
- b. Permitted but not yet implemented
- c. Submitted but not yet determined

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions			Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2017 (Site Year 1 of construction)	2018 (peak construction traffic year)	2023 (Year 1 of operation)		
Fulham Reach	Adjacent	2011/00407/COMB	St George (Central London) Ltd	<p>Hybrid Planning Application (part outline/part detailed) for the mixed use development of the site to provide; 744 residential units, ancillary residents' gym and pool; 3,823 sqm. of commercial floor space (Use Classes A1-A4, B1, D1 and D2); 440 sqm. boat storage facility and ancillary boat club facilities (Use Class B1/A4/D1/B8); comprising 8 blocks (ranging from 3 to 9 storeys in height); basement level parking for 470 cars, 44 motorcycles and 956 bicycles; a pontoon extending into the Thames River; landscaped open space; works to the Thames Path; new site access arrangements; alterations to the public highway and realignment of access routes through Frank Banfield Park and Park boundary treatment; (Approval sought for Access, Layout and Scale, with matters of Landscaping and Appearance reserved for later determination). Plus;</p> <p>Full details (Access, Layout, Scale, Appearance, Landscaping) for Phase 1; comprising 138 residential units; 1,169 sqm. of commercial floor space (Use Classes A1-A4, D1 and D2) and 440 sqm. boat club/storage facility (Use Classes B1/A4/D1/B8) within a 8 storey building, with podium level private amenity space (Block A); Thames Path works; Thames River Pontoon; vehicle access to basement parking level off Chancellor's Road and landscaping.</p> <p>Submission of reserved matters relating to external appearance and landscaping for Building B, pursuant to hybrid planning permission ref: 2011/00407/COMB granted 23rd December 2011, comprising a mixed use development of 167 new homes (938sqm GIA) of ground floor commercial floorspace (use classes A1-A4, D1/D2), landscaped open space and parking provision.</p>	A	<p>Phases 1-4 complete & operational</p> <p>Phases 5 & 6 under construction</p> <p>Phases 7 & 8 not started</p>	<p>Phases 1-5 complete & operational</p> <p>Phase 6 under construction</p> <p>Phases 7 & 8 not started</p>	<p>100% complete and operational.</p>	<p>Phasing plan and estimated construction dates provided by developer in April 2012 (in letter to LB of Hammersmith & Fulham).</p>	<p>2017: Base case = Phases 1-4 Cumulative = Phases 5 & 6</p> <p>2018: Base case = Phases 1-5 Cumulative = Phase 6</p> <p>2023: Base case = all phases No cumulative</p>

Note: phasing and site layout information has been sourced from local authority planning portals unless otherwise indicated.

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