



# 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 Water Utilities Limited



# Application for Development Consent

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

### **Volume 4: Acton Storm Tanks appendices**

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

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# Thames Tideway Tunnel

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### **Volume 4: Acton Storm Tanks appendices**

#### **Appendix A: Introduction**

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# Thames Tideway Tunnel

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## Appendix A: Introduction

### A.1 Summary

- A.1.1 This document presents the appendices that accompany the *Environmental Statement* Volume 4 Acton Storm Tanks 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
  - c. Appendix C: Ecology – aquatic
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  - k. Appendix K: Water resources – groundwater
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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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# Application for Development Consent

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

### **Volume 4: Acton Storm Tanks appendices**

#### **Appendix B: Air quality and odour**

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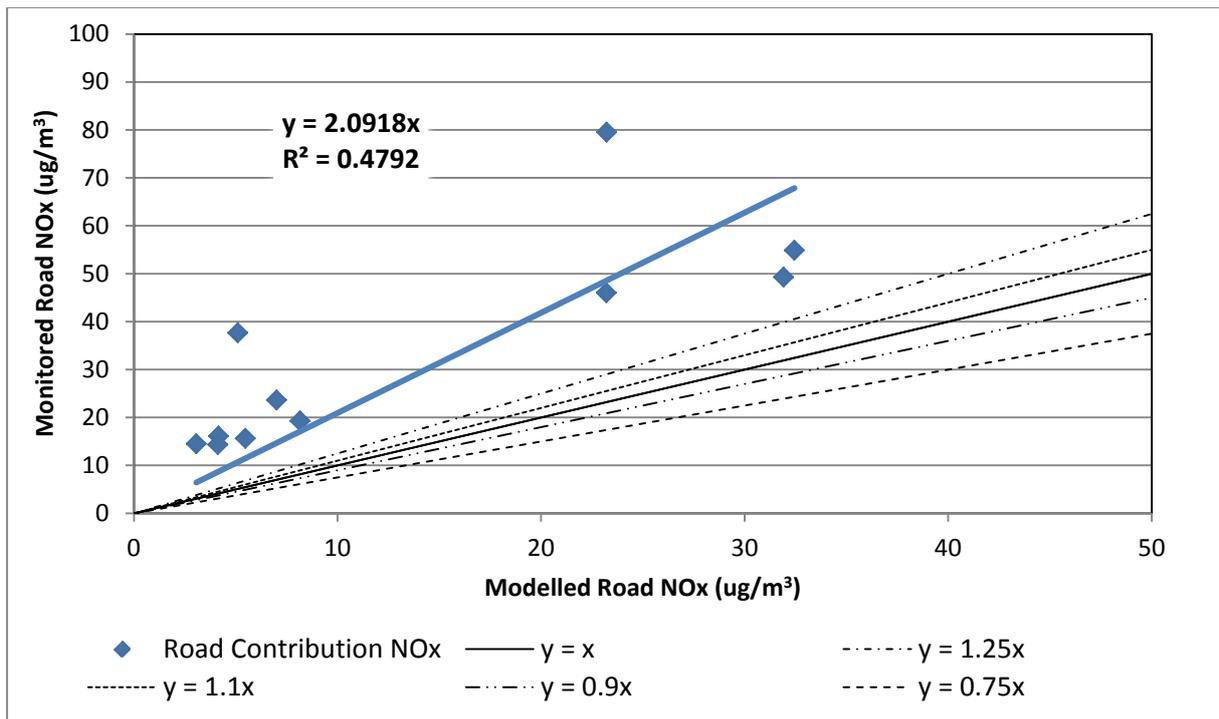
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## Appendix B: Air quality and odour

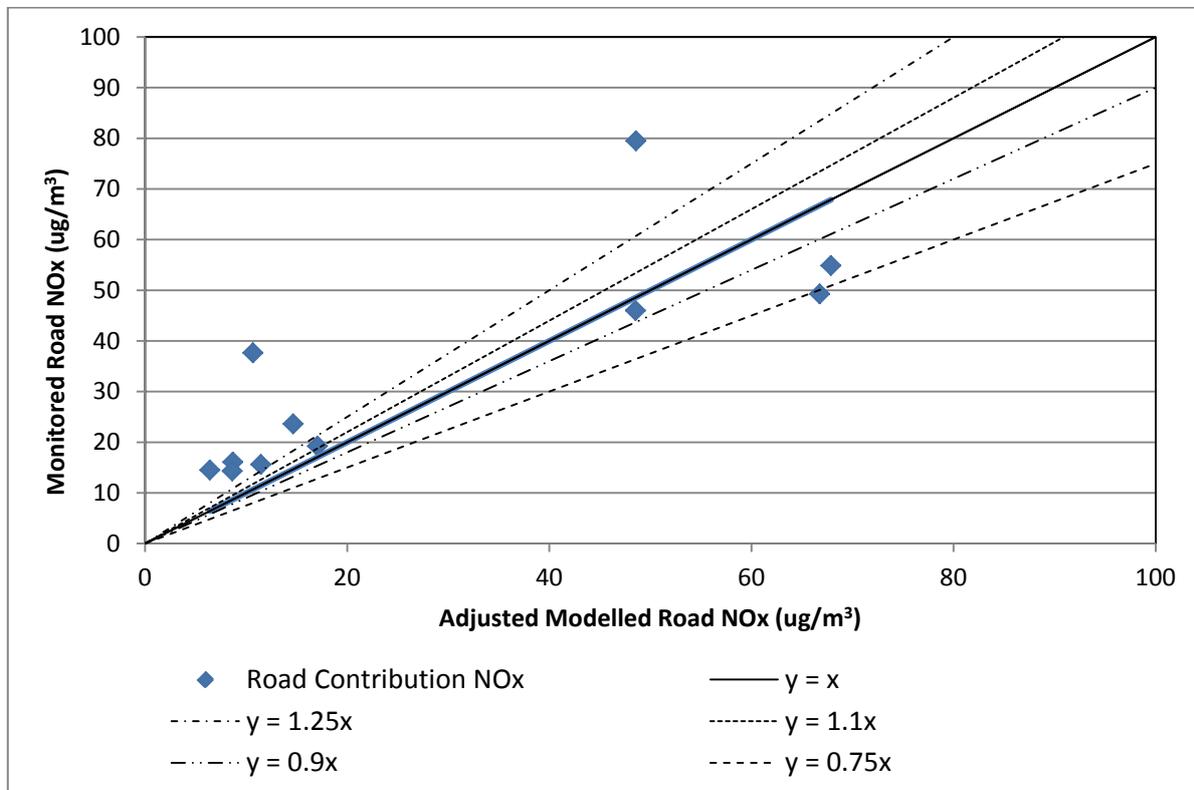
### B.1 Model verification

- B.1.1 Modelled NO<sub>2</sub> concentrations have been plotted against monitored concentrations at ten diffusion tube sites (ASTM1-ASTM8, 14 and 15) and one continuous monitoring site (EA2) as shown in Vol 4 Figure 4.4.1 (see separate volume of figures).
- B.1.2 This showed that the modelled results underestimated NO<sub>2</sub> concentrations by between 10% and 28%. 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<sub>x</sub> concentrations were plotted against calculated monitored road NO<sub>x</sub> concentrations (see Vol 4 Plate B.1 below). An adjustment factor of 2.09 was calculated for adjusting modelled roadside NO<sub>x</sub> concentrations, in accordance with LAQM.TG(09)<sup>1</sup> and subsequently applied. PM<sub>10</sub> monitoring data were available from one site and were compared with the modelled concentration. The model underestimated concentrations by 10%. An adjustment factor of 2.77 was calculated for adjusting modelled roadside PM<sub>10</sub> concentrations, in accordance with LAQM.TG(09), and subsequently applied.
- B.1.4 Applying the NO<sub>x</sub> adjustment factor and then calculating NO<sub>2</sub> concentrations, as shown in Vol 4 Plate B.2, provides better overall agreement between actual and predicted data. The subsequent linear regression calculation for monitored versus modelled total NO<sub>2</sub>, as shown in Vol 4 Plate B.3, indicated that nine of the eleven modelled concentrations were within 10% of the measured value and all are within 25% of the modelled value.

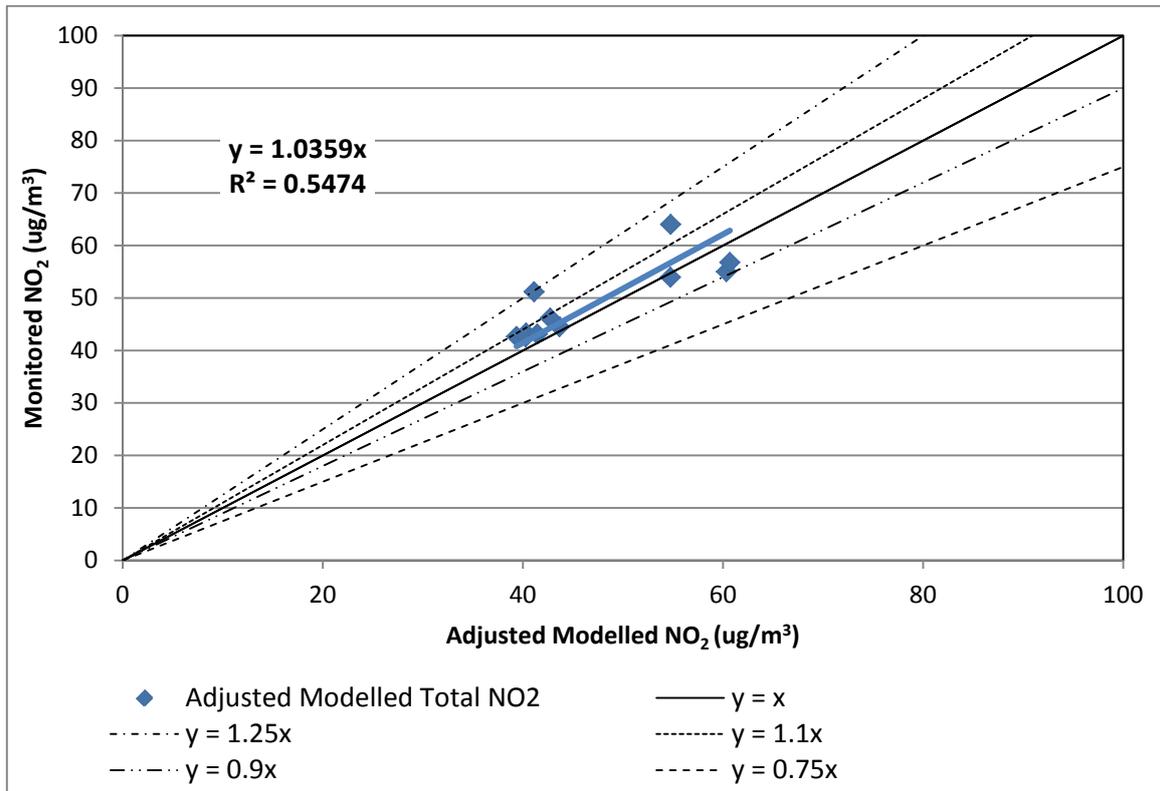
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**Vol 4 Plate B.2 Air quality – monitored road NO<sub>x</sub> vs. adjusted modelled road NO<sub>x</sub>**



**Vol 4 Plate B.3 Air quality – total monitored NO<sub>2</sub> vs. total adjusted modelled NO<sub>2</sub>**



## B.2 Traffic data

B.2.1 The traffic data used in the air quality modelling for the Acton Storm Tanks site are shown in Vol 4 Table B.1.

**Vol 4 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)
ATC** 'Indirect'	High Street	21201	11.0	30	25.7	7.2	25831	2	22742	11.0
Speed Limit	Eastman Road	2414	17.0	30	30.0	7.2	1919	0	2587	17.0
ATC 'Indirect'	The Vale	24106	8.0	30	25.7	7.2	25637	2	25855	8.0
TfL Model	Stanley Gardens	1791	3.8	30	12.8	7.2	11133	3	1922	3.9
Speed Limit	The Vale	23926	8.1	30	30.0	7.2	1583	2	25661	8.1
ATC 'Indirect'	East Acton Lane	10390	5.7	30	23.9	7.2	21494	0	11139	5.7
TfL Model	Warple Way	1477	2.9	30	16.7	7.2	6315	3	1586	3.1
Speed Limit	The Vale	20059	7.2	30	30.0	7.2	2031	4	21498	7.3

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	Peak construction year AADT	Peak construction year development case (total AADT)	Peak construction year development case AADT % HG (>3.5t)
Speed Limit	Larden Road	5893	6.1	30	30.0	7.2	8877	8877	0	6315	6.1
TfL Model	Valetta Road	1896	1.7	30	16.7	7.2	7274	7274	0	2031	1.7
ATC 'direct'	Larden Way	8284	2.9	30	23.9	7.2	19651	19651	0	8877	2.9
TfL Model	Larden Way	6788	3.1	30	13.5	7.2	15122	15122	0	7274	3.1
ATC 'Indirect'	The Vale	18339	10.9	30	23.9	7.2	20836	20836	4	19658	10.9
TfL Model	Old Oak Road	14112	7.9	30	12.9	7.2	16944	16944	4	15131	7.9
ATC 'Indirect'	Uxbridge Road	19445	7.8	30	25.7	7.2	25831	25831	0	20836	7.8
TfL Model	Askew Road	15813	6.5	30	30.0	7.2	1919	1919	0	16946	6.5

\* AADT – annual average daily traffic. \*\* ATC - automatic traffic count.

### B.3 Construction plant emission factors

B.3.1 For the purpose of the assessment, the following listed equipment in Vol 4 Table B.2 at Acton Storm Tanks has been modelled for the peak construction year at the Acton Storm Tanks site.

**Vol 4 Table B.2 Air quality - construction plant assessment model inputs**

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time	Power (kW)	NO <sub>x</sub> emission rate (g/s/m <sup>2</sup> )	PM <sub>10</sub> emission rate (g/s/m <sup>2</sup> )	
Site set up and general site	Ground level behind hoarding	Compressor 250cfm*	1	50	104	1.3 x 10 <sup>-7</sup>	8.4 x 10 <sup>-9</sup>	
	Ground level behind hoarding	Generator - 200kVA	1	100	160	4.1 x 10 <sup>-7</sup>	2.6 x 10 <sup>-8</sup>	
	Ground level behind hoarding	JCB with hydraulic breaker	1	50	67	8.7 x 10 <sup>-8</sup>	5.4 x 10 <sup>-9</sup>	
	Ground level behind hoarding	Cutting equipment (diamond saw)	2	10	2.3	3.0 x 10 <sup>-9</sup>	6.6 x 10 <sup>-9</sup>	
	Ground level behind hoarding	Telescopic handler / FLT**	1	30	60	4.6 x 10 <sup>-8</sup>	2.9 x 10 <sup>-9</sup>	
	Ground level behind hoarding	Hiab*** lorry/crane	1	5	56	7.2 x 10 <sup>-9</sup>	4.5 x 10 <sup>-10</sup>	
	Ground level behind hoarding	Well drilling rig	1	50	403	5.2 x 10 <sup>-7</sup>	3.3 x 10 <sup>-8</sup>	
	Shaft secondary lining	Ground level behind hoarding	100t crawler crane	1	50	240	3.1 x 10 <sup>-7</sup>	1.9 x 10 <sup>-8</sup>
		Ground level behind hoarding	Service crane 40t mobile crane	1	25	275	1.8 x 10 <sup>-7</sup>	1.1 x 10 <sup>-8</sup>

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time	Power (kW)	NO <sub>x</sub> emission rate (g/s/m <sup>2</sup> )	PM <sub>10</sub> emission rate (g/s/m <sup>2</sup> )
	Ground level behind hoarding	Concrete deliveries (discharging)	1	20	223	1.2 x 10 <sup>-7</sup>	7.2 x 10 <sup>-9</sup>
	Ground level behind hoarding	Concrete pump	2	20	223	2.3 x 10 <sup>-7</sup>	1.4 x 10 <sup>-8</sup>
Culvert works	Ground level behind hoarding	Service crane – 100t mobile crane	1	50	280	3.6 x 10 <sup>-7</sup>	2.3 x 10 <sup>-8</sup>
	Ground level behind hoarding	25t excavator	1	50	125	1.6 x 10 <sup>-7</sup>	1.0 x 10 <sup>-8</sup>
	Ground level behind hoarding	Dumper	1	50	81	1.0 x 10 <sup>-7</sup>	6.5 x 10 <sup>-9</sup>
	Ground level behind hoarding	Concrete deliveries (discharging)	1	20	223	1.2 x 10 <sup>-7</sup>	7.2 x 10 <sup>-9</sup>
	Ground level behind hoarding	Concrete boom pump	1	20	223	1.2 x 10 <sup>-7</sup>	7.2 x 10 <sup>-9</sup>
	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. \*\* FL T – fork lift truck. \*\*\*Hab – loader crane.*

## References

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

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# Application for Development Consent

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## Environmental Statement

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### **Volume 4: Acton Storm Tanks appendices**

#### **Appendix C: Ecology - aquatic**

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# Thames Tideway Tunnel

## Environmental Statement

### Volume 4 Acton Storm Tanks appendices

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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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# Application for Development Consent

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#### **Appendix D: Ecology - terrestrial**

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# Thames Tideway Tunnel

## Environmental Statement

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## Appendix D: Ecology – terrestrial

### D.1 Notable species survey report

#### Introduction

- D.1.1 A Phase 1 Habitat Survey was carried out on 26 November 2010 at the Acton Storm Tanks site as shown on Vol 4 Figure 6.4.2 (see separate volume of figures). Based on this, surveys for the following species have been undertaken:
- bats
  - wintering birds
  - reptiles.
- D.1.2 The purpose of the surveys is to determine the presence or likely absence of these species at and around the site.
- D.1.3 This report presents the survey findings. 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 to D.1.12). The results from the surveys are then presented (paras D.1.13 to D.1.14). The final section provides an interpretation of the results (paras D.1.21 to D.1.26). Figures referred to in this report are contained within Vol 4 Acton Storm Tanks Figures.
- D.1.4 Information on legislation, policy and methodology can be found in Volume 2 Environmental assessment methodology of the *Environmental Statement*. Information on site context can be found in Section 3 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 two stage bat survey was carried out. The first survey was a remote recording (bat triggering) survey using remote Anabat™ recording devices. Based on the habitat types identified during the Phase 1 Habitat Survey and their potential to support foraging, commuting or roosting bats, one location was chosen for the installation of the remote recording devices as shown on Vol 4 Figure 6.4.3 (see separate volume of figures).
- D.1.7 Location 1 is to the northwest of the site. This location was selected to record potential bat activity associated with foraging and commuting along the boundary and vegetation in this area.

- D.1.8 The bat triggering (remote recording) survey experienced an equipment failure on two out of the three nights of surveying. The absence of data from this failure is not considered to compromise the robustness of the assessment. The purpose of the bat triggering survey was to ascertain whether an additional dawn survey was required. The need for this additional survey was triggered with the single remote recording data; therefore it was considered that the triggering survey effort was adequate in fulfilling the aim of the survey. It considered that the data collected at location one and the completion of a dawn activity survey on the site ensures that adequate data was obtained to enable a robust assessment of effects to be undertaken.

#### **Wintering birds**

- D.1.9 Wintering birds are mainly associated with aquatic habitats such as intertidal mudflats and marshes, marginal vegetation and wetlands, which they use for resting and foraging. Some wintering bird species are also associated with terrestrial habitats such as scrub and grassland, which they use for roosting at high tide or foraging.
- D.1.10 Given the habitats on site (scrub, scattered trees and grassland) and the proximity of the site to the River Thames, the site was considered potentially suitable for wintering birds. The survey area comprises the proposed development site and vegetation immediately adjacent to the site as shown on Vol 4 Figure 6.4.4 (see separate volume of figures).

#### **Reptiles**

- D.1.11 Reptiles are associated with a variety of habitats including open woodland, abandoned and derelict land, large gardens, heathland, grassland, scrub and riparian habitats. Reptiles are usually found where there is a mosaic of these habitats that provide a range of conditions that provide shelter, foraging areas and areas for basking. They also require sheltered locations for hibernating in winter, such as piles of wood or stone.
- D.1.12 The site boundary and the area subject to reptile surveys is shown on Vol 4 Figure 6.4.5 (see separate volume of figures). The survey area comprises rank grassland/scrub, adjoining amenity grassland and tree lines.

#### **Results**

- D.1.13 In this section, the results of the desk study, notable species surveys and the invasive plant survey are presented. The results are then interpreted in paras. D.1.21 to D.1.26.

#### **Desk Study**

- D.1.14 Species data recorded within 500m of the site from 2001 to 2011, as supplied by Greenspace Information for Greater London (GIGL), are summarised in Vol 4 Table D.1 below.

**Vol 4 Table D.1 Terrestrial ecology - species found within 500m of the site between 2001 - 2011**

Common name	Latin name	Record count
Mammals		
Hedgehog	<i>Erinaceus europaeus</i>	5
Vesper bat (unidentified sp.)	<i>Vespertilionidae</i>	2
Noctule Bat	<i>Nyctalus noctula</i>	1
Common pipistrelle	<i>Pipistrellus pipistrellus</i>	1
Birds		
European serin	<i>Serinus serinus</i>	1
Common starling	<i>Sturnus vulgaris</i>	1
House sparrow	<i>Passer domesticus</i>	8
Lesser redpoll	<i>Carduelis cabaret</i>	1
Song thrush	<i>Turdus philomelos</i>	1
Amphibians		
Common frog	<i>Rana temporaria</i>	9
Smooth newt	<i>Lissotriton vulgaris</i>	1
Invertebrates		
Stag beetle	<i>Lucanus cervus</i>	16

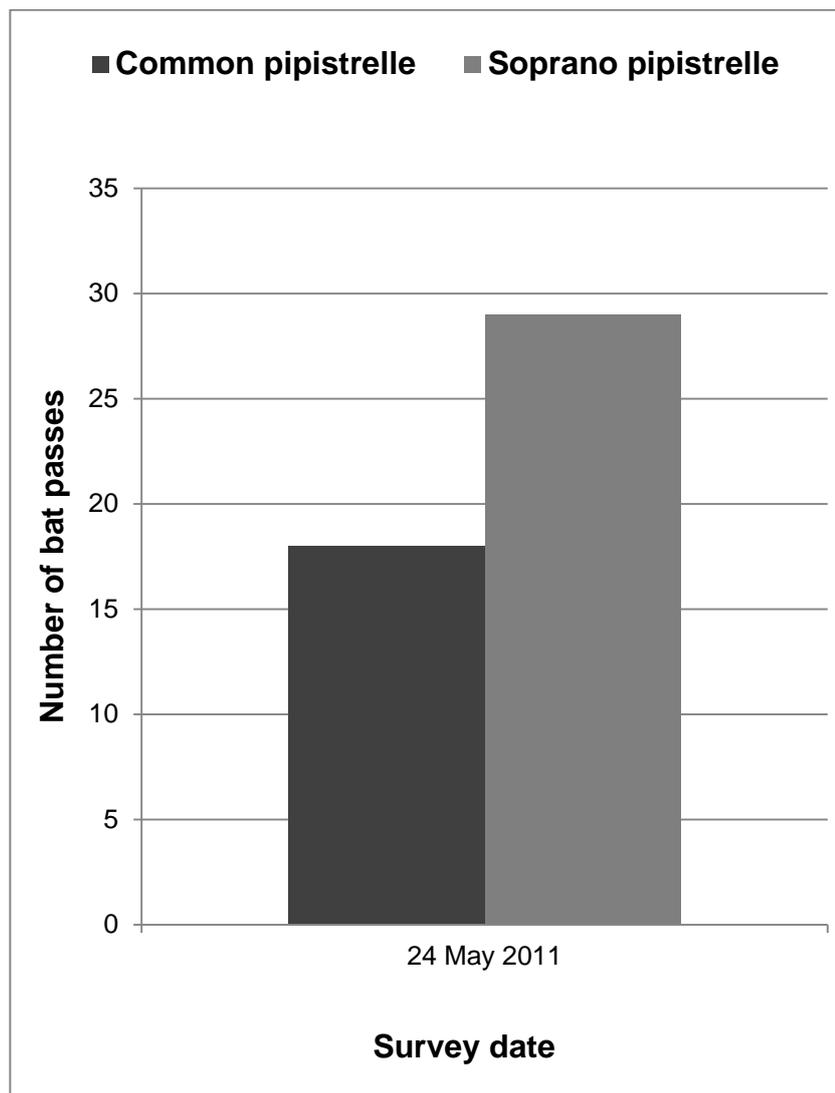
**Bat surveys****Bat triggering (remote recording) surveys**

- D.1.15 The bat triggering (remote recording) surveys were undertaken on the 24 May 2011 in suitable weather conditions (Vol 4 Table D.2).
- D.1.16 The remote recording survey undertaken at Acton Storm Tanks site recorded two species of bats using the site, common pipistrelle, (*Pipistrellus pipistrellus*) and soprano pipistrelle (*Pipistrellus pygmaeus*). A total of 18 common pipistrelle and 29 soprano pipistrelle passes were recorded (see Vol 4 Plate D.1). Some of these bat passes were recorded close to sunset indicating a possible roost site.

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

Survey visit	Weather conditions
24 May 2011	9°C, light breeze, 100% cloud cover, dry

**Vol 4 Plate D.1 Terrestrial ecology – bat passes recorded during remote recording surveys at one location at Acton Storm Tanks site**



**Bat activity (dawn) surveys**

- D.1.17 As there were records of bats close to dawn this triggered the need for a bat activity (dawn) survey to be undertaken (based on bat triggering criteria in Vol 2 Section 6). The bat activity survey was undertaken on 21 July 2011 in suitable weather conditions (14°C, light breeze, 100% cloud cover, dry). The bat activity survey results are shown on Vol 4 Figure 6.4.3 (see separate volume of figures).
- D.1.18 Limited foraging activity by a single common pipistrelle was recorded on site during the dawn survey. There were no soprano pipistrelle bats recorded during the dawn survey. No roosts were identified within, or in the immediate vicinity of the site.

**Wintering birds**

- D.1.19 The initial wintering bird survey was undertaken on the 21 December 2010. No notable wintering bird species on or in close proximity to the site. No further surveys were undertaken.

### Reptile surveys

- D.1.20 A total of ten reptile survey visits were conducted by experienced ecologists at an appropriate time of year and during suitable weather conditions (see Vol 4 Table D.3). No reptiles were recorded during the reptile survey.

**Vol 4 Table D.3 Terrestrial ecology - reptile survey weather conditions**

Date	Weather conditions
24 June 2011	Weather not relevant. Equipment setup (Mat placement).
7 July 2011	16°C, light breeze, 90% cloud, scattered showers
2 September 2011	20°C, light breeze, 15% cloud , dry
5 September 2011	21°C, light breeze, 25% cloud 25%, dry
16 September 2011	15°C, light breeze, 50% cloud , dry
19 September 2011	15°C, light breeze, 20% cloud , dry
21 September 2011	22°C, light breeze, 25% cloud , dry
22 September 2011	18°C, moderate breeze, 90% cloud, dry
23 September 2011	17°C, moderate breeze, 75% cloud, dry
26 September 2011	18°C, light breeze, 90% cloud, dry
28 September 2011	20°C, light breeze, 15% cloud, dry

### Interpretation

#### Bats

- D.1.21 The site is used for foraging by common and soprano pipistrelle bats.
- D.1.22 During the remote recording survey low numbers of common pipistrelle bats were recorded, some of these being close to dawn when bats return to their roost sites for the day. However, no common pipistrelle bats were observed entering the building on site or any of the residential buildings in close proximity to the site during the dawn activity survey. Therefore, it is considered unlikely that there is a roost on or in close proximity to the site.
- D.1.23 The maximum number of soprano pipistrelle bat passes was 29 and this activity is considered likely to be associated with bats foraging around trees and scrub on and adjacent to the site. No records were made close to dusk or dawn, when bats leave and return to their roosts. No soprano pipistrelle bats were observed during the dawn activity survey. Therefore, no roost is suspected on or in close proximity to the site.

#### Wintering birds

- D.1.24 Although there is potential habitat on site for sheltering wintering birds associated with the River Thames, no notable species were observed on site during the initial survey visit and no further surveys were therefore required at this site.

- D.1.25 The lack of notable wintering bird species is likely to be due to the limited connectivity between the River Thames and the Acton Storm Tanks site given the urban nature of the surrounding area.

### **Reptiles**

- D.1.26 Although some of the habitat around the perimeter of the site appeared suitable for reptiles, no reptiles were found. The habitat is limited in extent and it is likely that reptiles are locally absent. It is considered unlikely that reptiles would colonise this area in future whilst there is the lack of habitat connectivity to existing populations of reptiles.

**Thames Tideway Tunnel**  
Thames Water Utilities Limited



# Application for Development Consent

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

### **Volume 4: Acton Storm Tanks appendices**

#### **Appendix E: Historic environment**

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

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January 2013

**Thames  
Tideway Tunnel**



Creating a cleaner, healthier River Thames

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# Thames Tideway Tunnel

## Environmental Statement

### Volume 4 Acton Storm Tanks appendices

#### 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 4 Table E.1 below, with their location shown on the historic environment features map (Vol 4 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**

**Vol 4 Table E.1 Historic environment – gazetteer of known heritage assets within the site and assessment area**

HEA Ref no.	Description	Site code/ HER ref/ List Entry Number
1	MOLA site visit in March 2011 noted upstanding remnants of the original 19th century sewage works in the form of historic machinery; cobbled access road and a granite slab naming the councillors and contractors involved in the construction.  In August and September 2011, MOLA archaeologically monitored three geotechnical boreholes, dug in the northern and southern parts of the site. This revealed modern disturbance at the southern end of the site and possible late post-medieval remains beneath modern made ground in the northern part of the site.	-
2	Beech Avenue, Bromyard Avenue. Department of Greater London Archaeology evaluation in 1991 revealed shallow features cut into the Brickearth subsoil, dating to the 19th or early 20th century. They were thought to represent clay pits associated with East Acton Brickworks.	BEA91
3	Acton Vale, near Sewage Farm. The GLHER notes the chance find of a prehistoric blade.	050396
4	Bath Road Car Park. A post-medieval culvert and market garden are noted on the GLHER.	052362 052361
5	Rylett Road. Post-medieval brickfield noted on the GLHER.	054572
6	Benbow Road. Post-medieval clay pit noted on the	054824

HEA Ref no.	Description	Site code/ HER ref/ List Entry Number
	GLHER.	
<b>7</b>	Emlyn Road. Post-medieval clay pit noted on the GLHER.	054827
<b>8</b>	2 Addison Grove, Grade II listed. 4 and 6 Addison Grove, Grade II listed. 8 and 10 Addison Grove, Grade II listed.	1079618 1079619 1358669
<b>9</b>	16 Addison Grove, Grade II listed. 18 and 20 Addison Grove, Grade II listed. 22 Addison Grove, Grade II listed.	1358670 1079621 1188590
<b>10</b>	1 Addison Grove, Grade II listed. 3 Addison Grove, Grade II listed. 5 Addison Grove, Grade II listed. 7 and 9 Addison Grove, Grade II listed. 11 and 13 Addison Grove, Grade II listed.	1079613 1079614 1079615 1079616 1079617
<b>11</b>	12 and 14 Addison Grove, Grade II listed.	1079620
<b>12</b>	38 Bath Road, Grade II listed. 40 and 42 Bath Road, Grade II listed. 44 and 46 Bath Road , Grade II listed.	1079600 1358660 1188681
<b>13</b>	29 Bath Road, Grade II listed.	1079590
<b>14</b>	50-58 Bath Road, Grade II listed.	1294619
<b>15</b>	28 and 30 Bath Road, Grade II listed. 32 and 34 Bath Road, Grade II listed.	1079598 1079599
<b>16</b>	60 and 62 Bath Road, Grade II listed.	1358661
<b>17</b>	33 and 35 Bath Road, Grade II listed. 37 Bath Road, Grade II listed.	1079592 1079593
<b>18</b>	9 and 11 Bath Road, Grade II listed.	1358671
<b>19</b>	13 and 15 Bath Road, Grade II listed. 17-27 Bath Road, Grade II listed.	1188634 1079624
<b>20</b>	12 Blenheim Road, Grade II listed.	1079449
<b>21</b>	13 Blenheim Road, Grade II listed. 15 Blenheim Road, Grade II listed. 17 Blenheim Road, Grade II listed. 19-25 Blenheim Road, Grade II listed.	1358739 1294573 1079444 1079445
<b>22</b>	1 Fairfax Road, Grade II listed. 3 and 5 Fairfax Road, Grade II listed.	1358310 1080322

HEA Ref no.	Description	Site code/ HER ref/ List Entry Number
	7 Fairfax Road, Grade II listed.	1080323
<b>23</b>	37 and 39 Priory Avenue, Grade II listed. 41 Priory Avenue, Grade II listed buildings	1293911 1358331
<b>24</b>	23 and 25 Priory Avenue, Grade II listed. 27 and 29 Priory Avenue, Grade II listed.	1358330 1293909
<b>25</b>	28 Priory Avenue, Grade II listed. 30 and 32 Priory Avenue, Grade II listed. 34 and 36 Priory Avenue, Grade II listed.	1080292 1190244 1080293
<b>26</b>	43 and 45 Priory Avenue, Grade II listed. 47 Priory Avenue, Grade II listed.	1293913 1080290
<b>27</b>	20 and 22 Priory Avenue, Grade II listed. 24 and 26 Priory Avenue, Grade II listed.	1358333 1190239
<b>28</b>	38 Priory Avenue, Grade II listed. 40 and 42 Priory Avenue, Grade II listed. 44 and 46 Priory Avenue, Grade II listed. 48 Priory Avenue, Grade II listed.	1358334 1293888 1080294 1240253
<b>29</b>	31 Priory Avenue, Grade II listed. 33 and 35 Priory Avenue, Grade II listed.	1080288 1080289
<b>30</b>	14 and 16 Queen Anne's Gardens, Grade II listed.	1358758
<b>31</b>	2 Rupert Road, Grade II listed.	1261096
<b>32</b>	35 Woodstock Road, Grade II listed. 37 Wood stock Road, Grade II listed. 39-45 Woodstock Road, Grade II listed.	1189595 1079358 1079359
<b>33</b>	46 and 48 Woodstock Road, Grade II listed. 50 and 52 Woodstock Road, Grade II listed buildings	1240515 1240373
<b>34</b>	23 and 25 Woodstock Road, Grade II listed. 27 and 29 Woodstock Road, Grade II listed. 31 and 33 Woodstock Road, Grade II listed.	1294211 1079357 1358776
<b>35</b>	40 and 42 Woodstock Road, Grade II listed.	1260976
<b>36</b>	54 Woodstock Road, Grade II listed. 56 Woodstock Road, Grade II listed. 58 and 60 Woodstock Road, Grade II listed.	1240528 1240374 1240375
<b>37</b>	278-282 The Vale. Museum of London Archaeology Service evaluation in 2000 revealed natural Brickearth overlaid by 19th-century made	VLE00

HEA Ref no.	Description	Site code/ HER ref/ List Entry Number
	ground in the form of redeposited Brickearth, building rubble and garden soils. No archaeological features were identified.	

## E.2 Site location, topography and geology

### Site location

- E.2.1 The triangular site is a Thames Water sewage pumping station bounded to the northeast by Warple Way road, to the southwest by a car park along a disused railway line, and to the north by industrial/retail units of Canham Road. The site falls within the historic parish of Acton and formerly lay within the county of Middlesex.
- E.2.2 The site is located approximately 1.5km to the north of the River Thames. The closest natural watercourse to the site is the western branch of the Stamford Brook, which borders the site to its immediate east. It is a tributary of the Thames which is now covered over, and which formed a natural boundary of the ancient parish of Acton. Stamford Brook is the confluence of two smaller streams; an eastern branch arose near the Old Acton Wells approximately 2km north of the site and flowed south down Old Oak Common Road and Old Oak Road. The western branch, known locally as The Warple, ran just west of Horn Lane and south down Warple Way, to the immediate east of the site. By 1900, the brook had been covered over and is now a sewer.

### Topography

- E.2.3 The land slopes from the northwest down to the south and is drained by two subterranean streams, Bollo Brook and Stamford Brook's western branch (The Warple).
- E.2.4 The site is fairly flat, with a general level between 106.7m ATD (above Tunnel Datum; the equivalent to 6.7m Ordnance Datum) in the northwest and 106.4m ATD in the southeast. The former railway line that borders the southeastern side of the site lies at 104.0–105.4m ATD.
- E.2.5 Six large rectilinear storm tanks occupy the majority of the site. Access to the storm tanks is via a tarmac road from the northwest. The tanks are surrounded by grassed areas on the northeastern and southern sides. The eastern boundary, abutting Warple Way, is lined with trees.

### Geology

- E.2.6 The site is located on the Kempton Park Gravel Terrace, overlain by Brickearth (Langley Silt Complex), which is 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. The interface of the higher Thames river terrace, the Taplow Gravels, lies to

the north, although the exact boundary of the two terraces is obscured by the overlying Brickearth. Fine-grained interglacial sediments potentially survive at the boundary of the river terraces<sup>1</sup>. These sediments have potential for holding palaeoenvironmental information on the nature of the climate and vegetation as well as organic material for radiocarbon dating.

- E.2.7 Three geotechnical boreholes were drilled on the site in August and September 2011, and these were archaeologically monitored by Museum of London Archaeology (MOLA). Two in the northwestern part of the site (SR4073 west of the Storm Tanks 5/6, and SA4303 to the east of Tanks 5/6) recorded c 1.5m of made ground comprising modern and undated brick rubble, as well as historic soils / subsoils formed in brickearth. The made ground overlay about 1.0m of brickearth which did not appear to have been truncated. This sealed 5–6m of sands and gravels, presumably belonging to the Kempton Park Terrace. The sand and gravel sequence included sandy deposits, which could belong to temperate stages of the Ipswichian Interglacial, or to early stages of the Devensian cold stage and which might be of archaeological (Middle Palaeolithic and Quaternary) interest (ie, c. 128,000 to 25,000 BP).
- E.2.8 The presence of the brickearth suggests the location of the site was ‘high and dry’ on the river terrace and not influenced by the Stamford Brook, immediately to the east of the site, although occasionally major overbank flood events could have distributed alluvial channel sediments across the area. In prehistory, from the Mesolithic onward, the proximity of the Brook would have provided freshwater resources as well as a route through the landscape. Similar tributaries have revealed distributions of Upper Palaeolithic and Early Mesolithic artefacts sealed by later wetland deposits within their valleys.
- E.2.9 The higher level brickearth, in contrast to the alluvium of the floodplain, does not provide a good medium for palaeoenvironmental survival although features or artefacts relating to agricultural activity may survive beneath any made ground. In later prehistory and the historic period it is likely that the well drained, easily managed fertile soils typical of this geology would have been exploited for increasingly intensive crop production.
- E.2.10 Eight historical borehole records suggest that the gravel surface across the site lies between 103.0 and 105.0m ATD. One historical borehole (GLC1343 BH1) recorded peat from 103.35m ATD towards the centre of the site. To the north of the site alluvial clay was recorded from c. 104.0m ATD.
- E.2.11 The geotechnical borehole from the very southern tip of the site (SA4072) revealed modern truncation, which had removed the brickearth and here modern made ground was recorded to a depth of 3.5m and the underlying sand and gravels not reached.

### **E.3 Past archaeological investigations within the assessment area**

- E.3.1 In 2011, MOLA archaeologically monitored three geotechnical boreholes on the site, dug as part of the current project. This revealed modern disturbance in the southern part of the site, and possible post-medieval (late 19th century?) remains in the northern part of the site.
- E.3.2 There have only been two past archaeological investigations within the assessment area, approximately 450m to the north (**HEA 2**) and 550m to the northwest (**HEA 37**) of the site. These comprise an evaluation by the Department of Greater London Archaeology (DGLA) in 1991 and an evaluation by the Museum of London Archaeology Service (now named MOLA) in 2000. These investigations revealed post-medieval activity in form of clay pits and evidence of market gardens and 19th-century and later dumping. No earlier archaeological remains were recorded.
- E.3.3 There is a general paucity of archaeological finds in the assessment area, which may simply reflect the lack of past investigation. The area is thus little understood archaeologically, in particular of the prehistoric and Roman periods, for which there is no documentary or cartographic evidence.

### **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 Tunnel project, and the individual site-specific assessments, within a broader historic environment context (ie, 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 Lower and Middle Palaeolithic (approximately 700,000 to 40,000 BC) landsurfaces could survive at the base of the Brickearth. At Creffield Road in Acton, approximately 1.8km to the northwest of the site, there is evidence of Levalloisian culture stone tool manufacture beneath the Brickearth<sup>2</sup>.
- E.4.3 To date, prehistoric remains are poorly represented in the assessment area. The Greater London Historic Environment Record (GLHER) records only one chance find from Acton Vale, near Sewage Farm, approximately 300m northwest of the site, in the form of a prehistoric blade (**HEA 3**). A few isolated prehistoric finds in the form of flint artefacts approximately 800m to the north, west and east of the site (outside the assessment area), indicate some activity in the general area. The lack of finds is possibly a reflection of the limited archaeological investigation in the assessment area in the past, and consequently current understanding of

the nature and distribution of human activity in the area in the prehistoric is limited.

### Roman period (AD 43–410)

- E.4.4 The City of London (*Londinium*) was occupied soon after the invasion of AD 43 and the area that is now Ealing would have been located in the hinterland of the city, approximately 10km to its west. The major Roman road from London to Silchester (*Calleva Atrebatum*) passes through the southern part of the assessment area, approximately 530m south of the site, and crossed the River Colne at Staines (Pontes), approximately 17km to the southwest of the site.
- E.4.5 Whilst it may be presumed that an extensive agricultural landscape existed around London, very little Roman activity has been identified in the area around the site. Settlement and other activity in the general area would have been influenced by administrative and infrastructure factors associated with the establishment of *Londinium* as the provincial capital by the 2nd century AD. Small, nucleated, settlements were typically located along the major roads leading to the capital, and these acted both as markets and as producers to the capital. These hinterland settlements appear to have followed the general socio-economic trends that characterise the Roman period; a period of prosperity in the early 2nd century followed by a general decline in the late 2nd to early 3rd century and a brief revival in the 4th century<sup>3</sup>.
- E.4.6 To date there is no evidence of Roman activity in the assessment area, although as noted above, this may simply reflect the limited amount of past archaeological investigation. Two Roman pits found in the area of Acton shopping centre, approximately 1.0km northwest of the site, indicate some Roman activity in the wider area.

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

- E.4.7 Following the withdrawal of the Roman army from England in the early 5th century AD the whole country fell into an extended period of socio-economic decline. In the 9th and 10th centuries, the Saxon Minster system began to be replaced by local parochial organisation, with formal areas of land centred on settlements served by a parish church.
- E.4.8 The site fell within the eastern part of manor (estate) of Acton. The Saxon place name means 'oak town', and is first recorded in AD1181. The manor was a division of the bishop of London's manor of Fulham, which he acquired between AD704 and 709<sup>4</sup>.
- E.4.9 The site would have been located outside the focus of settlement. It lies approximately 300m to the south of the eastern part of Uxbridge Road, which is thought to have its origin in the Saxon period. The route led from Acton northwest over Ealing common to Haven Green and the site, at the north end of Ealing village, and west-southwest to Hanwell. The route was from London to Oxford, which was a newly founded settlement by AD 911<sup>5</sup>. Roadside settlement might have existed along the route<sup>6</sup>.
- E.4.10 There is no known archaeological evidence for this period from the site and it is likely that much surrounding area was open fields or possibly

woodland. But as with earlier periods, the general lack of information may be a reflection of the limited past investigations.

### Later medieval period (AD 1066–1485)

- E.4.11 There is little material evidence for the survival of medieval remains in the area, and no evidence has been found to date within the assessment area.
- E.4.12 The manor of Acton, within which the site lay, is not mentioned in Domesday Book (1086) but was probably accounted for under the larger Fulham or Ealing estate. The main settlement, Church Acton or Acton town, lay approximately 1.3km to the northwest of the site, along the main road from London to Oxford (Uxbridge Road), beside a church dedicated to St. Mary which existed by 1231. By 1380, a number of the tenements along the south side of the road were inns, servicing travellers along the road<sup>7</sup>.
- E.4.13 Another settlement was the hamlet of East Acton, mentioned in 1294, located on the north side of Uxbridge Road, approximately 320m to the north of the site. It consisted of farmhouses and cottages north and south of common land, which was later known as East Acton Green. Other than the two main settlements of Church Acton and East Acton, there would have been a few outlying farms<sup>8</sup>. Much of the manor to the north, located on the heavy London Clay, would have been heavily wooded.
- E.4.14 In all likelihood the site, on the edge of the manor, lay within open fields under arable cultivation or pasture.

### Post-medieval period (AD 1485–present)

- E.4.15 The earliest map consulted, Rocque's map of 1746 (Vol 4 Plate E.1) is a small scale-map that shows buildings indicatively, along with main roads, topographic features and land use. The map shows the site in an area of extensive arable cultivation to the northeast of Acton Common and to the south of Uxbridge Road. The surrounding area is generally sparsely populated, with scattered farms. The map shows a north-south aligned trackway running through the western part of the site and crossing a northwest to southeast aligned creek over a bridge. The creek is most likely to be the western branch of Stamford Brook, which, probably due to inaccuracies in the map, is shown here further south than on later, more accurate maps. Stamford Brook follows the boundary of the parish which bounds the site to its east. The north to south trackway is not shown on later maps but The Avenue, leading northwards from Chiswick High Road and turning west just south of the site, and Stanley Gardens Road to the north of the site, may be remnants of this old trackway.
- E.4.16 The early Ordnance Survey 1": mile map of 1830–5 (Vol 4 Plate E.2) is a small scale map that whilst not detailed, shows the site in a broader landscape context of settlements, roads and open fields. The map shows the site on open ground, with Uxbridge Road to the north and Chiswick High Road to the south. The largest settlement in the area is Acton (or Acton Church) approximately 1.3km to the northwest of the site. There is no settlement in close proximity of the site and activity is focussed along

the main thoroughfares to the north and south. This map shows the Stamford Brook to the northeast of the site.

- E.4.17 The Ordnance Survey 1st edition 25": mile map of 1868–82 (Vol 4 Plate E.3) shows the site in undeveloped open land, on the north side of the North & South Western Junction Railway (NSWJR) line. The map also shows the boundary between the parishes of Acton and Hammersmith which runs along the eastern boundary of the site. The NSWJR was authorised in 1851 to connect the London and North Western Railway (LNWR) at Willesden Junction with the London and South Western Railway (LSWR) Hounslow Loop Line by a west-facing link at Old Kew Junction. The only branch line of the NSWJR ran from Acton station (opened in 1853), to a terminus at Hammersmith. Acton station (renamed Acton Central in 1925) is located approximately 750m to the northwest of the site. In 1865, the North London Railway and the LNWR opened a station at Broad Street, providing Acton with a direct rail link to the City, which could be reached by a few fast trains in 30 minutes. From 1869 a line from South Acton junction to Richmond provided a more direct route, and trains ran alternately to Richmond and Kew Bridge. South Acton station, just north of South Acton junction, was opened in 1880<sup>9</sup>.
- E.4.18 The Ordnance Survey 2nd edition 25" mile map of 1896–99 (Vol 4 Plate E.4) is the first map to show development on the site. In 1884–88, the Metropolitan Board of Works constructed the Acton Sewage Disposal Works on the site<sup>10</sup>, in order to meet the requirements of rapid suburban development of the Acton area, brought about by the railways. The map shows filter beds and a building (labelled 'pump house' on later maps) in the northern part of the site. To the south of these is an earthwork embankment and a circular tank, with a small access road leading towards it. The southern part of the site is open and undeveloped. Hachures indicate a small slope down to the railway line to the southwest, which is shown on an embankment. The area surrounding the site is still sparsely occupied.
- E.4.19 The map shows a house, just north of (outside) the site, near the corner of Canham Road. The site visit noted the date 1897 recorded on a date stone on the first floor of the southeast principal elevation (Vol 4 Plate E.8). The first floor elevations have overlapping tile cladding. A cobbled surface is visible wrapping around the building from the southwest to northwest (Vol 4 Plate E.9). This two-storey mock Elizabethan structure has seen successive phases of alterations to the rear of the building. The building is associated with the first phase of the Acton Sewage disposal works on the site and was probably built to house the foreman or workers, and their families.
- E.4.20 The Ordnance Survey 3rd edition 25" map of 1909–1920 (Vol 4 Plate E.5) shows some changes within the site. The filter beds have been enlarged and another large filter bed is now covering the entire southern part of the site. This was constructed on the site in 1902 (shortly after this, in 1905, an Act allowed all the sewage to pass into the London County Council sewers, with only storm water draining into the Thames)<sup>11</sup>. The surrounding area has undergone major changes and is now occupied with

large residential areas and associated infrastructure. The map shows Canham road bounding the site to the north. There are new footbridges over the railway to the northwest and southeast of (outside) the site. Passenger services for the line were withdrawn during World War I but they were never reinstated and the line carried freight only.

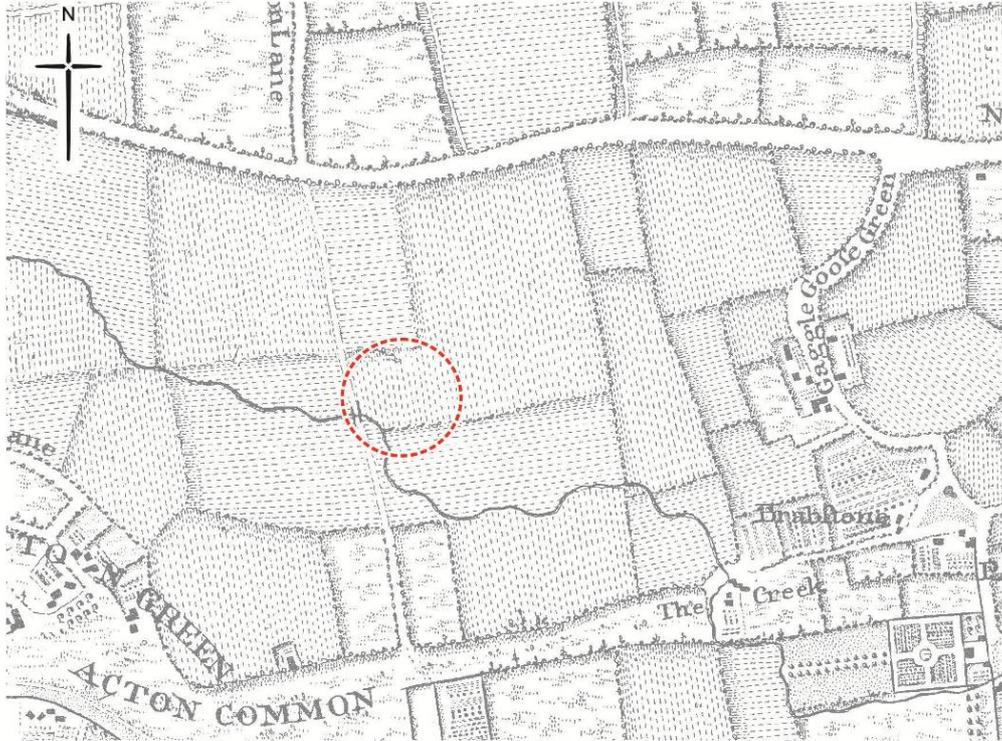
- E.4.21 The Ordnance Survey revised edition 25" map of 1932–47 (Vol 4 Plate E.6) shows no notable changes within the site, although the building in the northern part of the site appears to have been modified slightly (or demolished and rebuilt) and is labelled 'pump house'. The southern part of the site is now annotated as filter beds. The area surrounding the site has undergone further development and is densely occupied.
- E.4.22 The Ordnance Survey 1:2500 scale map of 1980–91 (Vol 4 Plate E.7) shows a complete reconfiguration of the filter beds. These have been replaced with the six existing rectangular storm tanks. A water cooler has been added in the northeastern part of the site.

### The current site

- E.4.23 The site is currently occupied by a series of six large storm tanks to contain overflow from the street drains. Since 1980–91, the pump house in the northern part of the site has been demolished and brick building constructed beside the access road. Other buildings within the site are late 20th century brick-built sheds to house machinery relating to the current use of the site. The Acton Storm tanks are surrounded by a pre-fabricated concrete wall and metal railings. The area surrounding the site is characterised by mixed residential and commercial use, with new residential areas under construction to the east.

## E.5 Plates

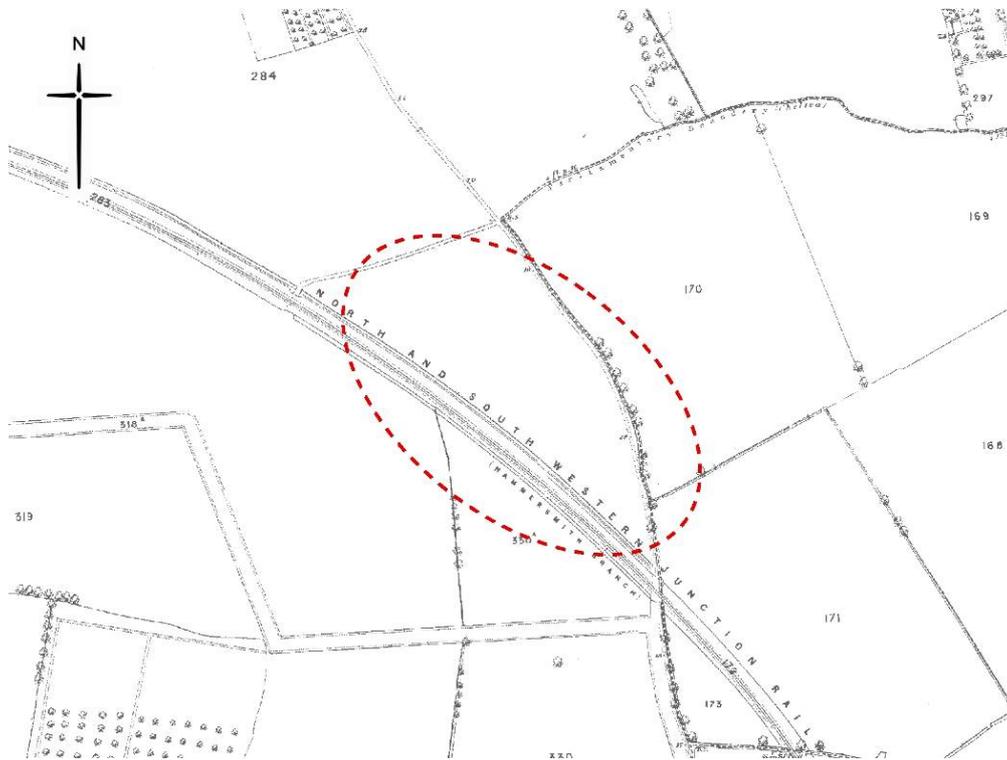
Vol 4 Plate E.1 Historic environment – Rocque’s map of 1746, which incorrectly shows Stamford Brook too far to the south.



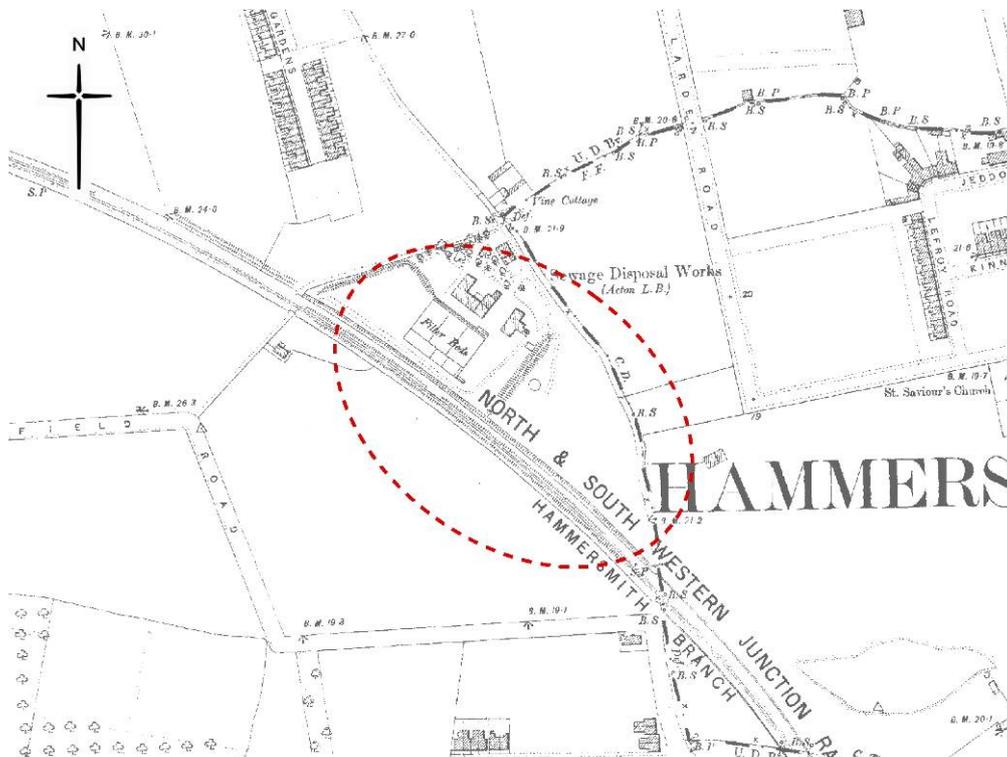
Vol 4 Plate E.2 Historic environment – Ordnance Survey 1": mile map of 1830-5 (not to scale).



**Vol 4 Plate E.3 Historic environment – Ordnance Survey 1st edition 25" : mile map of 1868–82 (not to scale).**

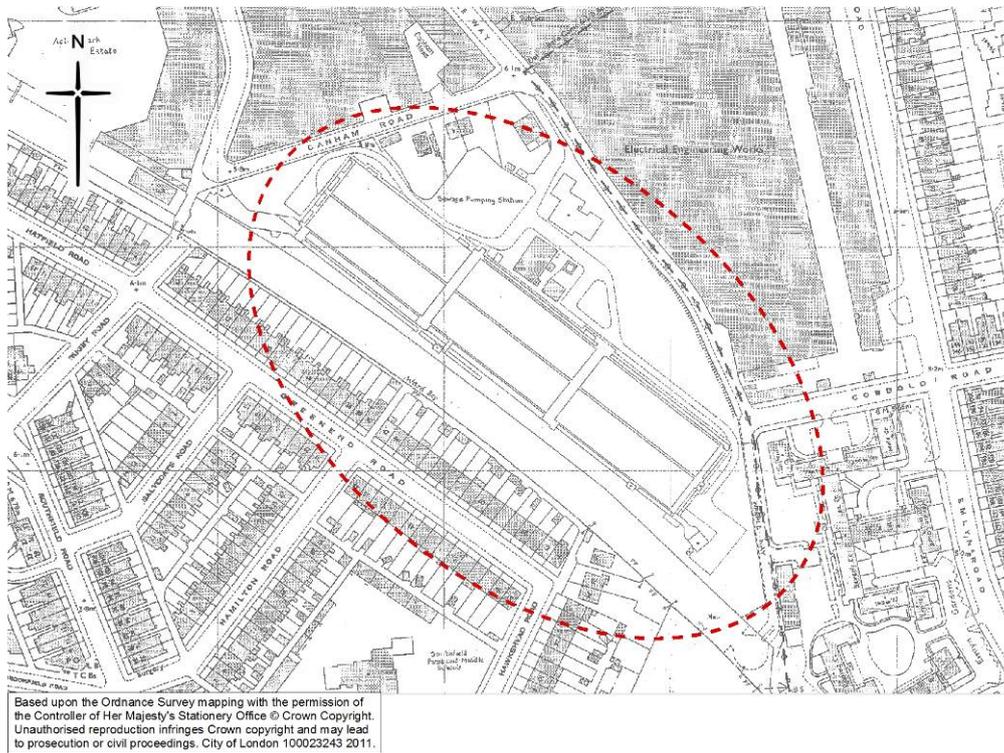


**Vol 4 Plate E.4 Historic environment – Ordnance Survey 2nd edition 25" : mile map of 1896–99 (not to scale).**





**Vol 4 Plate E.7 Historic environment – Ordnance Survey 1:2500 scale map of 1980–1991 (not to scale).**



**Vol 4 Plate E.8 Historic environment – View of a house to the north, outside the site, at the corner of Canham Road and Warple Way. The stone dates the house to 1887.**



*Looking south; standard lens; MOLA; 18<sup>th</sup> March 2011*

**Vol 4 Plate E.9 Historic environment – View of cobbled road surface, taken from the entrance of the site.**



*Looking northeast; standard lens; MOLA; 18<sup>th</sup> March 2011*

**Vol 4 Plate E.10 Historic environment – View of a piece of redundant machinery on the site. Located near the centre of the site.**



*Looking northwest; standard lens; MOLA; 18<sup>th</sup> March 2011*

**Vol 4 Plate E.11 Historic environment – View of the inscribed granite tablet near the centre of the site.**



*Looking southwest; standard lens; MOLA; 18<sup>th</sup> March 2011*

## References

- <sup>1</sup> Bridgeland D, *Quaternary of the Thames*. Geological Conservation Review Series 7 London. Chapman, and Hall (1994).
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- <sup>3</sup> Museum of London Archaeology Service, *The archaeology of Greater London*. An assessment of archaeological evidence for human presence in the area now covered by Greater London (2000).
- <sup>4</sup> Victoria County History *A History of the County of Middlesex. Volume 7: Acton, Chiswick, Ealing and Brentford, West Twyford, Willesden*. T F T Baker, C R Elrington (Editors) (1982), 7–14.
- <sup>5</sup> Victoria County History *A History of the County of Oxford. Volume 4: The City of Oxford*. Alan Crossley, C R Elrington (Editors) (1979), 3–9.
- <sup>6</sup> Victoria County History *A History of the County of Middlesex. Volume 7: Acton, Chiswick, Ealing and Brentford, West Twyford, Willesden*. T F T Baker, C R Elrington (Editors) (1982), 101–105.
- <sup>7</sup> Victoria County History *A History of the County of Middlesex. Volume 7: Acton, Chiswick, Ealing and Brentford, West Twyford, Willesden*. T F T Baker, C R Elrington (Editors) (1982), 7–14.
- <sup>8</sup> Victoria County History *A History of the County of Middlesex. Volume 7: Acton, Chiswick, Ealing and Brentford, West Twyford, Willesden*. T F T Baker, C R Elrington (Editors) (1982), 7–14.
- <sup>9</sup> Victoria County History *A History of the County of Middlesex. Volume 7: Acton, Chiswick, Ealing and Brentford, West Twyford, Willesden*. T F T Baker, C R Elrington (Editors) (1982), 2–7.
- <sup>10</sup> Victoria County History *A History of the County of Middlesex. Volume 7: Acton, Chiswick, Ealing and Brentford, West Twyford, Willesden*. T F T Baker, C R Elrington (Editors) 1982, 32–35.
- <sup>11</sup> Victoria County History *A History of the County of Middlesex: Volume 7: Acton, Chiswick, Ealing and Brentford, West Twyford, Willesden*. T F T Baker, C R Elrington (Editors)(1982), 32–35.

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**Thames Tideway Tunnel**  
Thames Water Utilities Limited



# Application for Development Consent

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

### **Volume 4: Acton Storm Tanks appendices**

#### **Appendix F: Land quality**

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

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**Thames Tideway Tunnel**  
**Environmental Statement**  
**Volume 4 Acton Storm Tanks appendices**  
**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, which includes historic maps and environmental records
- c. stakeholder engagement
- d. the initial results from preliminary intrusive ground investigation.

#### Site walkover

F.1.2 A site walkover was undertaken on 26th November 2010.

F.1.3 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.1.4 The storm tanks comprise open concrete lined tanks approximately 4m deep.

F.1.5 An approximately 36,400l capacity gas oil tank is located centrally within the site (approximately 70m to the east of the CSO drop shaft). At the time of the inspection, the tank was surrounded by a painted brick bund which was dry and showed no evidence of leakage of fuels. The filling point of the tank appeared to be situated within the bunded area.

F.1.6 Detailed site walkover notes are provided in the Vol 4 Table F.1 below.

**Vol 4 Table F.1 Land quality – site walkover report**

Item (Site ref: PEG2X, Acton Storm Tanks)		Details
Date of walkover	26th November 2010	
Site location and access	Acton Storm Tanks, Canham Road/Warple Way	
Size and topography of site and surroundings	Record elevation in relation to surroundings, any hummocks, breaks of slope etc.	Ground level within the site is approximately 1.5m above the surrounding road at its southerly most point. This change in ground level becomes progressively shallower to the north. Ground levels at the site may have been raised at some point and that a cover of Made Ground is present beneath this area.
Neighbouring site use (in	North	Commercial/light industrial and residential properties located along

Item (Site ref: PEG2X, Acton Storm Tanks)		Details
particular note any potentially contaminative activities or sensitive receptors)		Canham Road. Small area of properties present in the northeast corner adjacent to the boundary of the site. Properties along Warple Way.
	South	Residences located along Greenend Road.
	East	Residential properties located on Warple Way.
	West	Terraced residential properties situated on Greenend Road.
Site buildings	Record extent, size, type and usage. Any boiler rooms, electrical switchgear?	None within the worksite itself, within the wider site area are the storm tanks which comprise open concrete lined tanks approximately 4m deep and 36368l fuel oil tank located south east. At the time of the inspection, the tank was surrounded by a painted brick bund which was dry and showed no evidence of leakage of fuels.
Surfacing	Record type and condition	The proposed shaft is located within the concrete surfaced base of tanks 5 and 6. The remainder of the construction site is located on existing soft and hard landscaping toward the north and west of the wider Acton Storm Tanks site.
Vegetation	Any evidence of distress, unusual growth or invasive species such as Japanese Knotweed?	None invasive species observed at time of survey. The work site within the wider Acton Storm Tanks site is on an area of grass with a small number of mature trees bordering the north of the site and younger trees situated to the west.
Services	Evidence of buried services?	None observed
Fuels or chemicals on-site	Types/ quantities?	None
	Tanks (above ground or below ground)	One above ground gas oil tank located within the overall Acton site (outside of proposed construction area).
	Containment systems	Brick bunding for the gas oil tank, no

Item (Site ref: PEG2X, Acton Storm Tanks)		Details
	(eg, bund, drainage interceptors). Record condition and standing liquids	evidence of leakage.
	Refill points located inside bunds or on impermeable surfaces etc?	None observed
Vehicle servicing or refuelling onsite	Record locations, tanks and inspection pits etc.	None observed
Waste generated/stored onsite	Adequate storage and security? Fly tipping?	None observed.
Surface water	Record on-site or nearby standing water	None
Site drainage	Is the site drained, if so to where? Evidence of flooding?	None observed
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?	No obvious potential contaminative sources were identified during the survey.
Summary of potential contamination sources		Presence of gas oil tank.
Any other comments	Eg access restrictions/ limitations	No

### Review of historical contamination sources

F.1.7 Historical mapping (dated between 1896 and 1989) was reviewed in order to identify potentially contaminating land-uses at the site and within the 250m assessment area (see Vol 4 Plate F.1 to Vol 4 Plate F.6).

F.1.8 Vol 4 Table F.2 tabulates the potentially contaminating land-uses, inferred dates of operation and typical contaminants associated with the land-uses in question. Potential contaminants are sourced from CLR8: *Potential contaminants for the assessment of land* (Defra/EA, 2002)<sup>1</sup> and former Department of the Environment industry profiles (Department of the environment, 2011)<sup>2</sup>.

F.1.9 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.1.10 Items listed in the table below are also shown on Vol 4 Figure F.1.1 (see separate volume of figures). In addition, figures illustrating the historical environment of the site and surrounding area are provided in Vol 4 Appendix E.

**Vol 4 Table F.2 Land quality – potentially contaminating land- uses**

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item <sup>1,2</sup>
<b>On-site</b>			
1	Sewage treatment works/ storm tanks facility	c1887–present	Heavy metals, arsenic, free cyanide, nitrates, sulphates, sulphides, asbestos, oil/fuel hydrocarbons, chlorinated aliphatic hydrocarbon, chlorinated aromatic hydrocarbons, Polychlorinated Biphenyls (PCBs), pathogens (eg, faecal coliforms)
2	Railway	c1896-c1970	Polyaromatic Hydrocarbons (PAHs), heavy metals, phenols, sulphates, fuel oil, lubricating oil, greases, PCBs, solvents, asbestos, chlorinated aliphatic hydrocarbons, sulphates
<b>Off-site</b>			
3	Motor car repairing works and garage (185m north)	c1915-c1938	Heavy metals, paints, asbestos, total petroleum hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, solvents, de-greasers, cutting oils, mineral oil,

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item <sup>1,2</sup>
			volatile organic compounds (VOCs)
4	Corrugated paper works (adjacent north)	c1915-c1935	Chlorinated hydrocarbons and chlorine compounds, sulphur, ammonia, dyes
5	Motor car engineering works (adjacent northwest)	c1915-c1920	Heavy metals, paints, asbestos, total petroleum hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, solvents, de-greasers, cutting oils, mineral oil, VOCs
6	Motor coach works (80m north)	c1935	
7	Engineering works (adjacent northwest)	c1935	Heavy metals, asbestos, PCBs, total petroleum hydrocarbons, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
8	Slaughter house (125m north)	c1935	Pathogens
9	Laundry (165m north)	c1935	Chlorinated hydrocarbons
10	(a) Soap works (205m north)	c1935-c1955	Oils, fats, hydrocarbons
	(b) Works (205m north)	c1983-c1986	Heavy metals, asbestos, total petroleum hydrocarbons, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
11	(a) Electrical engineering works (adjacent east)	c1935-c1955	Heavy metals, asbestos, PCBs, total petroleum hydrocarbons, aromatic

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item <sup>1,2</sup>
			hydrocarbons, chlorinated aliphatic hydrocarbons.
	(b) Works (adjacent east)	c1986-c1987	Heavy metals, asbestos, total petroleum hydrocarbons, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
12	Works (185m north)	c1935	Heavy metals, total petroleum hydrocarbons, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
13	(a) Diesel engineering works (adjacent north)	c1954-c1955	Heavy metals, total petroleum hydrocarbons, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
	(b) Works (adjacent north)	c1983-present	Heavy metals, asbestos, total petroleum hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons
14	Depot (155m and 200m east)	c1954-c1989	Heavy metals, asbestos, total petroleum hydrocarbons, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, VOCs
15	Garages x2 (10m and 45m south)	c1954-c1983	Heavy metals, paints, asbestos, total petroleum hydrocarbons, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, solvents, de-greasers, cutting oils, mineral oil, VOCs
16	Electrical substation (5m east)	c1954-c1955	Oils, PCBs

### On-site

- F.1.11 The Acton Storm Tanks site was developed as a sewage treatment works in the mid 1890s; this included filter beds in a similar position to the present storage tanks. The filter beds and other infrastructure such as a pump house were extended to cover the majority of the existing site throughout the 20th century and the filter beds were replaced by the existing storm tanks during the 1980s.
- F.1.12 Historical mapping identified that the western boundary of the site was formerly occupied by a railway which was dismantled in the 1960s/70s.

### Off-site

- F.1.13 Within the 250m assessment area, the historical mapping shows that the area surrounding the Acton Storm Tanks site on its northern and eastern side has a manufacturing history dating back to the early part of the 20th Century, although to the east some of the area has now been redeveloped for housing. The surrounding area also has a number of past uses associated with vehicle manufacture and storage. These are now predominantly commercial units or warehousing.
- F.1.14 Land immediately to the south and west was first developed for housing and a garage (presumably a vehicle repair or sale garage) in the 1930s, prior to which the area was open fields.

### Geology

- F.1.15 Data from the Thames Tideway Tunnel project ground investigation indicates the anticipated geological succession, as summarised in Vol 4 Table F.3 below.

**Vol 4 Table F.3 Land quality – anticipated site geology**

Geological unit/ strata	Description	Approximate depth below ground level (m)
Made Ground	Varies	0.0-1.75
Alluvium	Soft silty clay with occasional organic matter	1.75-2.65
River Terrace Deposits	Medium dense to dense to dense sand and gravel (predominantly quartz sand and flint gravel).	2.65-8.8
London Clay	Slightly silty and sandy clay	8.8-47.62

### Unexploded ordnance

- F.1.16 During 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.1.17 A desk based assessment for UXO threat was undertaken for the Acton Storm Tanks site (see Vol 4 Appendix F.3). The report reviews information sources such as the Ministry of Defence (MoD), Public Records Office and the Port of London Authority.
- F.1.18 The report advises that one high explosive bomb strike occurred within the site and a further - three within the buffered site boundary. In addition four bomb strikes were recorded within 100m of the buffered site boundary.
- F.1.19 Since WWII the site has undergone redevelopment and as such there is a possibility that buried UXO items were removed during this time.
- F.1.20 Taking into account the findings of this study and the known extent of the proposed works, it is considered that there is an overall low/medium threat from UXO at the Acton Storm Water Tanks site.

### Thames Tideway Tunnel ground investigation data

- F.1.21 This section summarises the ground investigation undertaken by the Thames Tideway Tunnel project.
- F.1.22 Five boreholes were drilled on-site (borehole reference 4302, 4073, 4303, 4304 and 4072) into the top of the London Clay, as shown on Vol 4 Figure F.1.2 (see separate volume of figures). One borehole was extended into the underlying Lambeth Group.
- F.1.23 Vol 4 Figure F.1.2 also identifies other boreholes excavated on and within the vicinity of the site, these are not considered relevant to the contamination status of the site, either due to their distance from the proposed shaft location or because certain boreholes were excavated purely for geotechnical purposes.

### Soil contamination data

- F.1.24 A total of seven samples of Made Ground and Alluvium retrieved from the boreholes were tested for wide screen of potential contaminants that may reasonably be expected at the site given its current and historical association with wastewater.
- F.1.25 Samples were tested for: TPH, speciated PAH, arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc, ammoniacal nitrogen as N, sulphide, nitrate, sulphate, pH, cyanide (free), cyanide (total), magnesium, soil organic matter, speciated monohydric phenols
- F.1.26 Bacteriological testing (total coliforms) was also undertaken on two samples.
- F.1.27 The levels of chemical contaminants were found to be very low. They were found at concentrations well below widely used long term human health screening values (Defra/EA, 2009)<sup>3</sup> (Chartered Institute of Environmental Health, 2009)<sup>4</sup>.
- F.1.28 A single sample was however recorded as containing elevated levels of coliforms which is typical of sites used for wastewater.
- F.1.29 See Vol 2 Environmental assessment methodology for full guidance on the benchmarks used.

**Soil gas data**

F.1.30 No soil gas testing was undertaken as part of the investigation.

**Groundwater contamination data**

F.1.31 Two samples of groundwater were taken from standpipe installations in the River Terrace Deposits.

F.1.32 Groundwater data shows low levels of contamination with respect to coliforms, faecal coliforms, nickel, tetrachloroethene and turbidity within the River Terrace Deposits on-site. Refer to Section 13 Water resources – groundwater of this volume for further information.

**Third party ground investigation data**

F.1.33 No third party ground investigation was available for review at the Acton Storm Tanks site.

**Other environmental records**

F.1.34 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 4 Table F.4 below. Pertinent records are discussed in further detail below.

F.1.35 The location of these records is shown on Vol 4 Figure F.1.3 (see separate volume of figures).

**Vol 4 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	3
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	0
Registered waste transfer	0	0

Item	On-site	Within 250m of site boundary
site		
Registered waste treatment or disposal site	0	0

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

- F.1.36 Inspection of the data has identified areas both on-site and within 250m of the Acton Storm Tank site that are classified as being of past potential contaminated industrial use. The past on-site potential contaminated industrial use relates to the Acton Storm Tanks facility as shown on Vol 4 Figure F.1.1 (see separate volume of figures) along with other historical land-uses within the 250m assessment area. Common contaminants associated with such land-uses are identified in Vol 4 Table F.2.
- F.1.37 Within 250m of the Acton Storm Tank site, inspection of the data has identified three Local Authority Pollution Prevention and Controls. One of these is located 200m to the southwest of the site on the corner of Hamilton Road and Southfield Road and relates to a dry cleaning shop.
- F.1.38 The other two are to the northeast of the site on Larden Road near Valetta Road, approximately 160m and 175m from the site. Of the two nearest entries, one is related to the former factory site, the reason for the other entry is unclear.

### Thames water operational records

- F.1.39 Thames Water records of contaminating substance storage at the Acton Storm Tanks site within the last five years were reviewed.
- F.1.40 Thames Water records confirm the storage of fuel oil within the wider Acton Storm Tanks operation land, as observed during the site walkover.
- F.1.41 No spillages of any potentially contaminating substances to ground were recorded.

### Land quality data from local authority

- F.1.42 The site is located within the London Borough (LB) of Ealing although the eastern boundary with Warple Way marks the boundary with the LB of Hammersmith and Fulham. The boundary of LB of Hounslow is located immediately to the south.
- F.1.43 Each of the three local authorities was consulted on information they hold in relation to land condition.
- F.1.44 The LB of Ealing and LB of Hounslow both stated that they did not hold any pertinent data in respect of the site or search area.
- F.1.45 The LB of Hammersmith and Fulham holds extensive information relating to the redevelopment of land adjacent to the eastern boundary of the Acton Storm Tanks Facility.
- F.1.46 This information outlined that the adjacent site has a long history of vehicle component manufacturing (between c1904 and c2004) and that some

remedial measures were required for the construction of the existing residential properties. Given this site has been developed and remediated and is a considerable distance from the CSO drop shaft, it can be discounted as a viable contamination source which may directly impact upon construction.

F.1.47 The response from LB of Hammersmith and Fulham is provided in full within Section F.2.

### Summary of contamination sources

F.1.48 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 as a result of the sewage treatment works, filter beds: soil contamination does however appear to be relatively low, although some slightly elevated levels of coliforms have been found locally
- b. groundwater monitoring shows some bacteriological and minor volatile organic compounds (VOC) contamination
- c. current site operations and gas oil tank (bund)
- d. potential UXO.

F.1.49 The surrounding area immediately to the north and east has previously supported potentially contaminating land-uses. In particular, the area to the east was a former factory site that had become contaminated. This has been remediated and redeveloped for housing and is not considered to be a viable off-site contamination source any longer. Additionally, the area immediately to north is currently only used for commercial units and is not considered to represent a current high risk pollution source.

## F.2 Local authority consultation

### London Borough of Hammersmith & Fulham

Public protection and safety  
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CR0 2EE

11 January 2011

Our reference: 2011-00002 (Thames Tunnel\_Acton Storm Tank Area\_Jan11).doc

Dear Dino

#### Thames Tunnel – Acton Storm Tank Area

I refer to your e-mail dated 15 December 2010 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. These plans are discussed below with the inclusion of any pertinent historical planning information to which I am currently party.

*OS Map 1871:* The site and surrounding area appear relatively undeveloped. Water features are shown approximately 12 and 105 metres to the north and northeast of the property respectively. The Hammersmith Branch of the North and South Western Junction Railway is shown to slightly overlap the southwest edge of the site running in a northwest to southeast direction.

*OS Map 1896:* The site appears relatively unchanged with the exception of Vine Cottage identified in its northwest corner and an undefined structure in the lower third of the subject area. The immediate surrounding area to the north, east and south remain undeveloped whilst terraced developments are shown further to the east of the property including some Industrial Type Buildings labelled as Jeddo Works (Boot) (label not shown on this OS map) located approximately 190 metres to the west of the site. Trade directory records indicate that this site was operated by Peal and Co. as a Boot and Shoe Factory from at least 1896 through to at least 1817. An unidentified feature (likely a Sand Pit) is located approximately 50 metres to the south-southeast of the site. Sparse developments are shown to the southwest of the property and a Sewage Disposal Works (Acton L.B.) is located adjacent to the western border of the property. This Works comprises Filter Beds, a number of undefined buildings, embanked areas and an undefined circular structure.

*OS Map 1915:* The site is now occupied by clusters of terraced properties in its northwest corner and along its eastern boundary in the top two thirds of the site. A large Industrial Type Building occupies the site extending to the western boundary of the site from the terraced properties along the eastern boundary. Council records indicate that this Building was occupied since 1904 by Charles A. Vandervell's company, CAV, which manufactured Accumulators, Electric Carriage Lamps and Switchboards. Further details on this site are provided in the 'Council Records' section of this report. Allotment Gardens are identified as occupying the bottom third of the site and continuing southwards. The surrounding area has been extensively developed to the north, east and southwest. Jeddo Works appears to have been redeveloped and larger buildings are now present on this site. Further Allotment Gardens are shown approximately 90 metres to the southeast (label not shown on OS Map)

and approximately 10 metres to the west of the site. The Sewage Disposal Works to the west is now labelled as the Sewage Pumping Station (Acton U.D. Council).

*OS Map 1935:* The large Industrial Type Building on site is now labelled as an Electrical Engineering Works. A Chimney and Weighing Machine are identified between two of the terraced property clusters on the eastern boundary of the site. A number of Industrial Type Buildings (labelled as Lucas Stores and Service Depot on the 1955 OS Map) and associated Chimney are shown approximately 45 meters to the east of the site. Further details regarding these buildings are provided under the 'Council Records' section of this report. A Pump House, Water Cooler and Tanks (of unspecified contents or capacity) are now labelled at the Sewage Pumping Station to the west. A Large additional Filter Bed is shown to the southeast of the main Sewage Station with additional Tanks (of unspecified contents or capacity) further to the southeast. This additional Filter Bed is shown to be at a reduced level to the site. The surrounding area appears relatively unchanged.

*OS Map 1955:* The Electrical Engineering Works on site has been expanded and associated buildings now cover the area previously occupied by terraced properties along the eastern boundary of the site. The Allotment Gardens occupying the southern portion of the site have been redeveloped into Emlyn Gardens, a residential development, which continues south of the southern property boundary. Electricity Substations are labelled onsite; one is located in the northwest boundary and two are shown in the south. The surrounding area appears relatively unchanged. The Industrial Type Buildings to the east of the site are now labelled as Lucas Stores and Service Depot. The remaining surrounding area appears relatively unchanged.

*OS Map 1971-1974:* The structures on the eastern boundary of the site have been redeveloped and appear to comprise a small Industrial Type Building in the northeast corner and a large Industrial Type Building covering the remainder of the eastern boundary leaving an access road between it and the main Electrical Engineering Works. The Railway which formerly ran along the southwest tip of the site has been dismantled and is now indicated as an area of wooded vegetation extending from the site to the southeast. Adjacent to this southwest tip is an Undefined Works. Council records indicate that planning permission was granted in June of 1965 at the site of a Motor Vehicle Works located approximately 140 metres to the east of the site for use as a Scrap Metal Storage and Sorting facility; I am not aware of how long the premises had been a Motor Vehicle Works prior to this nor whether this change of use was implemented. Jeddo Works is now labelled simply as a Works and appears to have been extended. An additional structure marked as Works formerly associated with Jeddo Works is situated adjacent to the east of this Works, but is not shown.

*OS Master Map:* The Works at the site has been redeveloped with a mixed use residential and commercial properties. The former Lucas Depot to the east has likewise been developed into residential properties. Sylvia Grey Dry Cleaners is permitted to operate under the Environmental Permitting Regulations 2010 at the Works at the site of the former Jeddo Works shown on this Map. The Works adjacent to the east of this Dry Cleaners comprises an Undefined Works.

### Council Records

***Electrical Engineering Works:*** Charles A. Vandervell moved his company later known as CAV, which made accumulators, electric carriage lamps, and switchboards, from Willesden to the subject property in 1904. Between 1904 and 1908 the firm pioneered the dynamo-charged battery principle and in 1911 it produced the world's first public service vehicle six hundred employees in 1916 and one thousand by 1918. Wireless components were also made from 1923. In 1926 CAV was bought by Joseph Lucas Ltd. and in partnership with Robert Bosch Ltd. it began making fuel injection pumps for the new diesel industry and, in the Second World War, fuel systems for aircraft. From 1978 the company's name was Lucas CAV. The group's headquarters remained at the subject property, where in 1980 approximately three thousand employees made heavy duty electric equipment for commercial vehicles. From: 'Acton: Economic history', A History of the County of Middlesex: Volume 7: Acton, Chiswick, Ealing and Brentford, West Twyford, Willesden (1982), pp. 23-30.

Council records indicate that the site was an Authorised Part B process for metal and plastic coating (reference: 2009/00023/COATIN, Process Guidance Note 6/23) and required this authorisation for coil dipping, varnish impregnation and spray painting. Council records indicate that the site began winding down operations in 2004 at which time it was operated by Prestolite Electric who manufactured alternators and starter motor components for the automotive industry at the site. Council records indicate that a number of potentially polluting sources existed at the site including: Underground and Above Ground Storage Tanks storing fuel oils, cutting oils, cyanide, acids and paint; a Waste Storage area included Special Wastes including oils, waste coolants, waste solvents, degreasing solvents; an Effluent Treatment Plant which contained sodium hypochlorite and sodium hydroxide; a Plating Shop where various chemicals including acids (i.e. hydrofluoric acid), alkalis, hexavalent chromium and cyanide tanks as well as Settling Tanks of polyelectrolytes; and Electricity Substations including electrical switchgear capacitors in sealed units.

A planning application, 2005/00232/FUL to redevelop the site as mixed use residential and commercial was approved in March of 2005. A condition requiring that contaminated land be assessed at this site was placed on the planning permission. However, in February of 2007, a consequent application (2006/02023/FUL) was approved and two conditions were placed on the planning permission requiring that a desktop study, site investigation, risk assessment and remediation strategy be submitted to and approved by the Council as well as reports verifying the implementation of this remediation strategy. The site was decommissioned and demolished by the end of 2007. Submissions have been made towards the satisfaction of these conditions and the development of the site is on-going. As a consequence, not all of the requirements of the conditions have been submitted and approved.

The site investigation found the site geology to comprise of variable depths of made ground (up to approximately 3m bgl), followed by intermittent lenses of clay (from 0m to approximately 3.5m in thickness), over terrace gravels (extending to and average depth of approximately 7m bgl), over London clay. A continuous groundwater body was not proved beneath the site, however perched water was encountered in the clay lenses across the site and in the terrace gravels. The investigation also uncovered infilled tunnels throughout the site which are believed to have been used in association with air raid bunkers known to have existed at the site before being converted for storage purposes after the war.

Heavy metal and hydrocarbon contamination was encountered in the soil across the site. Hydrocarbons were also found to have impacted the groundwater beneath the site and, in agreement with the Environment Agency, remediation was implemented in the form of dual phase vapour extraction to improve the condition of the groundwater and to diminish the thickness of free product. Two extraction zones were chosen, one in the south of the site, adjacent to Cobbold Road, and another in the northeast of the site. Remediation was considered complete by the remediation contractors in 2008. The potential for the off-site migration of this groundwater contamination was investigated and monitoring wells were placed in the northern boundary of Emlyn Gardens and in the allotment to the south west, both in the direction of the prevailing hydraulic gradient known in this area. Hydrocarbon contamination was not found at either of these locations. However, as site development works progressed, an area of hydrocarbon impacted soil was identified to the south of the southern remediation zone and, as a precautionary measure, a clay barrier wall was placed in the south of the site bordering Cobbold Road.

Carbon dioxide and methane were both found to be elevated across the site. The residential and commercial blocks across the site have been built or retrofitted with gas and hydrocarbon resistant membranes to prevent the ingress gasses.

As mentioned above, the development is on-going and the full satisfaction of conditions is outstanding. However, conditions have been discharged regarding blocks across the site as partial fulfilment of conditions. Further details may be acquired by viewing submissions towards the satisfaction of these conditions through the planning portal on [www.lbhf.gov.uk](http://www.lbhf.gov.uk) using the planning application numbers provided above.

**Lucas Stores and Services Depot:** An undefined works was located at the site from the 1930's to the 1950's. A depot was then located at the site between the 1950's and 1970's. Council records indicate that this site was associated with the Electrical Engineering Works at the subject property which, from at least 1978, was also associated with Joseph Lucas. The site was redeveloped under planning application 1983/00799FUL which was approved in July of 1983. I have no record of potentially contaminated land having been addressed at this premises. The applicant, Barratt Central London Ltd., were contacted by the Council in 2005 by the Council to ascertain whether such records were kept; their response was that no records were found regarding this site.

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.

As agreed, please forward a cheque for £200 + VAT made payable to the London Borough of Hammersmith and Fulham for the provision of this letter.

Yours sincerely,



Elizabeth Fonseca  
Environmental Quality Manager

Enc: Site Plan  
Historical Ordnance Survey Plans

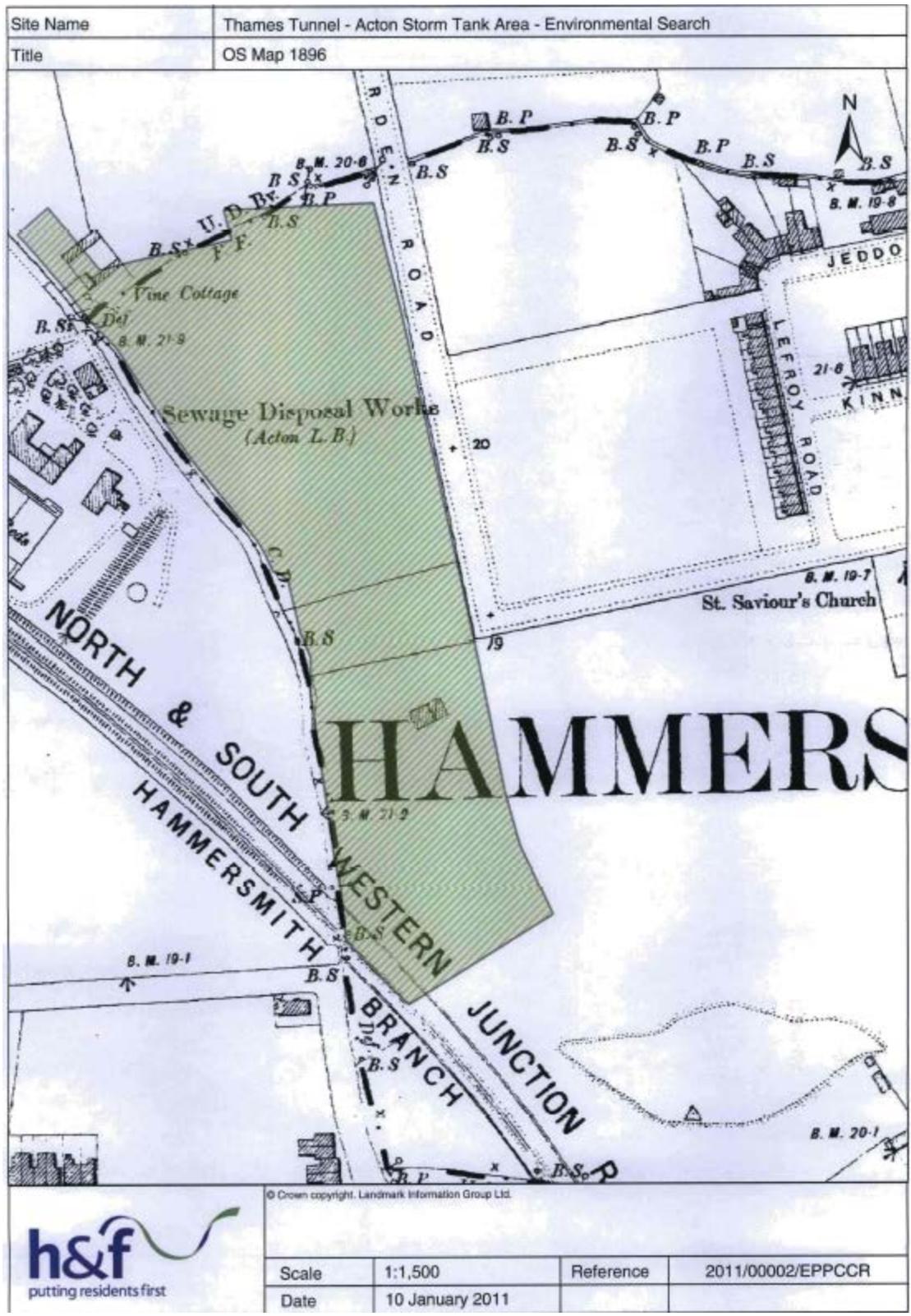
Vol 4 Plate F.1 Land quality – OS Master Map



**Vol 4 Plate F.2 Land quality – OS Map 1871**



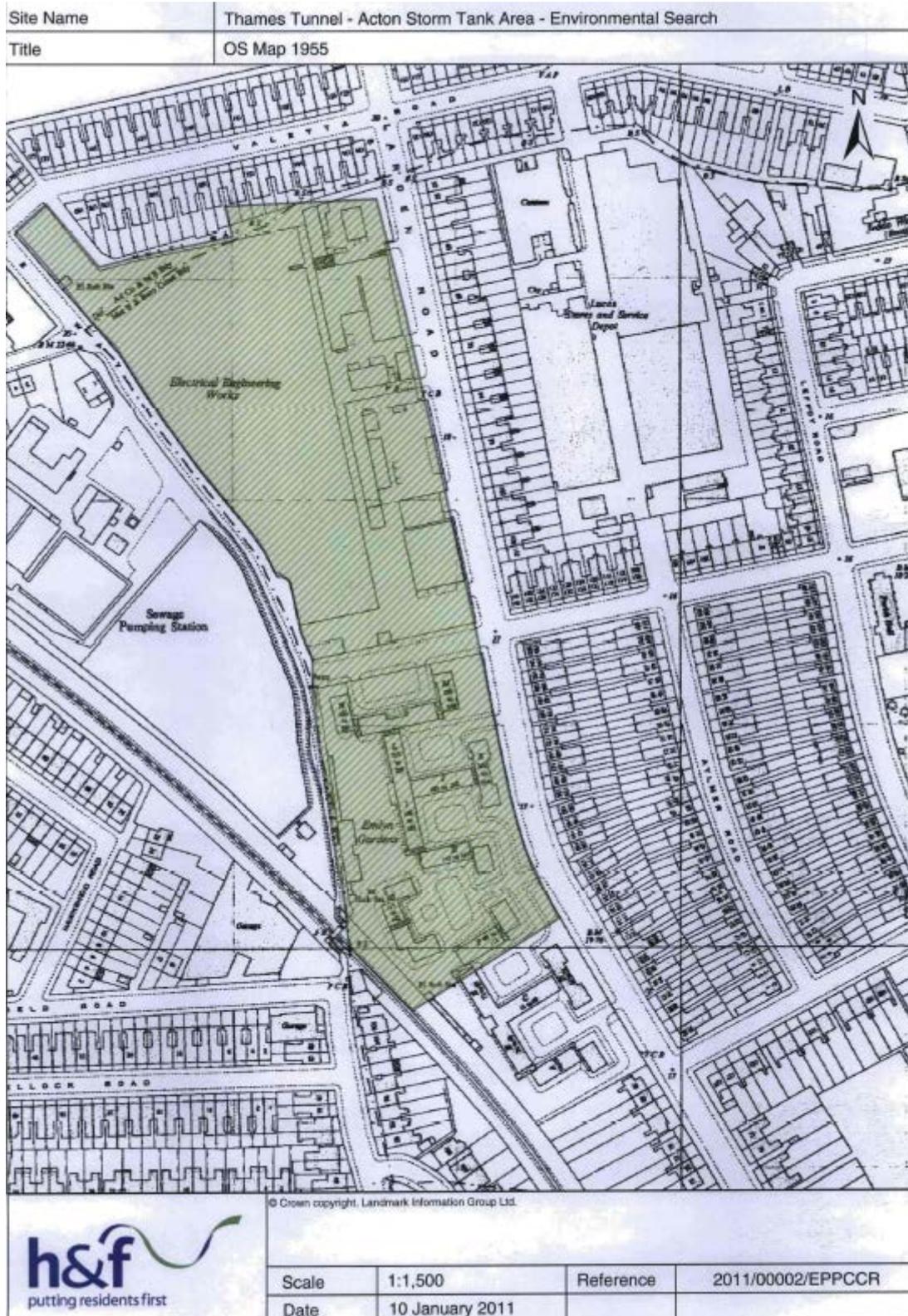
Vol 4 Plate F.3 Land quality – OS Map 1896



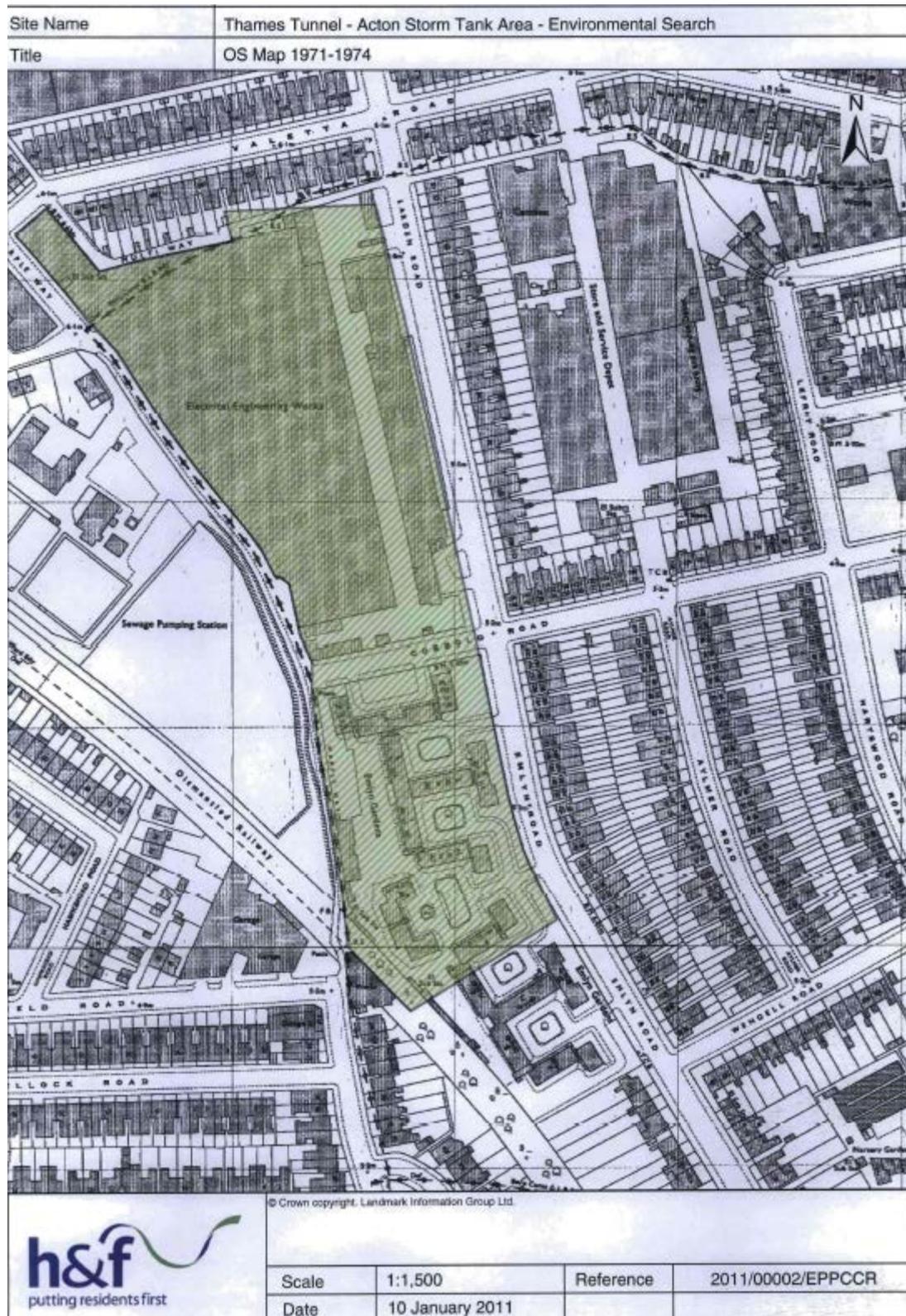
Vol 4 Plate F.4 Land quality – OS Map 1935



**Vol 4 Plate F.5 Land quality – OS Map 19355**



**Vol 4 Plate F.6 Land quality – OS Map 1971-1974**



**F.3 Detailed Unexploded Ordnance (UXO) risk assessment**

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## Detailed Unexploded Ordnance (UXO) Risk Assessment

**Study Site:** Work Area PEG2X – Acton Storm Tanks

**Document Number:** 336-RG-TPI-PEG2X-000001

**Client Name:** Thames Water

**6 Alpha Project Number:** P2853\_R14\_V1.0

**Date:** 13<sup>th</sup> June 2012

**Originator:** Max Chainey (13<sup>th</sup> June 2012)

**Quality Review:** Lisa Askham (14<sup>th</sup> June 2012)

**Released by:** Lee Gooderham (22<sup>nd</sup> June 2012)

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Figure Seven – London County Council Bomb Damage Mapping

Figure Eight – WWII High Explosive Bomb Density



## EXECUTIVE SUMMARY

<b>Study Site</b>	The Client has specified the Study Site as Work Area PEG2X, located at National Grid Reference "521235, 179666".
<b>Key Findings</b>	<p>In light of the research for this report, 6 Alpha has assessed the threat on this Site based on these pertinent facts:</p> <ul style="list-style-type: none"> <li>• The Work Area is situated on what was predominantly developed land during World War Two (WWII), and is surrounded by residential housing and industrial works, which would have provided a high footfall within the area.</li> <li>• Several WWII bombing targets were located within the vicinity of the Work Area, these are identified as a "works" and "railway stations and infrastructure". Numerous other "opportunistic" bombing targets were found within 1,000m of the Work Area.</li> <li>• The Site is located overlapping <i>Acton Metropolitan Borough</i> and <i>Hammersmith Metropolitan Borough</i>, which experienced a bombing density of 199 High Explosive (HE) bombs and 132 HE bombs per 1,000 acres respectively.</li> <li>• One HE bomb strike occurred within the Work Area, three strikes within the buffered Site boundary and a further four HE bomb strikes were recorded within 100m of the buffered Site boundary. Given the development of the Site, it is likely that UXO would have been witnessed and reported across much of the Site.</li> <li>• No significant bomb damage was recorded within the Work Area, however it is possible that the "pumping station" located on the Site kept their own records of bomb damage.</li> <li>• The Work Area has been mostly redeveloped since WWII, and most notably the "filter beds", and thus there is a possibility that buried UXO items may have been removed.</li> </ul> <p>The risk assessment and risk mitigation outlined below are based on the indicative engineering drawings and proposed works provided by <i>Thames Water</i>, and therefore it should be noted that any changes to the engineering drawings or proposed works may affect the risk assessment.</p>
<b>Potential Threat Source</b>	The threat is primarily posed by WWII <i>German</i> HE bombs, with a secondary threat from Incendiary Bombs and <i>British</i> Anti-Aircraft Artillery (AAA) projectiles.
<b>Risk Pathway</b>	Given the type of munitions that might be present on Site, all types of aggressive intrusive engineering activities may generate a significant risk pathway.
<b>Risk Level</b>	<b>LOW/MEDIUM</b>
<b>Recommended Risk Mitigation</b>	<p><b>The following actions are recommended before undertaking any activity on the Study Site:</b></p> <ol style="list-style-type: none"> <li><b>1. Operational UXO Risk Management Plan;</b> appropriate site management documentation should be held on site in the event of a suspected or real UXO discovery.</li> <li><b>2. UXO Safety &amp; Awareness Briefings;</b> the briefings are essential when there is a possibility of explosive ordnance encounter and are a vital part of the general safety requirement. All personnel working on the site should receive a general briefing on the identification of unexploded bombs (UXB), what actions they should take to keep people and equipment away from the hazard and to alert site management. Posters and information of the general nature of the UXB threat should be held in the site office for reference and as a reminder.</li> </ol>

## ASSESSMENT METHODOLOGY

<b>Approach</b>	<p>6 Alpha Associates are independent, specialist risk management consultants and the UXO related risk on the Site has been assessed using the process advocated by both the <i>Construction Industry Research &amp; Information Association</i> (CIRIA) best practice guide (C681) and by the <i>Health &amp; Safety Executive</i> (HSE).</p> <p>Therefore, any risk levels identified in the assessments are objective, quantifiable and not simply designed to generate “follow on survey or contracting work”; any mitigation solution is recommended <i>only</i> because it delivers the Client a risk reduced to As Low As Reasonably Practicable (ALARP) at best value.</p> <p>Potential UXO hazards have been identified through investigation of Local and National archives covering the Site, <i>Ministry of Defence</i> (MoD) archives, local historical sources, historical mapping as well as contemporaneous aerial photography (as and if, 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 is referenced within this document, whilst data of lesser relevance (which may have been properly considered and discounted by 6 Alpha), is available upon request.</p> <p>The assessment of UXO risk is a measure of <b>probability of encounter</b> and <b>consequence of encounter</b>; 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 (and/or other “sensitive receptors”), to the hazard at the moment of encounter.</p> <p>Should a measurable UXO risk be identified, the methods of mitigation recommended are reasonably and sufficiently robust to reduce these to As Low As Reasonably Practicable (ALARP). We believe that the adoption of the legal ALARP principle is a key factor in efficiently and effectively ameliorating UXO risks. It also provides a ready means for assessing the Client’s tolerability of UXO risk. In essence the principle states that if the cost of reducing a risk significantly outweighs the benefit, then the risk may be considered tolerable. Clearly this does not mean that there is no requirement for UXO risk mitigation, but any mitigation must demonstrate that it is beneficial. Any additional mitigation that delivers diminishing benefits <b>and</b> that consume disproportionate time, money and effort are considered <i>de minimis</i> and thus unnecessary. Because of this principle UXO risks will rarely be reduced to zero (nor need they be).</p>
<b>Important Notes</b>	<p>Although this report is up to date and accurate, our databases are continually being populated as and when additional information becomes available. Nonetheless, 6 Alpha have exercised all reasonable care, skill and due diligence in providing this service and producing this report.</p> <p>The assessment levels are based upon our professional opinion and have been supported by our interpretation of historical records and third party data sources. Wherever possible, 6 Alpha has sought to corroborate and to verify the accuracy of all data we have employed, but we are not accountable for any inherent errors that may be contained in third party data sets (e.g. National Archive or other library sources), and over which 6 Alpha can exercise no control.</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 a Threat &amp; Preliminary Risk Assessment Report that will be provided separately.</p> <p>Whilst 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 Client has specified the Study Site as Work Area PEG2X. The Site is located at National Grid Reference 521235, 179666. 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> <p>See <i>Figures 1</i> and <i>2</i> for the Site location.</p>																				
Location Description (Figure 3)	<p>The Work Area is situated to the west of the <i>City of London</i>, and lies between <i>Acton Metropolitan Borough</i> and <i>Hammersmith Metropolitan Borough</i>. Current aerial photography has identified the Work Area as land adjacent to residential housing with structural developments on Site.</p>																				
Proposed Engineering Works	<p><i>Thames Water</i> have specified a summary of the proposed engineering works, including working draft plans with drawing no's. 100-DA-CNS-PEG2X-240105_AI; 100-DA-CNS-PEG2X-240106_AI; and 100-DA-CVL-PEG2X-340020_AH. The proposed works may not represent the full scheme but rather those that may present an UXO risk:</p> <ul style="list-style-type: none"> <li>• Decommission and partial demolition of the two northernmost storm tanks to enable construction of the shaft and associated hydraulic structures;</li> <li>• Construction of a 15m internal diameter shaft, approximately 35m deep;</li> <li>• Reception of a 6.5m ID tunnel boring machine;</li> <li>• A connection culvert linking the existing storm tank inlet works to the main shaft. This connection culvert will include penstock and flap valve chambers;</li> <li>• A new overflow chamber and 270m of connection culvert along the site's western boundary to convey overflows from the storm tank inlet works to the existing <i>Acton Combined Sewer Overflow (CSO)</i>;</li> <li>• Construction of a new ventilation building up to 400m<sup>2</sup> in area and 9m high plus a 15m high ventilation column and associated below ground ducting. The ventilation building would be located in the north of the site adjacent to <i>Canham Rd</i>;</li> <li>• Construction of a permanent hard standing area to facilitate operational use with a permanent vehicle access off <i>Canham Road</i>;</li> <li>• Installation, maintenance and removal of a suitable temporary construction working area to facilitate the construction of the above.</li> </ul> <p>The construction site will include storage areas for shaft lining materials, material handling facilities, grout batching and silo facilities, stockyard and spares storage facilities.</p> <p>The main construction area would be located in the north of the Site in the area of the northern pair of storm tanks. An additional shorter term working area in the west and south would be required to enable the construction of the overflow to the <i>Acton CSO</i>.</p> <p>The Site would require the formation of vehicle accesses off <i>Canham Road</i> to serve the construction Site and a temporary Site access off <i>Warple Way</i> in the south of the site to serve <i>Thames Water</i>. Temporary overhead crane and gantry facilities would be required during construction.</p>																				
Ground Conditions	<p><i>Thames Water</i> have indicated the following ground conditions for the Work Areas as:</p> <table border="1" data-bbox="263 1668 1481 1948"> <thead> <tr> <th>Site Geology</th> <th>Depth Below Ground Level (m)</th> <th>Thickness (m)</th> </tr> </thead> <tbody> <tr> <td>Made Ground and Superficial Deposits</td> <td>0.00</td> <td>7.00</td> </tr> <tr> <td>London Clay</td> <td>7.00</td> <td>41.50</td> </tr> <tr> <td>Lambeth Group</td> <td>41.50</td> <td>15.75</td> </tr> <tr> <td>Thanet Sand</td> <td>57.25</td> <td>7.75</td> </tr> <tr> <td>Seaford Chalk</td> <td>65.00</td> <td>Not Proven</td> </tr> </tbody> </table> <p>It is important to establish the ground conditions within this report to determine both the maximum <i>German UXB</i> bomb penetration depth (BPD) as well as the potential for other types of munitions to be buried on this Site.</p>			Site Geology	Depth Below Ground Level (m)	Thickness (m)	Made Ground and Superficial Deposits	0.00	7.00	London Clay	7.00	41.50	Lambeth Group	41.50	15.75	Thanet Sand	57.25	7.75	Seaford Chalk	65.00	Not Proven
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Seaford Chalk	65.00	Not Proven																			

## 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"> <li>1. Home Office WWII Bomb Census Maps;</li> <li>2. WWII &amp; post-WWII Aerial Photography;</li> <li>3. Official Abandoned Bomb Register;</li> <li>4. National Archives in Kew;</li> <li>5. Internet based research;</li> <li>6. Historic UXO information provided by 33 Engineer Regiment (Explosive Ordnance Disposal) at Carver Barracks, Wimbish.</li> </ol>
Site History and Use	<p>According to the County Series (CS) &amp; Ordnance Survey (OS) historical mapping, the following Site history can be recorded immediately prior to and post-WWII:</p> <p><b>1938 CS mapping</b> – The Work Area is situated on developed land and contains the <i>Acton Corp Sewage Pumping Station</i>, associated “filter beds”, a “water cooler” and an unidentified building.</p> <p><b>1949 OS mapping</b> – No significant or noticeable structural developments have occurred within the Site.</p>
1945 Aerial Photography (Figure 4)	<p>The 1945 aerial photography confirms structural development on Site, and despite the lack of clarity in the aerial photography, we can infer that much of the Site is intact, given the buildings present on the photograph are concomitant with mapping from 1938.</p>
WWII Luftwaffe Bombing Targets (Figure 5)	<p>No primary targets have been identified on or within the vicinity of the Site. However, numerous “opportunistic” targets surround the Site, including multiple “works” immediately adjacent and north of the Site, as well as “railway infrastructure”, “stations” and “depots” all located within 1,000m of the Site.</p>
WWII HE Bomb Strikes (Figure 6)	<p>Air Raid Precaution (ARP) reports indicate that one bomb strike occurred within the Work Area. Additionally, three bomb strikes occurred within the buffered Site boundary and four strikes occurred within 100m of the buffered Site boundary.</p>
WWII Bomb Damage (Figure 7)	<p><i>London County Council</i> (LCC) bomb damage maps indicate no bomb damage within the Site and only slight “blast damage” occurred within the buffered Site boundary to the north. Additionally, “total destruction” of structures by bomb damage occurred to the east of the Site.</p>
WWII HE Bomb Density (Figure 8)	<p>The Study Site is located between the <i>Acton Metropolitan Borough</i> and <i>Hammersmith Metropolitan Borough</i>, which recorded 199 HE bombs and 132 HE bombs per 1,000 acres respectively.</p> <p>This figure does not include incendiary devices, as they were often released in such large numbers that they were seldom recorded.</p>
Abandoned Bombs	<p>The Official Abandoned Bomb Register recorded no abandoned bombs on or within 1,000m of the Work Area.</p>

## STAGE THREE – DATA ANALYSIS

Was the ground undeveloped during WWII?	Partially; whilst the Work Area was fully developed with a “pumping station”, some of the associated structures such as “filter beds” contained large bodies of water.
Is there a reason to suspect that the immediate area was a bombing target during WWII?	Yes; the Work Area is located directly adjacent to numerous “works” and in close proximity to other “opportunistic” bombing targets.
Is there firm evidence that ordnance landed on Site?	Yes; one HE bomb strike was recorded within the Work Area.
Is there evidence of damage sustained on Site?	No; damage was not recorded to structures within the Site, however infrastructure compounds such as the “pumping station” within the Work Area would typically keep their own records of any bomb damage.  Additionally, no significant bomb damage has occurred to structures within the buffered Site boundary, with only one structure suffering notable “blast damage”.
Is there any reason to suspect that military training may have occurred at this location?	No; there is no evidence to suggest that military training occurred within any of the areas.
Would an UXB entry hole have been observed and reported during WWII?	Possibly; the Work Area was industrially developed and located adjacent to a main road ( <i>Warple Way</i> ), residential housing and further industrial areas, indicating a high volume of footfall. Therefore, it is likely that any UXB entry hole on visible ground may have been witnessed and investigated. Additionally, the LCC maps shows no bomb damage to buildings within the Work Area and therefore debris is unlikely to pose a significant hindrance to the observation of potential UXB entry holes.  However, the Site also contained two “filter beds” that would have held large bodies of water. Any UXO landing in either of these “filter beds” would likely not have been witnessed
What is the expected UXO contamination?	The most likely source of UXO contamination is from <i>German</i> aerial delivered ordnance, which ranges from small Incendiary Bombs through to large HE bombs (of which the latter forms the principal threat).
Would previous earthworks have removed the potential for UXO to be present?	Possibly; much of the Work Area has been redeveloped, including the “pumping station” and the “filter beds”, and so the potential for UXO to remain on site and undiscovered largely depends on the scale and depth of the post-WWII development.



## STAGE FOUR – RISK ASSESSMENT

<b>Threat Items</b>	The threat is predominately posed by WWII <i>German</i> HE bombs and Incendiary Bombs. Additionally, <i>British</i> Anti Aircraft Artillery (AAA) projectiles may also be present. However, AAA does not have the potential for deep burial, and thus is unlikely to be encountered at depths greater than 1m bgl.	
<b>Maximum Penetration</b>	<p>The general ground conditions (highlighted in Stage 1) of the Work Area that are relevant consist of Made Ground and Superficial Deposits, and thus the most likely Bomb Penetration Depth (BPD) for a 250kg bomb is assessed to be a maximum of 7m below ground level (bgl), dependant on the depth of any rock sediment.</p> <p>Whilst the <i>Luftwaffe</i> used larger bombs, their deployment was so few and only used against notable targets, to use them within this risk assessment would not be justified. Additionally, smaller items such as <i>German</i> Incendiary Bombs and <i>British</i> AAA projectiles would have a significantly reduced penetration capability and would not be expected to be encountered at depths greater than 1m.</p>	
<b>Risk Pathway</b>	Intrusive engineering activities are likely to be in the form of excavations. Although for the purposes of this report 6 Alpha will use a range of generic construction activities for the risk assessment.	
<b>Consequence</b>	<b>Potential consequences of UXO initiation</b>	<ol style="list-style-type: none"> <li>1. Kill and/or critically injure personnel</li> <li>2. Severe damage to plant and equipment</li> <li>3. Blast damage to nearby buildings</li> <li>4. Rupture and damage underground services</li> </ol>
<b>Consequence</b>	<b>Potential consequences of UXO discovery</b>	<ol style="list-style-type: none"> <li>1. Delay the project</li> <li>2. Disruption to local community/infrastructure</li> <li>3. Incurring additional costs</li> </ol>
<b>Site Activities</b>	A number of construction methodologies have been identified for analysis on this Site. There is a large amount of variation in the probability of encountering, or initiating items of UXO when conducting different activities on Site. Additionally the consequences of initiating UXO vary greatly depending on how the item of UXO was initiated on Site.	

## STAGE FOUR – RISK ASSESSMENT (...continued)

### UXO RISK CALCULATION TABLE

<b>Risk Rating Calculation</b>	6 Alpha's Semi-Quantitative Risk Assessment identifies the Risk Rating posed by the most probable threat items when conducting a number of different construction activities on the Site. Risk Rating is determined by calculating the probability of encountering UXO and the consequences of initiating it.
--------------------------------	---

<u>Activity</u>	WORK AREA		
	Probability (SHxEM=P)	Consequence (DxPSR=C)	Risk Rating (PxC=RR)
Enabling Works	1x1=1	3x3=9	1x9=9
Tunnelling	1x2=2	1x3=3	2x3=6
Shaft Installation	1x2=2	2x3=6	2x6=12
Open Excavations	1x2=2	2x3=6	2x6=12

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

If a geophysical survey is required are the ground conditions an issue?	<p><b>Non-Intrusive Methods of Mitigation;</b> The suitability for an effective non-intrusive method of mitigation is largely dependent on the depth and composition of made ground (7m at this Site) as any magnetometer results are highly likely to be affected by ferro-magnetic contamination due to previous construction activities within the Study Site location.</p> <p><b>Intrusive Methods of Mitigation;</b> Intrusive magnetometry is expected to be possible (although limited) on this Site. It should be noted that ferro-contamination of any Made Ground/Fill Material, particularly at the fill layer, is likely to adversely affect detection capability of the equipment.</p>
---	---

### MITIGATION MEASURES TO REDUCE RISK TO 'ALARP'

Activity	Risk Mitigation Measures	Final Risk Rating
ALL ACTIVITIES	<p><b>The following actions are recommended before undertaking any activity on the Study Site:</b></p> <ol style="list-style-type: none"> <li><b>1. Operational UXO Risk Management Plan;</b> appropriate site management documentation should be held on site to plan for and guide upon the actions to be carried out in the event of a suspected or real UXO discovery.</li> <li><b>2. UXO Safety &amp; Awareness Briefings;</b> the briefings are essential when there is a possibility of explosive ordnance encounter and are a vital part of the general safety requirement. All personnel working on the site should receive a general briefing on the identification of UXB, what actions they should take to keep people and equipment away from the hazard and to alert site management. Posters and information of the general nature of the UXB threat should be held in the site office for reference and as a reminder.</li> </ol>	ALARP

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



# Report Figures

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# Figure One

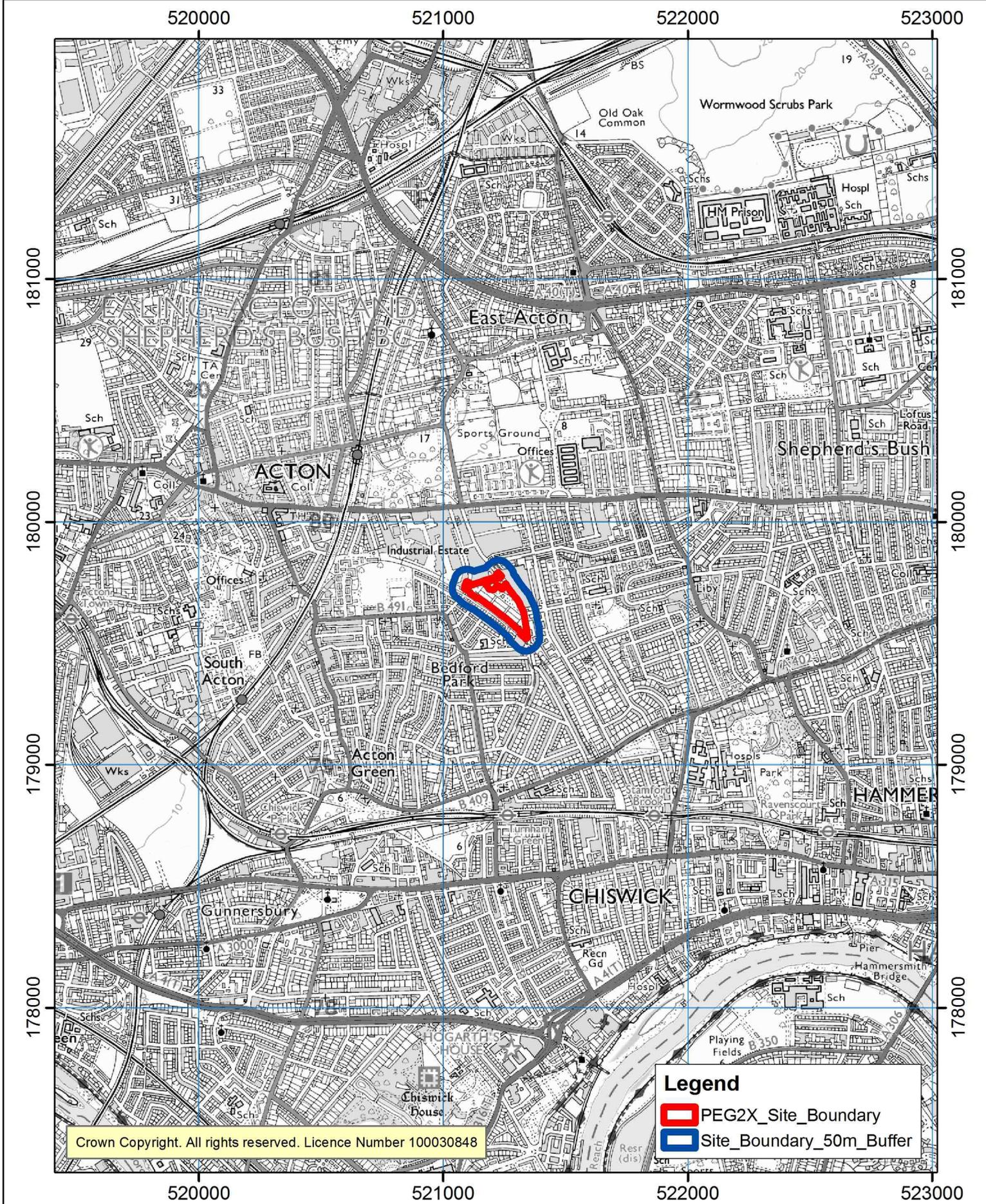
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## Site Location

# Thames Tideway Tunnel - Work Area PEG2X Site Location

## Figure 1

British National Grid



**Legend**

- PEG2X\_Site\_Boundary
- Site\_Boundary\_50m\_Buffer

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 Background data supplied by Ordnance Survey under licence.

Project Number: P2853\_PEG2X  
 Drawn By: Dominique René  
 Checked by: Lee Gooderham  
 Date: 24th May 2012



# Figure Two

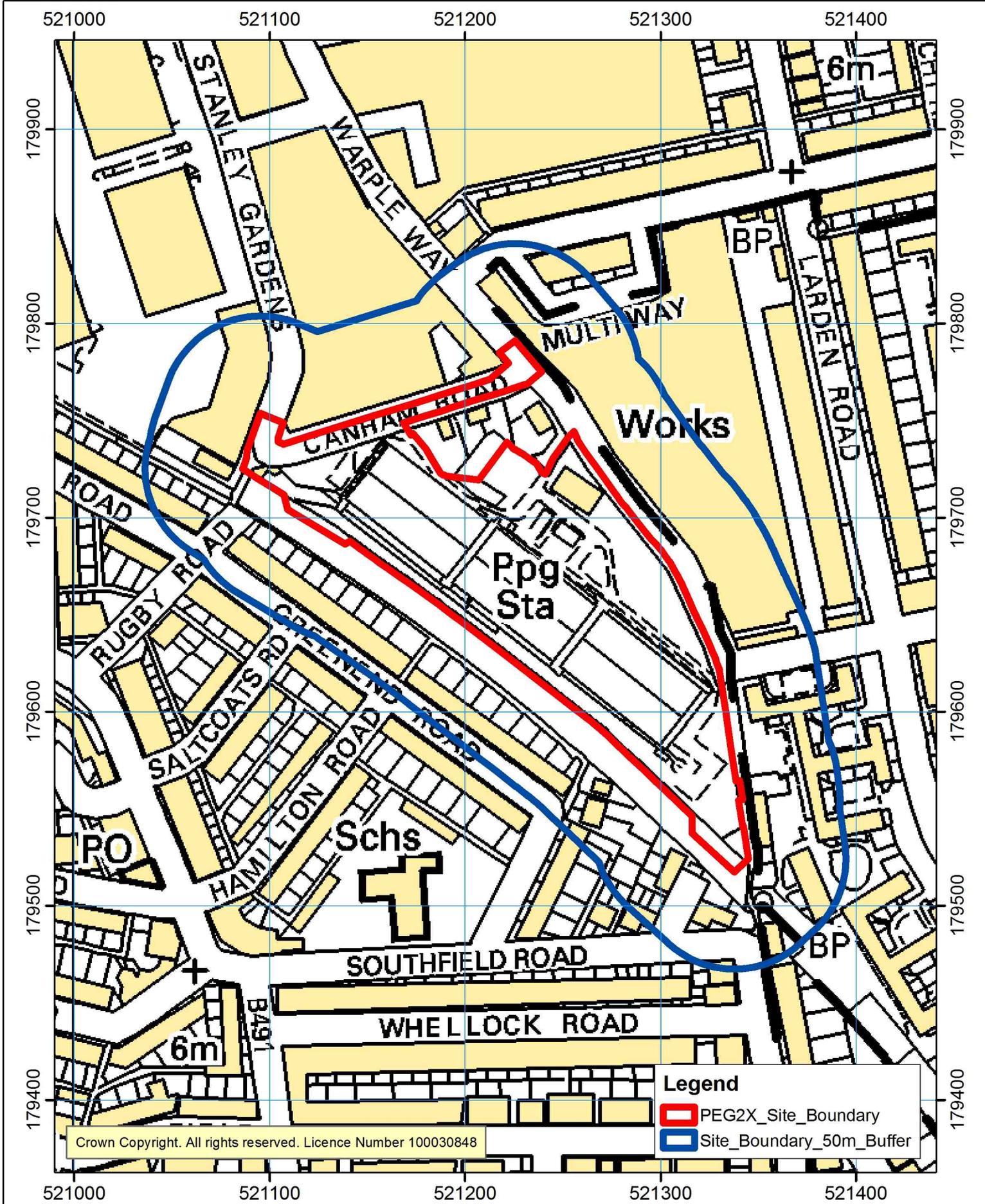
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## Site Boundary

# Thames Tideway Tunnel - Work Area PEG2X Site Boundary

## Figure 2

British National Grid



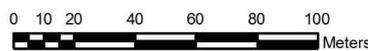
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### Legend

- ▬ PEG2X\_Site\_Boundary
- ▬ Site\_Boundary\_50m\_Buffer



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# Figure Three

---

## Current Aerial Photography

# Thames Tideway Tunnel - Work Area PEG2X Current Aerial Photography

## Figure 3

British National Grid



**Legend**

- PEG2X\_Site\_Boundary
- Site\_Boundary\_50m\_Buffer



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# Figure Four

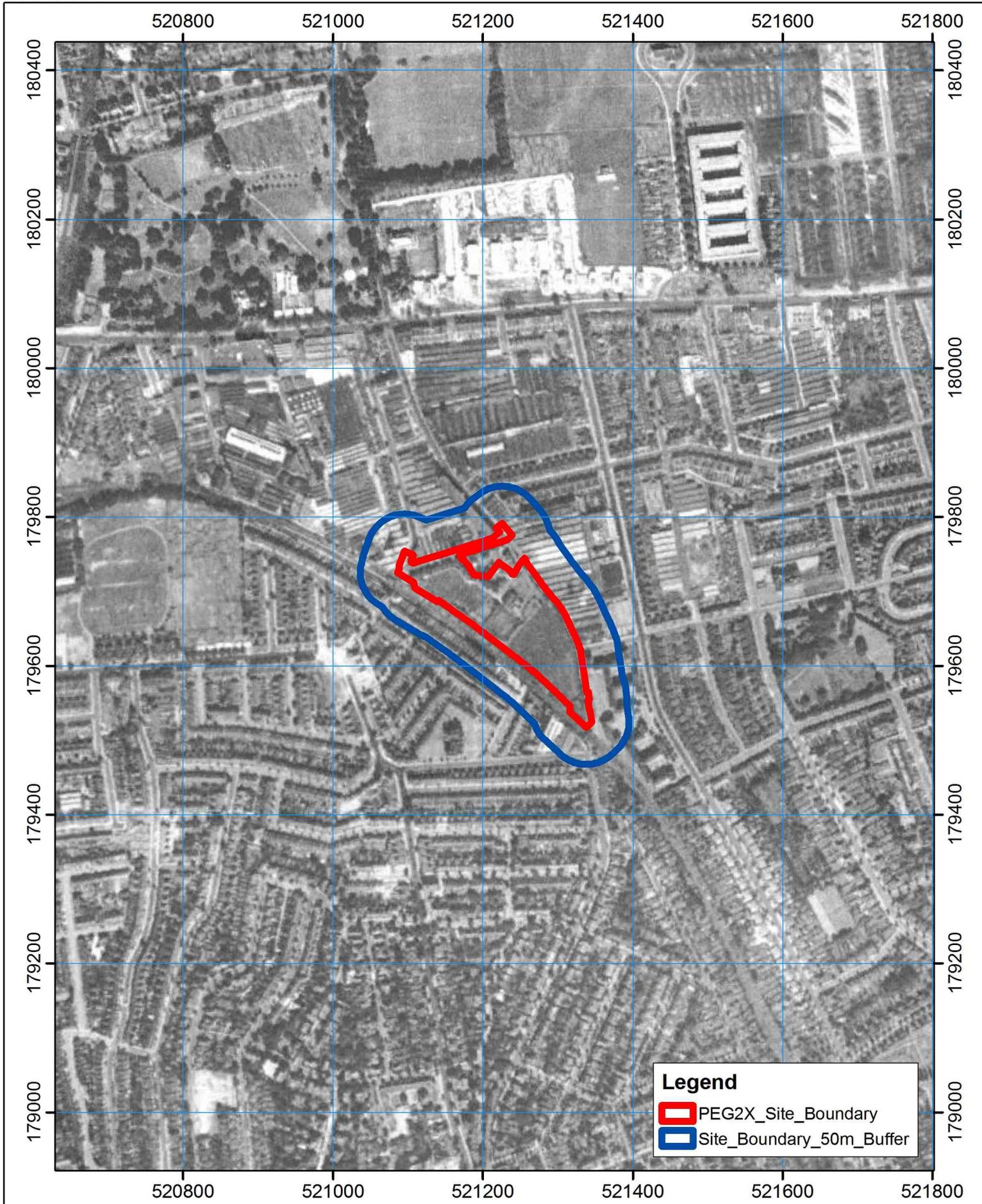
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## 1945 Aerial Photography

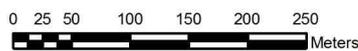
# Thames Tideway Tunnel - Work Area PEG2X 1945 Aerial Photography

## Figure 4

British National Grid



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# Figure Five

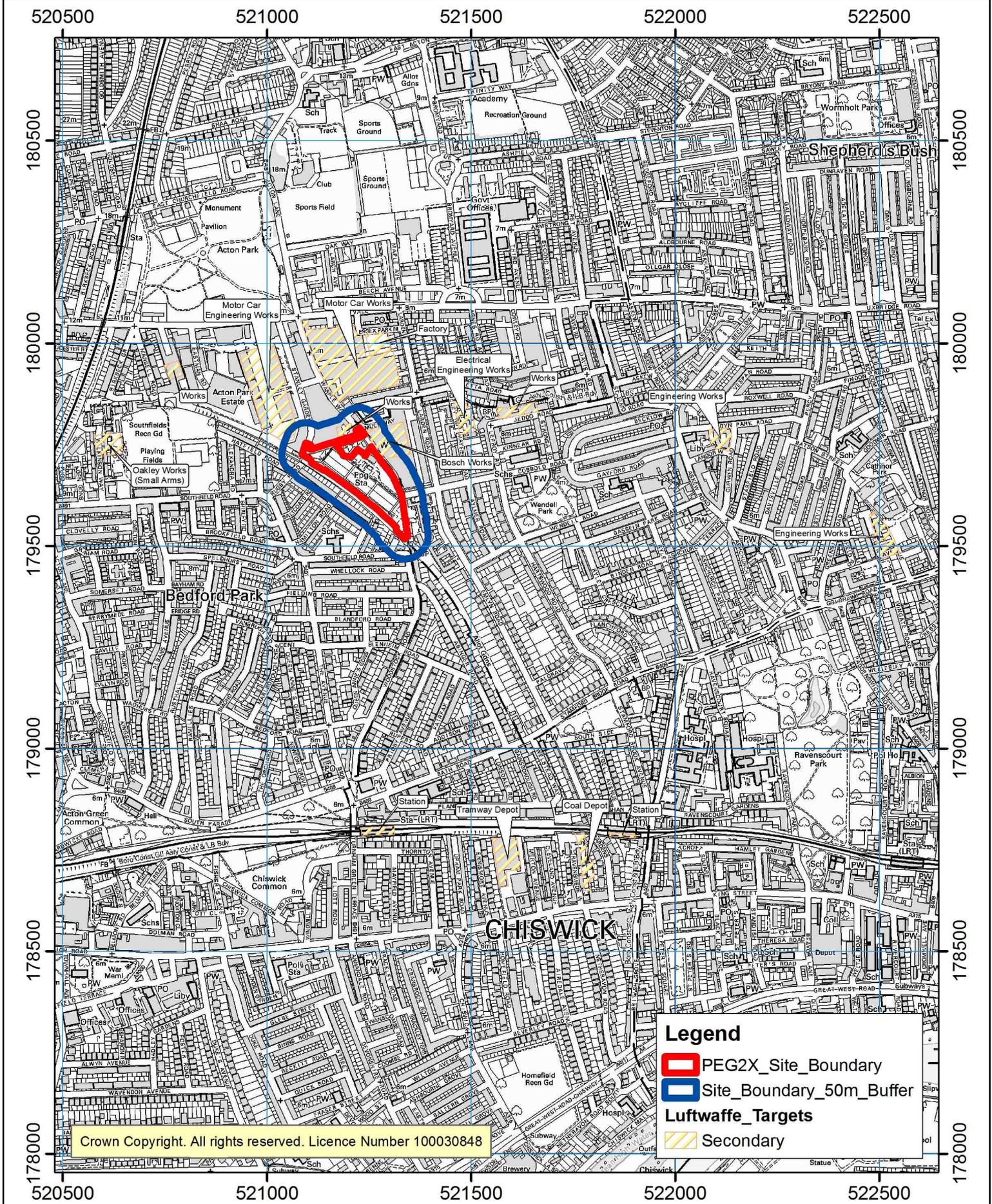
---

## WWII Luftwaffe Bombing Targets

# Thames Tideway Tunnel - Work Area PEG2X WWII Luftwaffe Bombing Targets

## Figure 5

British National Grid



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## Figure Six

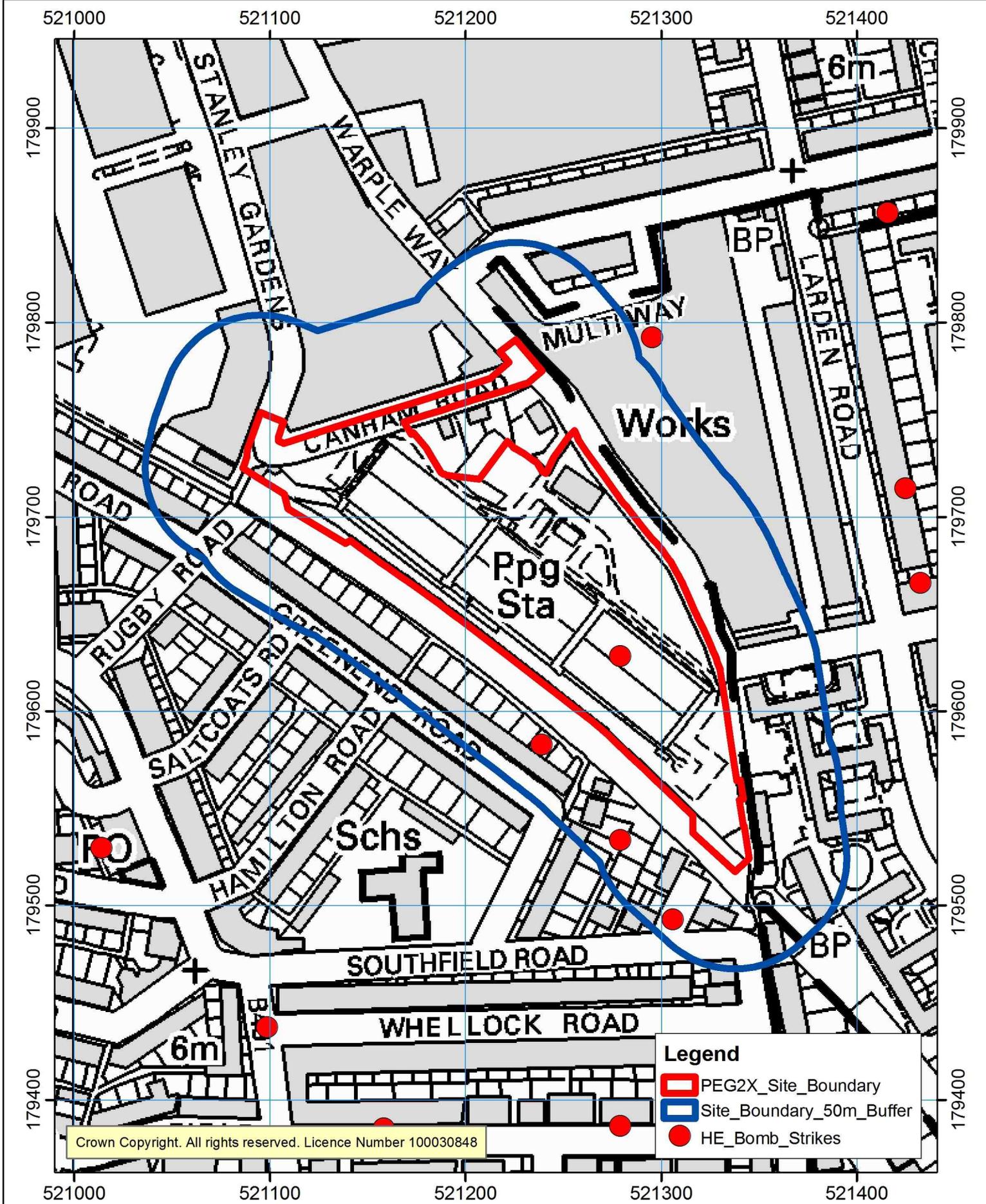
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### WWII High Explosive Bomb Strikes

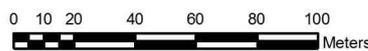
# Thames Tideway Tunnel - Work Area PEG2X WWII High Explosive Bomb Strikes

## Figure 6

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# Figure Seven

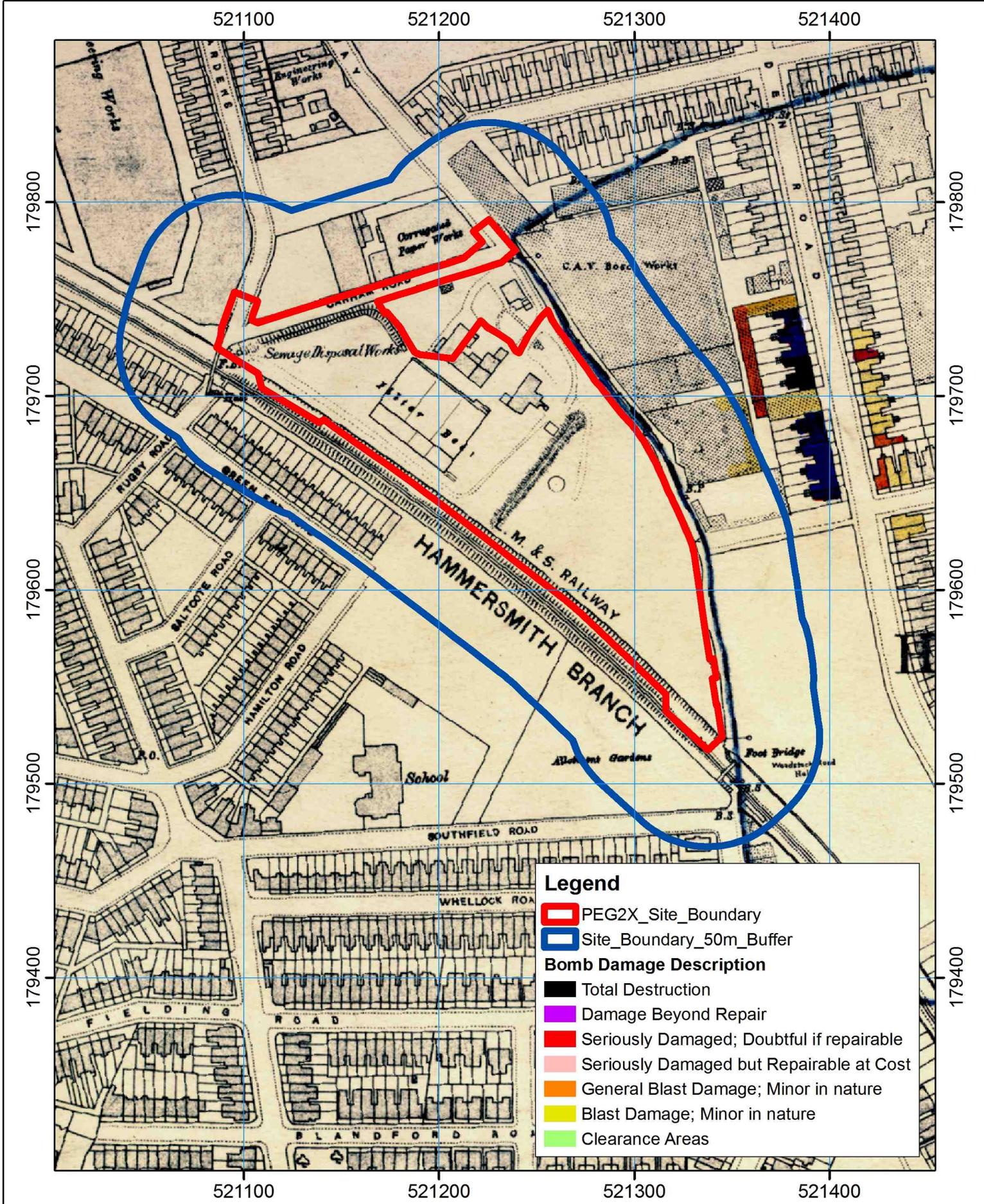
---

## London County Council Bomb Damage Mapping

# Thames Tideway Tunnel - Work Area PEG2X London County Council Bomb Damage Map

Figure 7

British National Grid



**Legend**

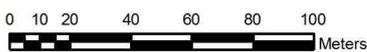
- PEG2X\_Site\_Boundary
- Site\_Boundary\_50m\_Buffer

**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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# Figure Eight

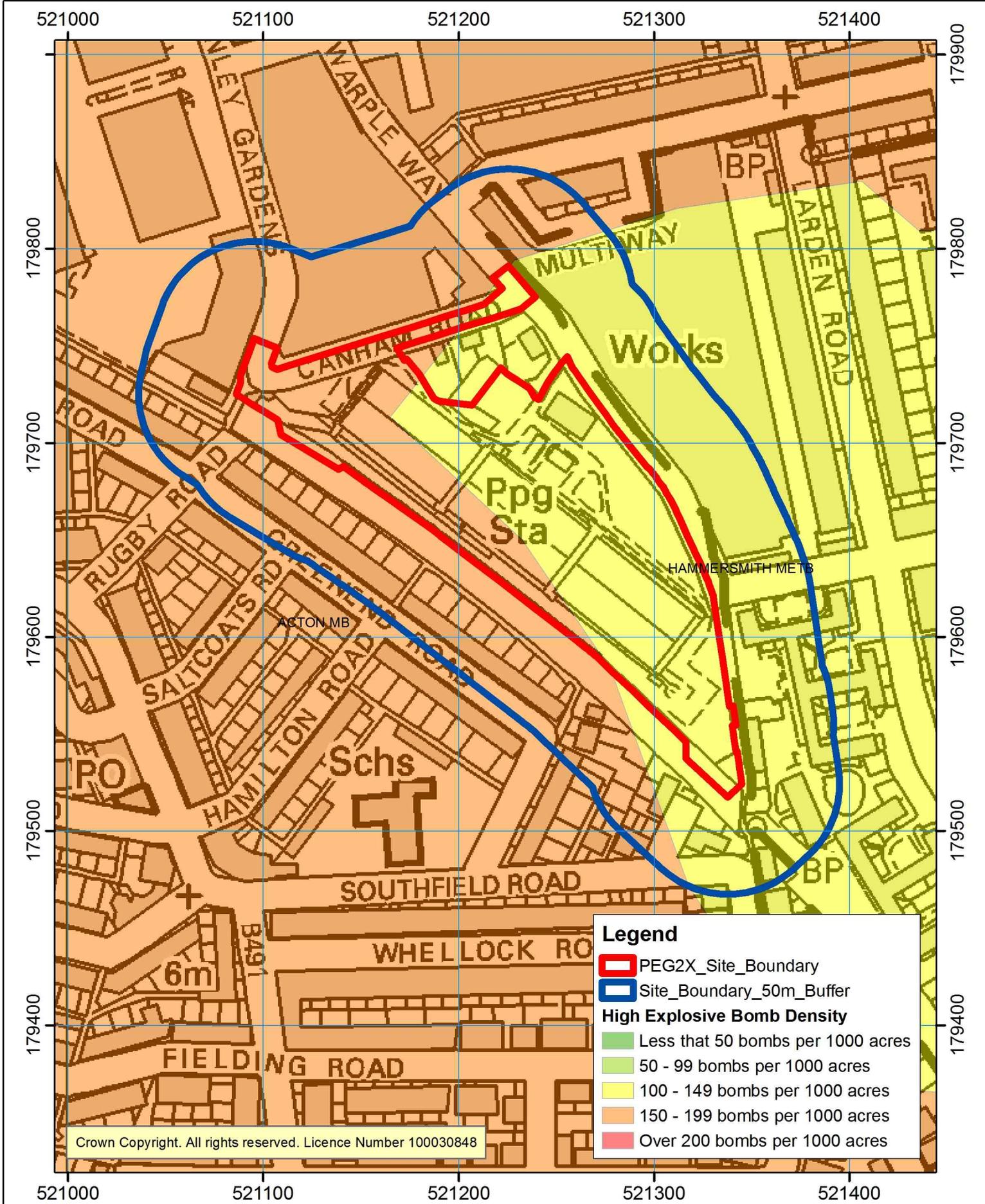
---

## WWII High Explosive Bomb Density

# Thames Tideway Tunnel - Work Area PEG2X WWII High Explosive Bomb Density

## Figure 8

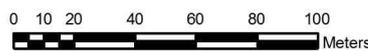
British National Grid



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## References

<sup>1</sup> Department for the Environment, Food and Rural Affairs and The Environment Agency, *CLR8: Potential Contaminants for the assessment of land*, Environment Agency (2002).

<sup>2</sup> Department of the Environment, Industry Profiles (various), available from <http://www.environment-agency.gov.uk/research/planning/33708.aspx>, accessed 25<sup>th</sup> March 2011.

<sup>3</sup> Defra/EA. *Soil Guideline values for industrial and light commercial land use* (2009).

<sup>4</sup> Land Quality Management/Chartered institute of Environmental Health. *Generic Assessment Criteria for Human Health Risk Assessment*, 2<sup>nd</sup> Edition (2009).

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**Thames Tideway Tunnel**  
Thames Water Utilities Limited



# Application for Development Consent

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

### **Volume 4: Acton Storm Tanks appendices**

#### **Appendix G: Noise and vibration**

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

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# Thames Tideway Tunnel

## Environmental Statement

### Volume 4 Acton Storm Tanks appendices

#### Appendix G: Noise and vibration

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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 Acton Storm Tanks are two residential dwellings and Stanley Studios (a non-residential building used as a recording studio) on Canham Road located immediately north of the proposed development, to the south and southwest of the site are terraced residential properties on Worcester Drive (5-8) and Greenend Road (2-26 and 46-54), to the east of the site is the apartment block Tesla Court (1-40) on Warple Way (part of the Factory Quarter development) and further southeast are the apartment blocks (1-66 Edison Court and 250-269 Longford Court) on Warple Way.

#### Survey methodology

- G.1.3 The London Borough of Ealing has been consulted regarding the noise assessment and monitoring locations, prior to completing the surveys.
- G.1.4 An initial baseline noise survey was completed on 1<sup>st</sup> through 5<sup>th</sup> April, 2011 and additional data was collected on 23<sup>rd</sup>-24<sup>th</sup> January, 2012. The initial baseline survey comprised short term attended measurements taken during the daytime, evening and night-time, as well continuous unattended monitoring. The additional survey comprised further continuous unattended monitoring, following further consultation with the London Borough of Ealing.
- G.1.5 During the initial baseline survey short term attended noise monitoring was completed at five locations. Measurements were undertaken during the interpeak periods of 10:00-12:00, 14:00-16:00 and 20:00-22:00 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. Continuous unattended monitoring was completed at two locations.
- G.1.6 Vol 4 Table G.1 describes the survey equipment that was used to collect the baseline data at the site.

Vol 4 Table G.1 Noise – survey equipment

Item	Type	Manufacturer	Serial Number(s)	Laboratory Calibration Date
Initial baseline survey: 1 <sup>st</sup> through 5 <sup>th</sup> April, 2011				
Hand-held analyser(s)	2250	Brüel & Kjær	2626231 2626232 2626233	20/01/2010* 15/02/2010* 15/02/2010*
			2446918	01/07/2010**
½ “ microphone(s)	4189	Brüel & Kjær	2621208 2621211 2621212	19/01/2010* 15/02/2010* 15/02/2010*
			2440900	01/07/2010**
B&K sound calibrator(s)	4231	Brüel & Kjær	2619373 2619374 2619375	10/02/2011* 21/02/2011* 12/01/2011*
Additional baseline survey: 23 <sup>rd</sup> -24 <sup>th</sup> 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	2052513	09/11/2011**

\*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 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.1.9 For the unattended measurements, the environmental cases used for the continuous data logging were locked to avoid any potential tampering. The microphones were tripod-mounted approximately 1.3m above ground level. Windshields with bird spikes were fitted over the microphones 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.1.10 The prevailing weather conditions observed for the baseline surveys are described in Vol 4 Table G.2.

**Vol 4 Table G.2 Noise – weather conditions during baseline noise surveys**

Wind Speed (ms <sup>-1</sup> )	Wind Direction	Temperature (°C)	Precipitation	Description
Initial baseline survey – 3 <sup>rd</sup> April, 2011 (daytime, 14:00-18:00)				
Maximum: 0.7-2.4 Average: 0.3-0.7	SW	15-17	No	Overcast, dry, light breeze
Initial baseline survey – 4 <sup>th</sup> April, 2011 (night-time, 00:00-04:00)				
Maximum: 3.6-4.6 Average: 0.8-1.5	Westerly	6-10	No	Partly cloudy, dry, breezy
Initial baseline survey – 4 <sup>th</sup> April, 2011 (daytime, 10:00-12:00)				
Maximum: 1.7-4.8 Average: 0.5-1.2	W, WSW	11-12	No	Cloudy with sunny intervals, dry and breezy
Initial baseline survey – 4 <sup>th</sup> April, 2011 (daytime, 14:00-16:00)				
Maximum: 3.2-5.2 Average: 1.3-1.7	SW	13-14	No	Cloudy with sunny intervals, dry and breezy
Initial baseline survey – 4 <sup>th</sup> April, 2011 (evening, 20:00-22:00)				
Maximum: 1.3-2.7 Average: 0.3-0.7	SW	10-11	No	Overcast, dry, light breeze
Initial baseline survey – 5 <sup>th</sup> April, 2011 (night-time, 00:00-04:00)				

Wind Speed (ms <sup>-1</sup> )	Wind Direction	Temperature (°C)	Precipitation	Description
Maximum: 1.0-3.4 Average: 0.3-0.7	SW	9-10	Yes - persistent drizzle from 03:00	Generally cloudy and dry with light breeze
Additional baseline survey – 23 <sup>rd</sup> January, 2012 (night-time, 00:00-04:00)				
Maximum: 0.5-2.6 Average: 0-0.7	Westerly	6-7	No	Partly cloudy dry, light breeze
Additional baseline survey – 24 <sup>th</sup> January, 2012 (night-time, 00:00-04:00)				
Maximum: 0-1.5 Average: 0-0.7	Westerly	1-3	No	Clear, dry and calm

### Measurement locations

G.1.11 Vol 4 Table G.3 details the measurement locations which are also presented in Vol 4 Figure G.1 (see separate volume of figures), and shown in Vol 4 Plate G.1 to Vol 4 Plate G.7.

**Vol 4 Table G.3 Noise – measurement locations**

Measurement location number	Description	Co-ordinates	
		X	Y
AST01	On public footpath adjacent to Stanley Gardens, in front of industrial building	521111	179764
AST02	Within private car park off Warple Way, behind rear gardens of residential dwellings on Greenend Road	521179	179647
AST03	On public footpath adjacent to Warple Way, in front of Longford Court	521339	179601
AST04	Within private car park off Warple Way, behind rear gardens of residential dwellings on Worcester Drive	521312	179530
AST05	On public footpath adjacent to Warple Way, in front of north-east boundary of Acton Storm Tanks	521305	179679
AST06	Within Acton Storm Tanks site, in front of the northern most storm tanks	521170	179736
AST07	Within private car park off Warple Way, at eastern boundary edge near to Rugby Road	521094	179697

## Results

- G.1.12 The range of values for each of the parameters collected during the baseline surveys are summarised in Vol 4 Table G.4 to Vol 4 Table G.10.
- G.1.13 A review has been undertaken of the unattended measurement results, which confirms that the attended measurements were undertaken over periods with typical ambient and background noise levels.

**Vol 4 Table G.4 Noise – sampled noise survey results - AST01**

<b>Location Detail: AST01, on public footpath adjacent to Stanley Gardens, in front of industrial building</b>						
<b>Measurement period</b>	<b>Noise level (dB(A) free-field)</b>			<b>Averaged ambient noise level, dBL<sub>Aeq,15min</sub></b>		<b>dBL<sub>Aeq,15min</sub> (rounded to nearest 5dB)</b>
	<b>L<sub>AFmax</sub></b>	<b>L<sub>A90,15min</sub></b>	<b>L<sub>Aeq,15min</sub></b>	<b>Free field</b>	<b>Façade</b>	<b>Façade</b>
Daytime (10.00-12.00, 14.00-16.00)	84	48	56-59	57	60*	60
Evening (20.00-22.00)	79	47	54-57	56	59*	60
Night (00.00-04.00)	47	40	43-47	46	49*	50
Weekend day (14.00-18.00)	76	49	51-58	56	59*	60
Weekend night (00.00-04.00)	62	48	48-49	49	52*	50

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

**Vol 4 Table G.5 Noise – sampled noise survey results- AST02**

<b>Location Detail: AST02, within private car park off Warple Way, behind rear gardens of residential dwellings on Greenend Road</b>						
<b>Measurement period</b>	<b>Noise level (dB(A) free-field)</b>			<b>Averaged ambient noise level, dBL<sub>Aeq,15min</sub></b>		<b>dBL<sub>Aeq,15min</sub> (rounded to nearest 5dB)</b>
	<b>L<sub>AFmax</sub></b>	<b>L<sub>A90,15min</sub></b>	<b>L<sub>Aeq,15min</sub></b>	<b>Free field</b>	<b>Façade</b>	<b>Façade</b>
Daytime (10.00-12.00, 14.00-16.00)	78	42	48-55	52	55*	55
Evening (20.00-22.00)	61	42	45	45	48*	50
Night (00.00-04.00)	54	36	35-39	37	40*	40
Weekend day (14.00-18.00)	72	40	43	43	46*	45
Weekend night (00.00-04.00)	51	37	38	38	41*	40

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

**Vol 4 Table G.6 Noise – sampled noise survey results - AST03**

<b>Location Detail: AST03, on public footpath adjacent to Warple Way, in front of Longford Court</b>						
<b>Measurement period</b>	<b>Noise level (dB(A) free-field)</b>			<b>Averaged ambient noise level, dBL<sub>Aeq,15min</sub></b>		<b>dBL<sub>Aeq,15min</sub> (rounded to nearest 5dB)</b>
	<b>L<sub>AFmax</sub></b>	<b>L<sub>A90,15min</sub></b>	<b>L<sub>Aeq,15min</sub></b>	<b>Free field</b>	<b>Façade</b>	<b>Façade</b>
Daytime (10.00-12.00, 14.00-16.00)	90	47	54-65	58*	61	60
Evening (20.00-22.00)	75	46	49-53	48*	51	50
Night (00.00-04.00)	72	38	38-47	42*	45	45
Weekend day (14.00-18.00)	84	44	50-56	50*	53	55
Weekend night (00.00-04.00)	53	38	39-40	36*	39	40

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

**Vol 4 Table G.7 Noise – sampled noise survey results- AST04**

<b>Location Detail: AST04, within private car park off Warple Way, behind rear gardens of residential dwellings on Worcester Drive</b>						
<b>Measurement period</b>	<b>Noise level (dB(A) free-field)</b>			<b>Averaged ambient noise level, dBL<sub>Aeq,15min</sub></b>		<b>dBL<sub>Aeq,15min</sub> (rounded to nearest 5dB)</b>
	<b>L<sub>AFmax</sub></b>	<b>L<sub>A90,15min</sub></b>	<b>L<sub>Aeq,15min</sub></b>	<b>Free field</b>	<b>Façade</b>	<b>Façade</b>
Daytime (10.00-12.00, 14.00-16.00)	83	43	50-57	54	57*	55
Evening (20.00-22.00)	63	42	44-48	47	50*	50
Night (00.00-04.00)	67	35	35-38	37	40*	40
Weekend day (14.00-18.00)	72	40	43-49	46	49*	50
Weekend night (00.00-04.00)	72	36	37-45	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 4 Table G.8 Noise – sampled noise survey results- AST05**

<b>Location Detail: AST05, on public footpath adjacent to Warple Way, in front of north-east boundary of Acton Storm Tanks</b>						
<b>Measurement period</b>	<b>Noise level (dB(A) free-field)</b>			<b>Averaged ambient noise level, dBL<sub>Aeq,15min</sub></b>		<b>dBL<sub>Aeq,15min</sub> (rounded to nearest 5dB)</b>
	<b>L<sub>AFmax</sub></b>	<b>L<sub>A90,15min</sub></b>	<b>L<sub>Aeq,15min</sub></b>	<b>Free field</b>	<b>Façade</b>	<b>Façade</b>
Daytime (10.00-12.00, 14.00-16.00)	80	46	52-57	54	57*	55
Evening (20.00-22.00)	74	45	51	51	54*	55
Night (00.00-04.00)	63	37	41-42	41	44*	45
Weekend day (14.00-18.00)	79	43	48-55	51	54*	55
Weekend night (00.00-04.00)	74	39	42-50	48	51*	50

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

**Vol 4 Table G.9 Noise – continuously logged noise survey results - AST06**

<b>Location Detail: AST06, within Acton Storm Tanks site, in front of the northern most storms tanks</b>				
<b>Day</b>	<b>Period</b>	<b>Period noise level (dB(A) free-field)</b>		
		<b>L<sub>AFmax</sub></b>	<b>L<sub>A90</sub></b>	<b>L<sub>Aeq</sub></b>
Weekday	07.00-08.00	79	46	53
	08.00-18.00	80	47	52
	18.00-19.00	69	47	51
	19.00-22.00	81	46	51
	22.00-07.00	77	41	49
Saturday	07.00-08.00	68	47	51
	08.00-13.00	76	47	51
	13.00-14.00	79	45	54
	14.00-22.00	75	43	49
	22.00-07.00	71	39	47
Sunday	07.00-21.00	87	44	50
	21.00-07.00	78	38	48

**Vol 4 Table G.10 Noise – continuously logged noise survey results - AST07**

<b>Location Detail: AST07, within private car park off Warple Way, at eastern boundary edge near to Rugby Road</b>				
<b>Day</b>	<b>Period</b>	<b>Period noise level (dB(A) free-field)</b>		
		<b>L<sub>AFmax</sub></b>	<b>L<sub>A90</sub></b>	<b>L<sub>Aeq</sub></b>
Weekday	22.00-07.00*	75	37	48
Sunday	09.00-07.00*	72	38	43

\* 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.

## Plates of noise measurement locations

G.1.14 The following plates (Vol 4 Plate G.1 to Vol 4 Plate G.7) illustrate the noise measurement locations.

### Vol 4 Plate G.1 Noise measurement location AST01



*Note: On public footpath adjacent to Stanley Gardens, looking north*

### Vol 4 Plate G.2 Noise measurement location AST02



*Note: Within private car park off Warple Way, looking southwest towards residential dwellings on Greenend Road*

**Vol 4 Plate G.3 Noise measurement location AST03**



*Note: On public footpath adjacent to Warple Way, looking north (façade measurement)*

**Vol 4 Plate G.4 Noise measurement location AST04**



*Note: Within private car park off Warple Way, looking southwest towards residential dwellings on Worcester Drive*

**Vol 4 Plate G.5 Noise measurement location AST05**



*Note: On public footpath adjacent to Warple Way, looking northeast towards residential flats*

**Vol 4 Plate G.6 Noise measurement location AST06**



*Note: Within Acton Storm Tanks, looking northwest towards Canham Road*

**Vol 4 Plate G.7 Noise measurement location AST07**



*Note: Within private car park off Warple Way, looking northwest towards Rugby Road*

## **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 4 Table G.11.
- G.2.4 Time histories of the predicted daytime construction noise levels across the programme of construction works are shown in Vol 4 Plate G.8 to Vol 4 Plate G.18.

**Vol 4 Table G.11 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	Excavator digging post holes for hoarding	1	105	30	BS5228-1: Table C.2, Item 2	Tracked excavator, 71 t
	Generator 35kVA	1	94	100	BS5228-1: Table C.4, Item 78	Diesel generator,
General site equipment NOT applicable during this phase	Circular saw cutting timber	1	113	5	BS5228-1: Table C.4, Item 71	Circular bench saw,
	Cutting equipment (diamond saw)	1	108	10	BS5228-1: Table C.4, Item 93	Angle grinder (grinding steel), 4.7 kg
	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
	Compressor 250cfm	1	93	15	BS5228-1: Table D.5, Item 5	Compressor for hand-held pneumatic breaker,
	Hand-held percussive breaker	1	111	30	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker,
Site set up and general site	Waste collection via skip or tipper lorry	1	106	10	BS5228-1: Table C.8, Item 21	Skip wagon,
	Oxyacetelne cutting equipment	1	93	10	BS5228-1: Table C.3, Item 35	Hand-held gas cutter, 230 bar
	Oxyacetelne cutting equipment	1	93	10	BS5228-1: Table C.3, Item 35	Hand-held gas cutter, 230 bar
	JCB with hydraulic breaker	1	116	50	BS5228-1: Table C.5,	Backhoe Mounted

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
					Item 1	Hydraulic Breaker,
	Cutting equipment (diamond saw)	1	108	10	BS5228-1: Table C.4, Item 93	Angle grinder (grinding steel), 4.7 kg
	Compressor 250cfm	1	93	50	BS5228-1: Table D.5, Item 5	Compressor for hand-held pneumatic breaker,
	Generator200 kVA	1	94	100	BS5228-1: Table C.4, Item 78	Diesel generator,
	Fuel delivery vehicle	1	104	5	BS5228-1: Table C.4, Item 15	Fuel tanker lorry, 11t
	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
	Dewatering Pump	1	104	100	Measured	Dirty water pump,
	Wheel wash	1	110	20	Measured	Jet wash,
	Well drilling rig	1	107	50	Manufacturer	Bauer BBA Well Drilling Rig,
	Water settling/treatment					
Demolition	Service Crane 25T mobile Crane	1	98	30	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
General site equipment	22T Excavator c/w hydraulic hammer	1	119	30	BS5228-1: Table D.2, Item 4	Tracked excavator fitted with breaker, 200 kg·m

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
also applicable during this phase	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,
	Vibrating rollers	2	101	50	BS5228-1: Table C.2, Item 38	Roller, 18 t
	Concrete crusher	1	110	80	BS5228-1: Table C.1, Item 15	Tracked crusher,
	Concrete deliveries (aggitating)		99		BS5228-1: Table C.4, Item 19	Cement mixer truck (idling),
	Concrete deliveries (discharging)		103		BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
Shaft sinking	100t crawler crane	1	103	80	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	25t mobile crane	1	98	50	BS5228-1: Table C.3, Item 29	Tracked mobile crane, 55 t
	400 cfm compressor	1	93	50	BS5228-1: Table D.5, Item 5	Compressor for hand-held pneumatic breaker,
	Vent fans	1	100	100	Estimated	Ventilation fans,
	12t excavator	1	106	80	BS5228-1: Table C.7, Item 1	Long reach tracked excavator, 21 m arm / 39 t
	Pneumatic breakers	4	111	15	BS5228-1: Table C.1,	Hand-held pneumatic

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Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
Main tunnel drive (TBM disassembly)					Item 6	breaker,
	25t excavator	1	105	50	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t
	Vibrating rollers	1	101	20	BS5228-1: Table C.2, Item 38	Roller, 18 t
	Waste water treatment plant	1	104	100	Measured	Dirty water plant
	Waste collection via skip or tipper lorry	1	104	50	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	250t mobile (disassembly)	1	106	80	BS5228-1: Table C.4, Item 38	Wheeled mobile telescopic crane, 400 t
	500t mobile (disassembly)	1	106	80	BS5228-1: Table C.4, Item 38	Wheeled mobile telescopic crane, 400 t
	Mains substation	1	94	100	BS5228-1: Table C.4, Item 78	Diesel generator,
	Concrete pump	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
	Air compressor 600cfm	2	93	100	BS5228-1: Table D.5, Item 5	Compressor for hand-held pneumatic breaker,
Main tunnel secondary lining	Concrete batching plant 40m <sup>3</sup> /hr	1	95	80	Measured	Batching,
	100t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
General site equipment also applicable during this phase						

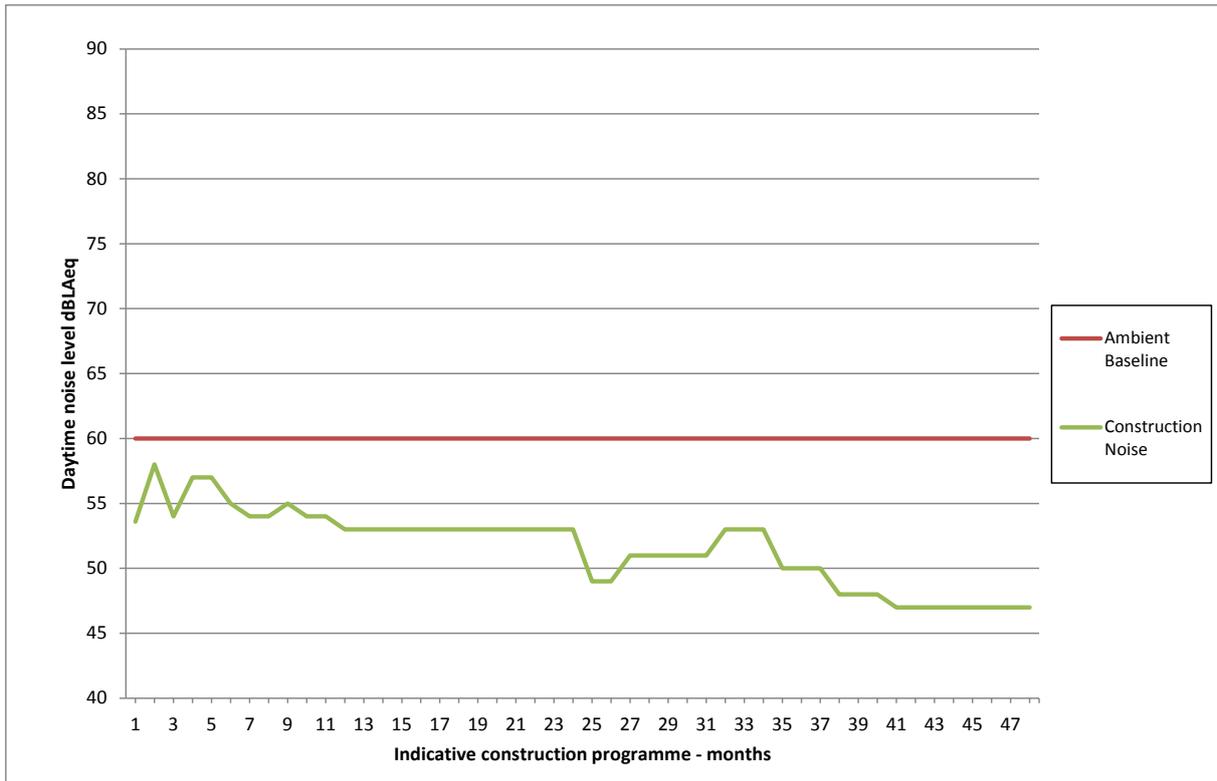
Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
	25T loading shovel	1	114	25	BS5228-1: Table C.9, Item 8	Wheeled loader, 50 t
	Sump pumps 150mm	2	96	100	BS5228-1: Table C.4, Item 88	Water pump (diesel), 100 kg
Shaft secondary lining	100t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	Service Crane 40T mobile Crane	1	98	25	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	Concrete deliveries (discharging)	1	95	20	BS5228-1: Table C.4, Item 24	Concrete pump + cement mixer truck (discharging), 8 t / 350 bar
Culvert and chamber works General site equipment also applicable during this phase	Concrete pump	2	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
	Service crane 100T mobile crane	1	103	50	BS5228-1: Table C.4, Item 41	Mobile telescopic crane, 100 t
	25t excavator	1	105	50	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t
	Dumper	1	104	50	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	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,	Truck mounted concrete

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
Landscaping General site equipment NOT applicable during this phase					Item 29	pump + boom arm, 26 t
	Fixed and portable concrete vibrators	4	102	20	BS5228-1: Table D.6, Item 20	Poker vibrator,
	25t excavator	1	105	50	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 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	93	10	BS5228-1: Table C.5, Item 5	Compressor for hand-held pneumatic breaker, 1 t
	Hand-held percussive breaker	1	111	10	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker,
	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

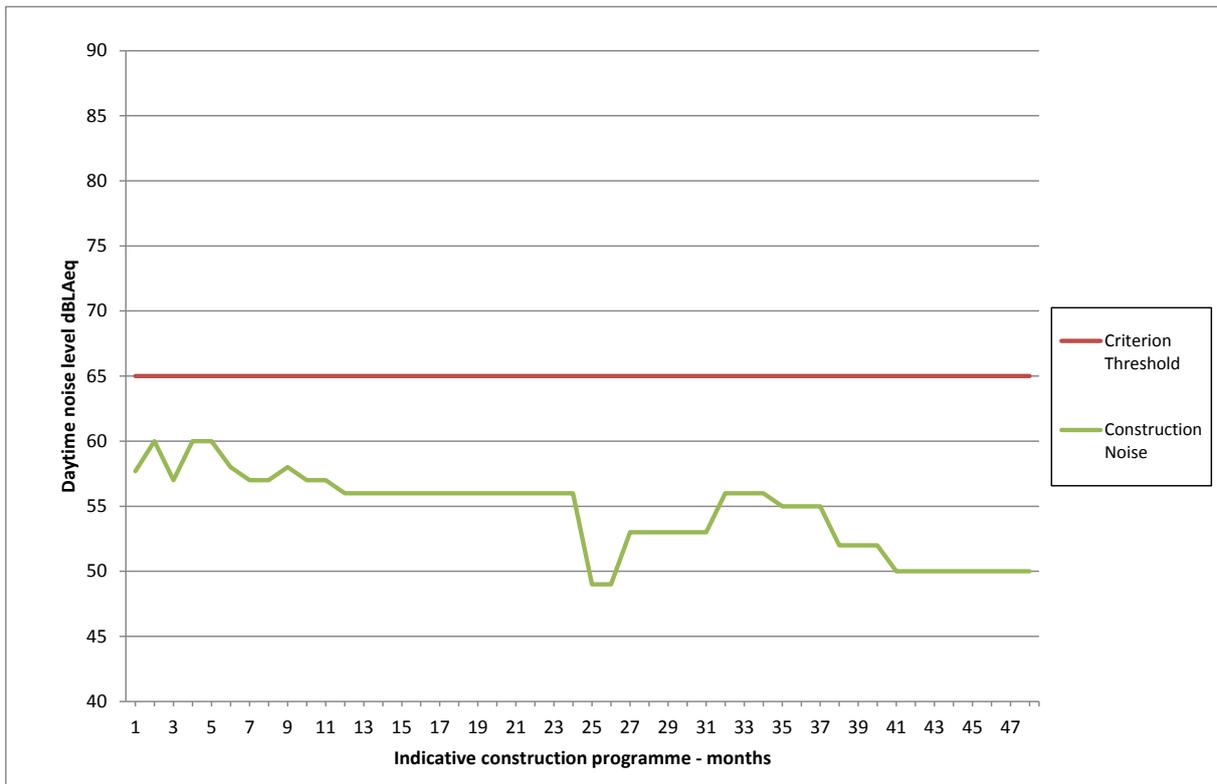
*Note: This schedule provides an illustration of typical plant that could be used in the construction of the Thames Tideway Tunnel at this site. The appointed Contractor must comply with section 6 of the CoCP but may vary the method and plant to be used. This schedule therefore represents the most reasonable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

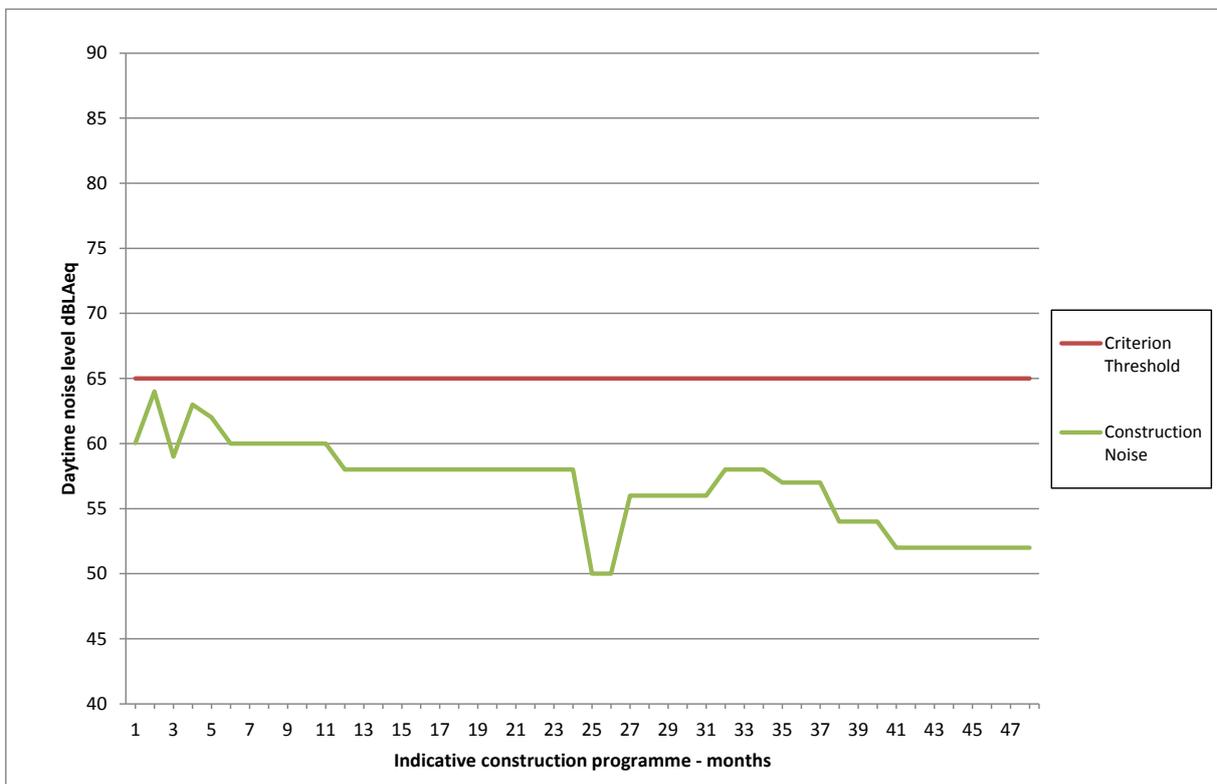
**Vol 4 Plate G.8 Average monthly daytime noise level over duration of construction – Stanley Studios (studio) (AS1)**



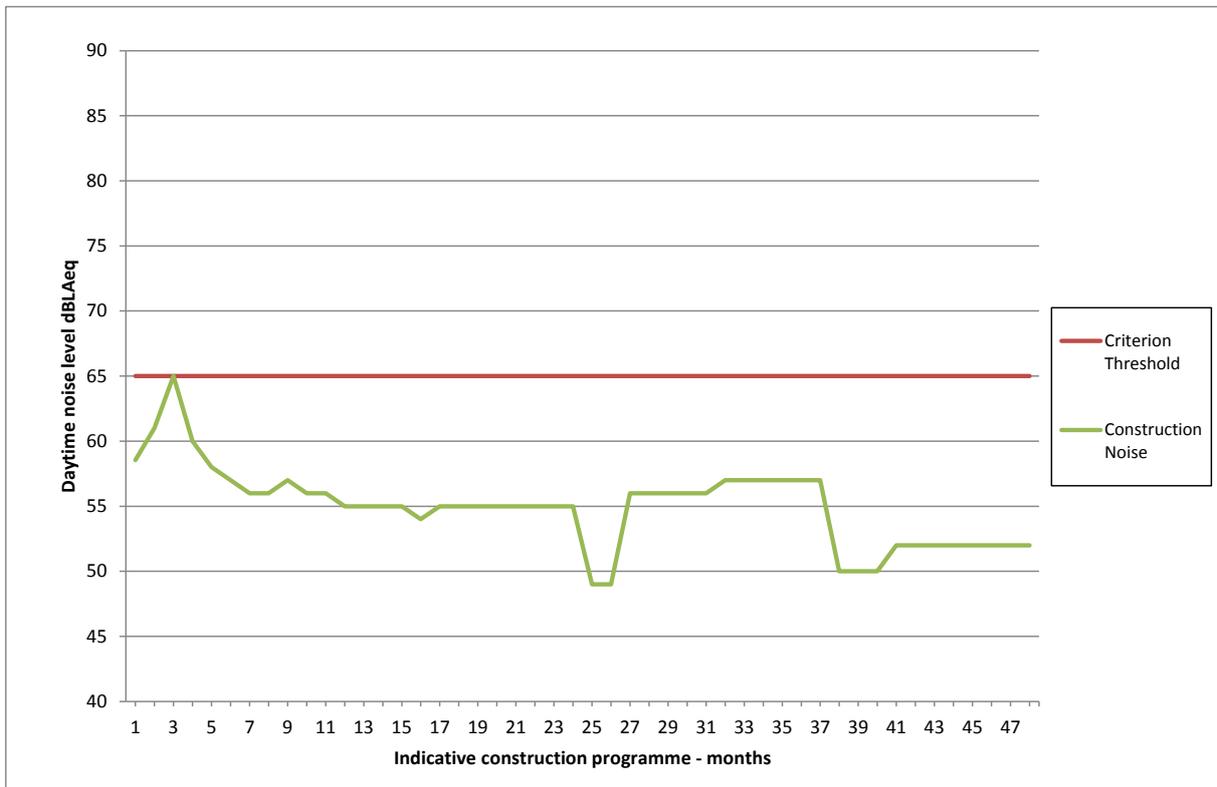
**Vol 4 Plate G.9 Average monthly daytime noise level over duration of construction – 2-12 Greenend Road (residential) (AS2)**



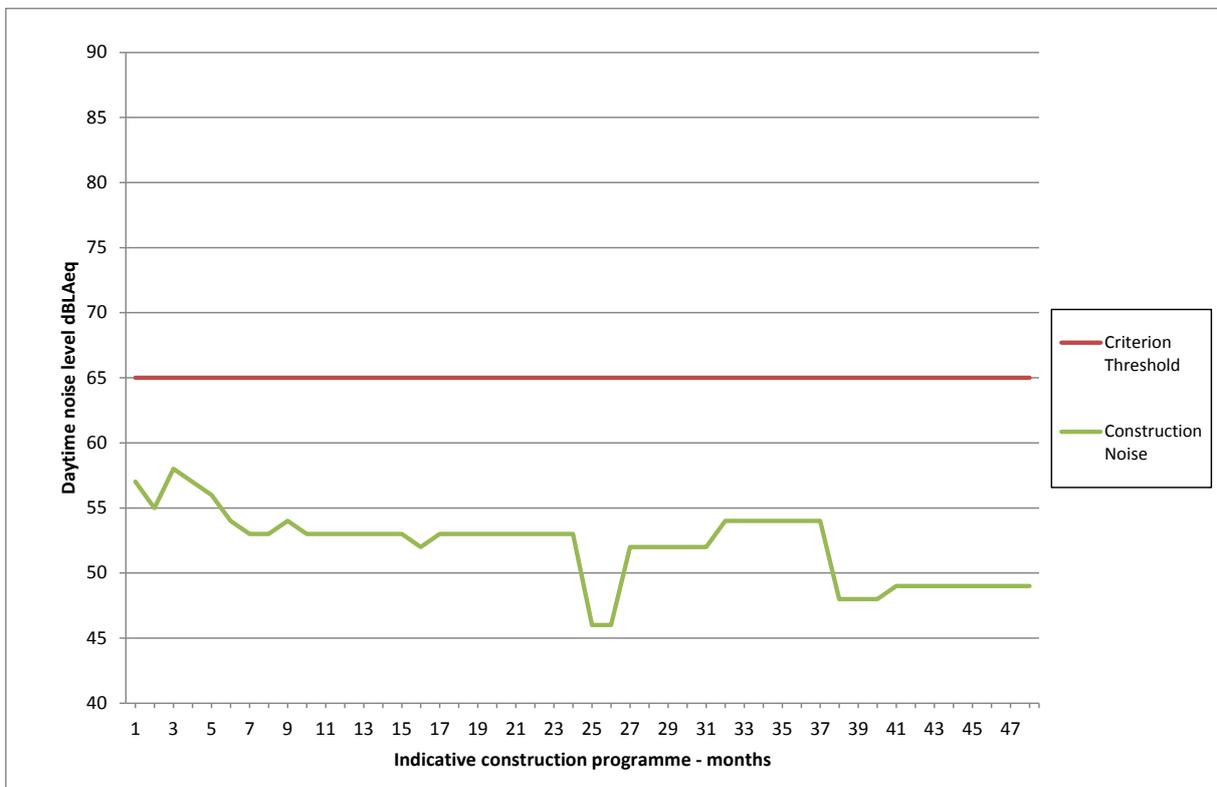
**Vol 4 Plate G.10 Average monthly daytime noise level over duration of construction - 14-26 Greenend Road (residential) (AS3)**



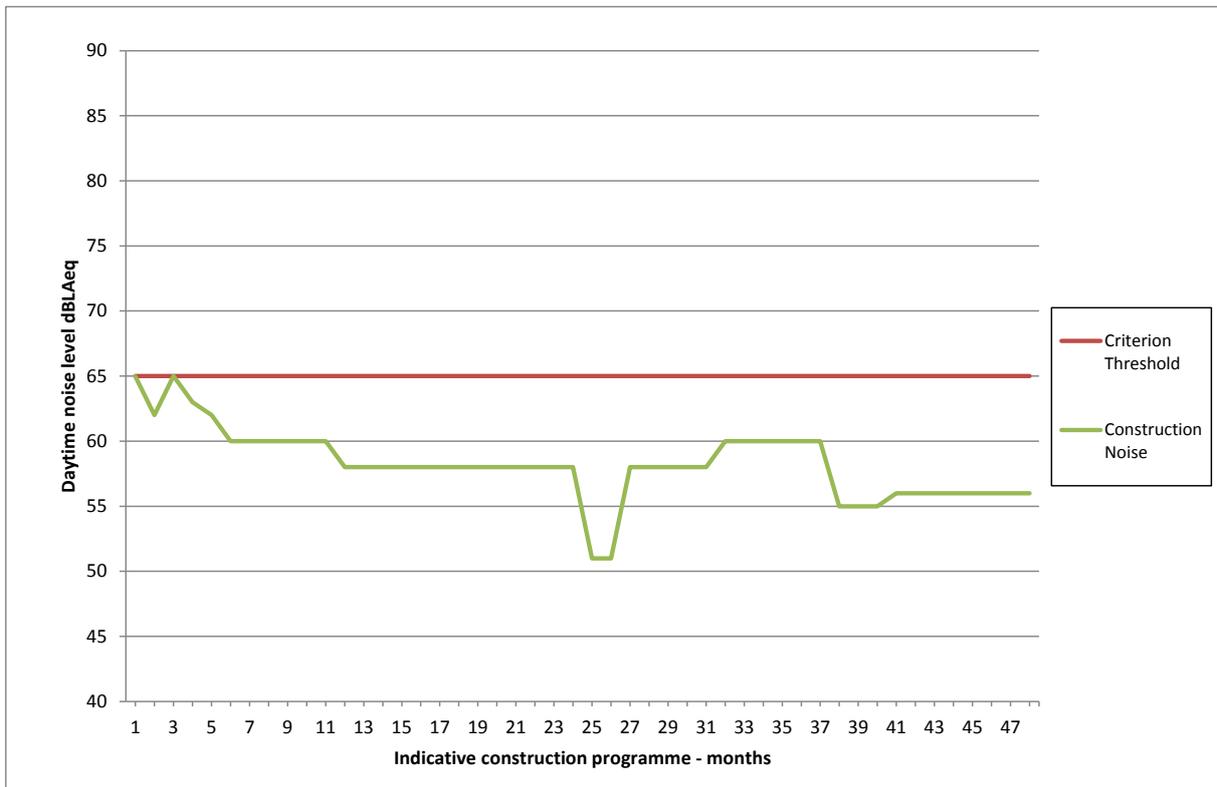
**Vol 4 Plate G.11 Average monthly daytime noise level over duration of construction – 46-54 Greenend Road (residential) (AS4)**



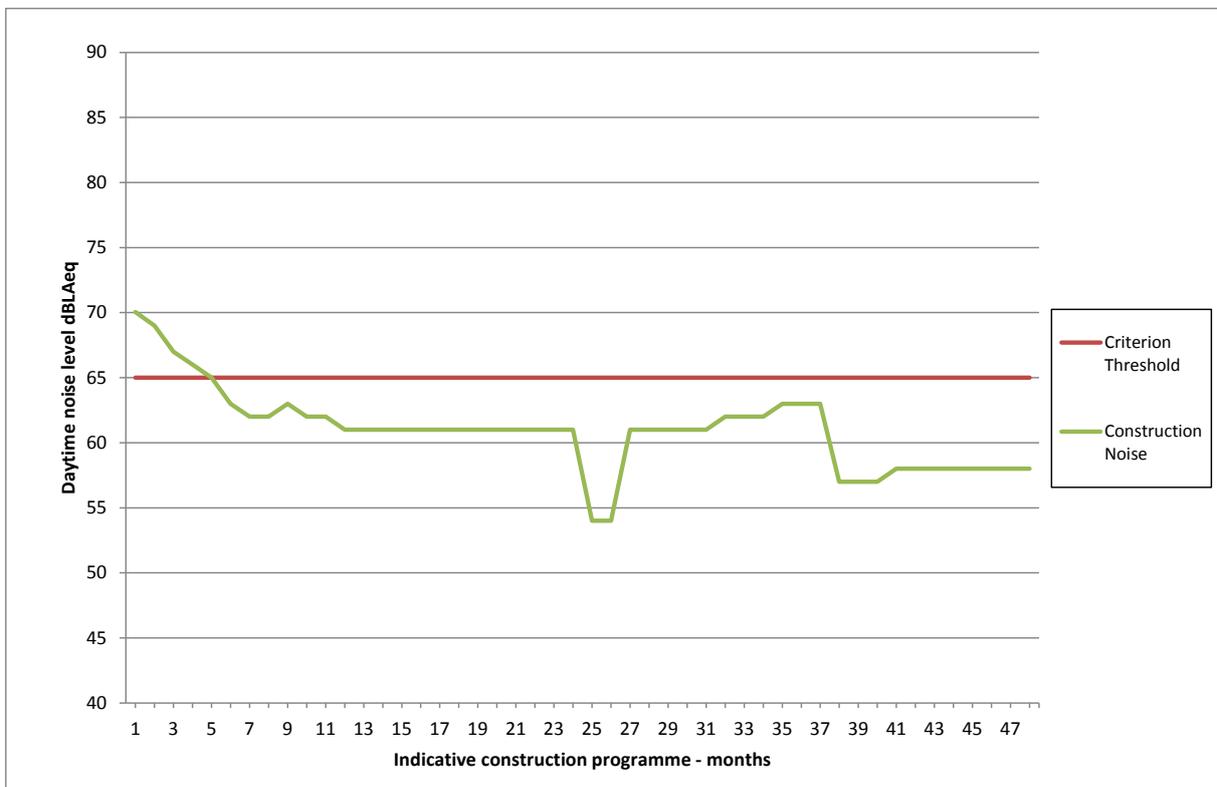
**Vol 4 Plate G.12 Average monthly daytime noise level over duration of construction – 5-8 Worcester Drive (residential) (AS5)**



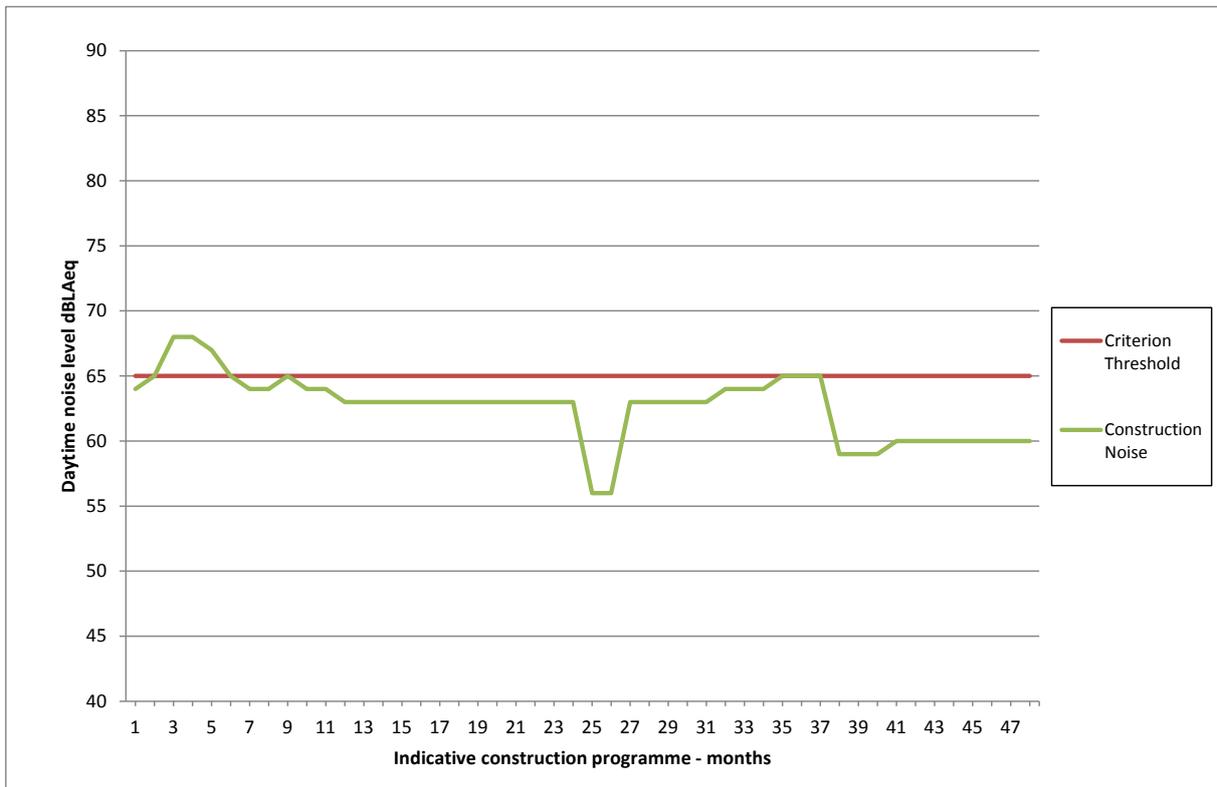
**Vol 4 Plate G.13 Average monthly daytime noise level over duration of construction –250 -269 Longford Court (residential) (AS6)**



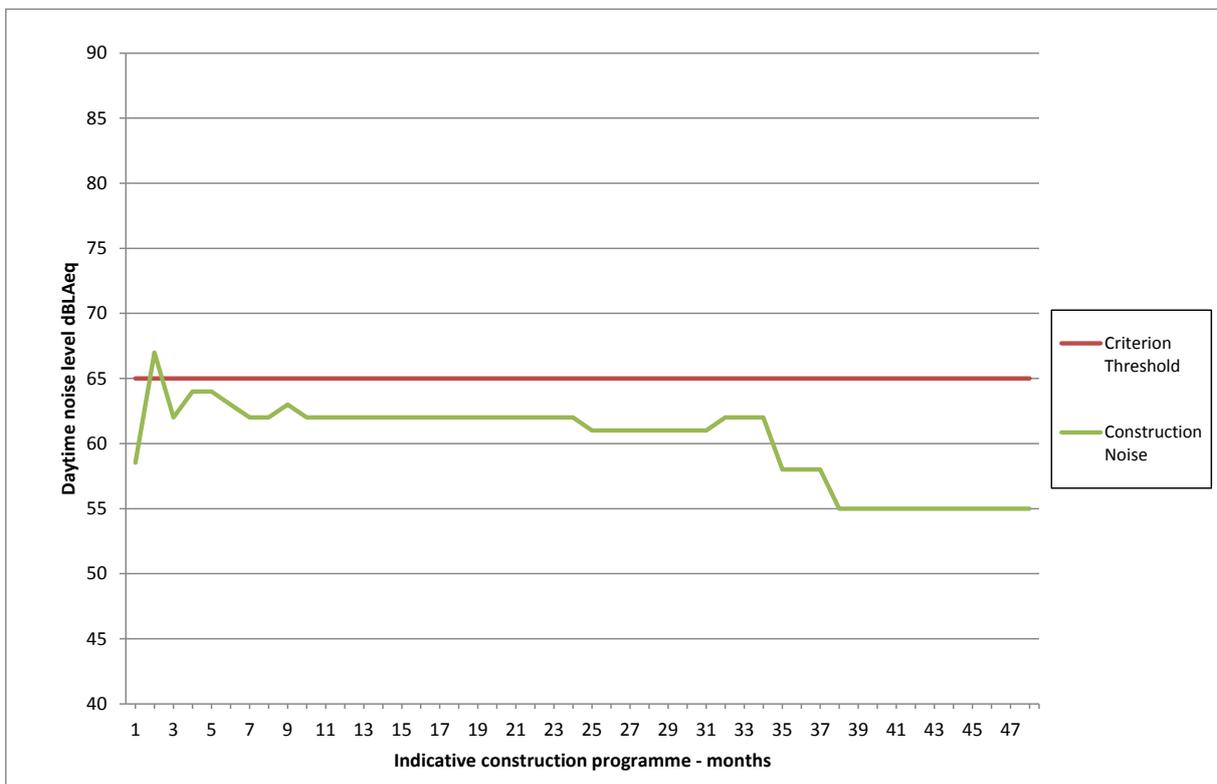
**Vol 4 Plate G.14 Average monthly daytime noise level over duration of construction –1-66 Edison Court (residential) (AS7)**



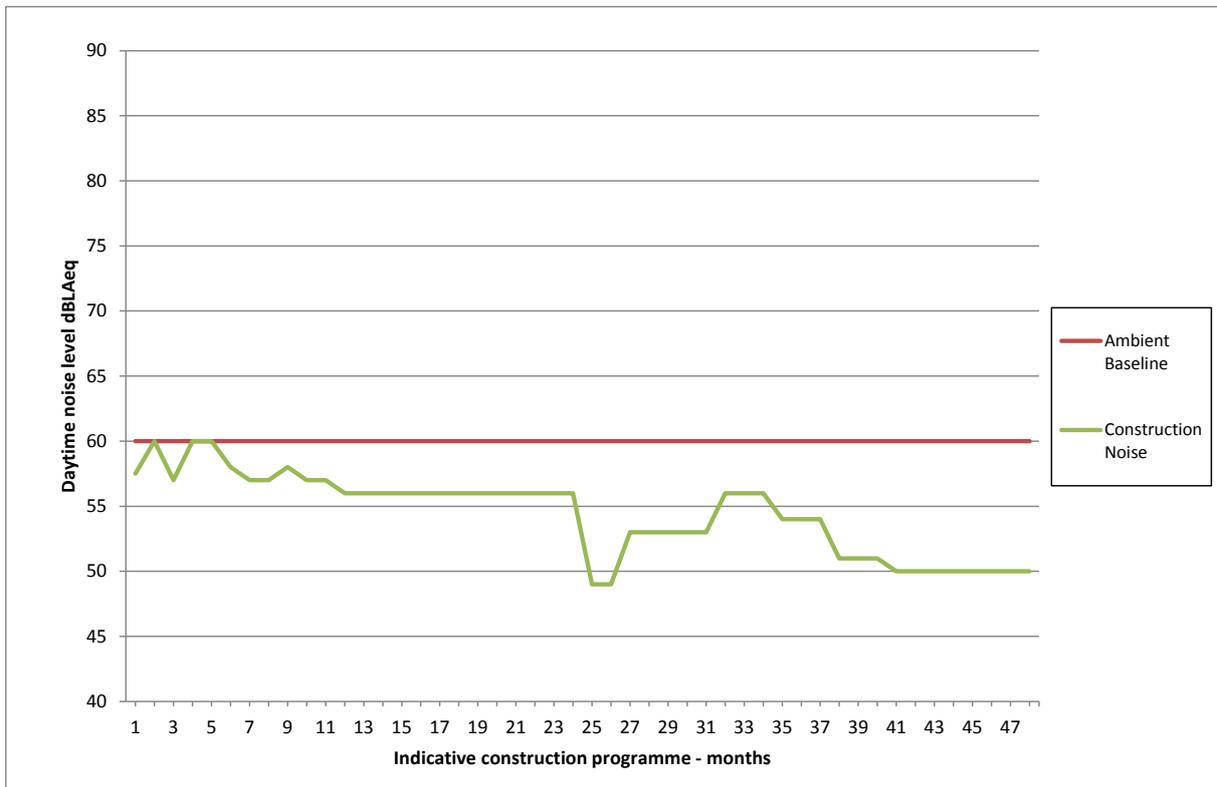
**Vol 4 Plate G.15 Average monthly daytime noise level over duration of construction –Tesla Court (residential) (AS8)**



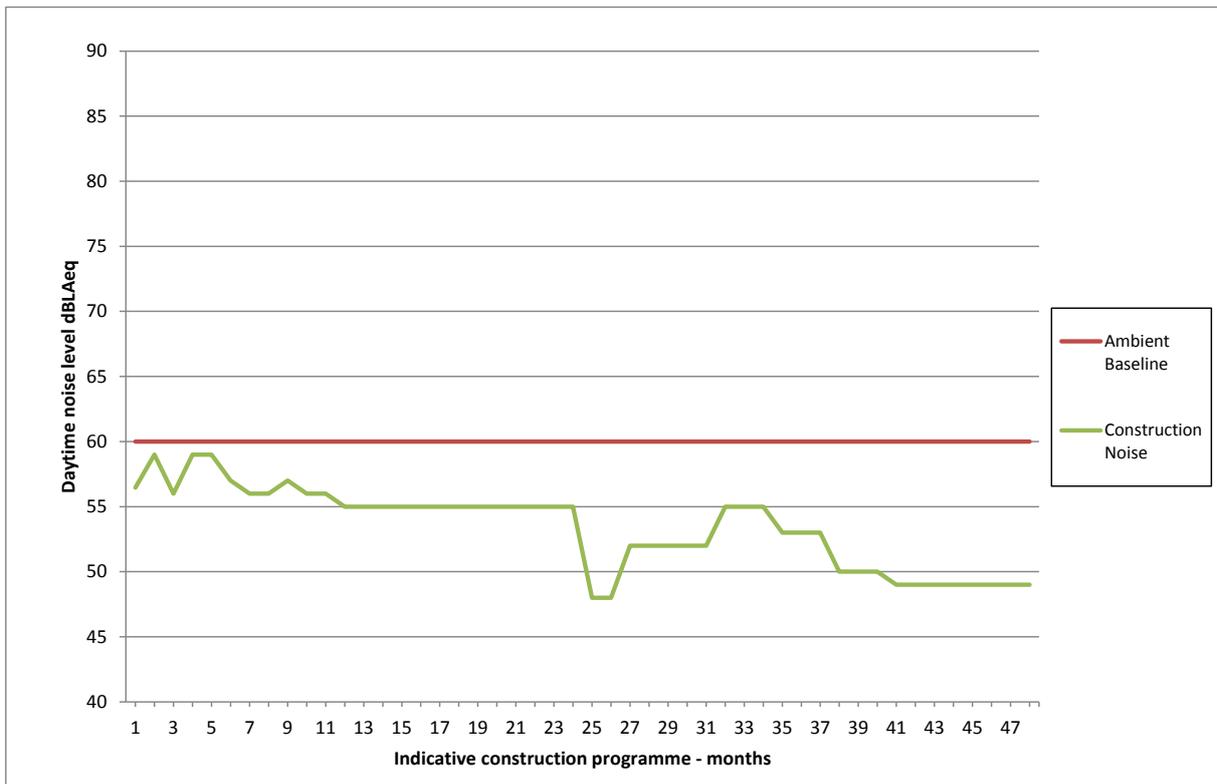
**Vol 4 Plate G.16 Average monthly daytime noise level over duration of construction –3-5 Canham Road (residential) (AS9)**



**Vol 4 Plate G.17 Average monthly daytime noise level over duration of construction –Scout Hut and Crèche (community hall) (AS10)**



**Vol 4 Plate G.18 Average monthly daytime noise level over duration of construction –TV Studio (Acton Industrial Estate Unit 11) (AS11)**



## References

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

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**Thames Tideway Tunnel**  
Thames Water Utilities Limited



# Application for Development Consent

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

**Volume 4: Acton Storm Tanks appendices**

**Appendix H: Socio-economics**

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

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Creating a cleaner, healthier River Thames

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# Thames Tideway Tunnel

## Environmental Statement

### Volume 4 Acton Storm Tanks appendices

#### Appendix H: Socio-economics

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## Appendix H: Socio-economics

### H.1 Baseline community profile

- H.1.1 The community profile is based on Output Area (OA) and local authority level data from the Office of National Statistics (ONS). The data have been obtained from four sources: Census 2001<sup>i</sup> (the last census for which data are available<sup>i</sup>), Department of Communities and Local Government Deprivation Indices 2010<sup>2</sup>, London Public Health Observatory 2012<sup>3</sup>, and the Network of Public Health Observatories 2011<sup>4</sup> (see Volume 2 Methodology). Data are grouped according to those ‘protected characteristics’<sup>ii</sup> 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 250m) and the overall borough level (which in this case is the London Borough [LB] of Ealing).
- H.1.3 The main protected characteristic group concentrated<sup>iii</sup> within the immediate area surrounding the proposed construction site is ‘persons who suffer from income deprivation’.

#### Resident population

- H.1.4 The resident population was approximately 3,700 within 250m of the site at the time of the last census.

#### Gender and age

- H.1.5 Of the total population within 250m of the site, 53.4% of residents are female, slightly higher than the proportion of females within the LB of Ealing (51.0%) and Greater London (51.6%).
- H.1.6 Vol 4 Table H.1 outlines age breakdown by assessment area, it illustrates that the proportion of under 16 year olds within 250m (15.8%) is somewhat lower than the LB of Ealing (19.8%) and Greater London level (20.2%).
- H.1.7 The proportion of over 65 year olds within 250m (10.2%) is slightly lower than at a borough wide level (11.5%) and Greater London level (12.4%).

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

<sup>ii</sup> 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.

<sup>iii</sup> In this instance, ‘concentrated’ refers to the occurrence of a particular protected characteristic group, the proportion of which is much higher than the borough wide proportions.

**Vol 4 Table H.1 Socio-economics - age breakdown by assessment area**

Age group	Assessment area		
	Immediate area (250m)	Borough wide (LB of Ealing)	Greater London
Under 16 years old	15.8%	19.8%	20.2%
Over 65 years old	10.2%	11.5%	12.4%

### Ethnicity

- H.1.8 Vol 4 Table H.2 outlines ethnicity by assessment area, showing that within 250m of the site, White residents make up over four fifths of the population (83.4%) with Black and Minority Ethnic (BME) groups comprising the remaining 16.6%.
- H.1.9 The proportion of White residents within 250m (83.4%) is somewhat higher than the Greater London average (71.2%) and moderately higher than the LB of Ealing proportion of White residents (58.7%).
- H.1.10 Within 250m, the proportion of Black residents (7.1%) is slightly lower than within the LB of Ealing (8.8%) and somewhat lower than within Greater London (10.9%). By contrast, the proportion of Asian residents within 250m of the site (3.5%) is considerably lower than the Greater London proportion (12.1%) and much lower than the LB of Ealing average (24.5%), where Asian residents account for approximately one in four of the population.

**Vol 4 Table H.2 Socio-economics - ethnicity by assessment area**

Ethnicity	Assessment area		
	Immediate area (250m)	Borough wide (LB of Ealing)	Greater London
White	83.4%	58.7%	71.2%
BME	16.6%	41.3%	28.8%
Asian	3.5%	24.5%	12.1%
Black	7.1%	8.8%	10.9%
Other	3.3%	4.3%	2.7%
Mixed	2.7%	3.6%	3.2%

4.1.1 *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 Within 250m of the site, Christians are the predominant religious group at 61.1%, broadly in line with Greater London levels (58.2%) and somewhat higher than the LB of Ealing average (50.7%). Muslims are the second most predominant religious group with 4.4% of residents within 250m,

considerably lower than the borough-wide level (10.3%) and Greater London average (8.5%).

H.1.12 Within 250m, the proportion of residents that do not follow a religion (31.2%) is somewhat higher than the borough wide (20.8%) and Greater London (24.3%) average.

### Health indicators

H.1.13 Vol 4 Table H.3 outlines health indicators by assessment area, noting that within 250m of the site, the proportion of residents suffering from a long term or limiting illness (11.1%) is somewhat lower than the LB of Ealing (15.1%) and Greater London (15.5%) averages.

H.1.14 The proportion of residents who claim disability living allowance within 250m (2.6%) is considerably lower than within the LB of Ealing (4.1%) and Greater London (4.5%).

**Vol 4 Table H.3 Socio-economics - health indicators by assessment area**

Health indicator	Assessment area		
	Immediate area (250m)	Borough wide (LB of Ealing)	Greater London
Long term limiting sick	11.1%	15.1%	15.5%
Disability living allowance	2.6%	4.1%	4.5%

H.1.15 In the local Middle Layer Super output Area (MSOA)<sup>iv5</sup> which the construction site falls within and relative to Greater London, levels of adult obesity fall within the lowest quintile (ie, the lowest being the best). For child obesity, the entire borough falls within the second lowest quintile relative to other Greater London boroughs.

H.1.16 In terms of adults undertaking physical activity as measured borough wide, the LB of Ealing falls within the second lowest quintile (ie, the lowest being the worst) relative to Greater London. By contrast, the proportion of children undertaking physical activity falls within the second highest quintile, also relative to Greater London.

H.1.17 For death rates by heart disease, circulatory disease, respiratory disease and strokes, the local MSOA ranks in the lowest quintile (ie, the lowest being the best) relative to Greater London. Death rates by cancer are more prevalent and the local MSOA ranks within the second highest quintile.

H.1.18 For male and female life expectancy, the local MSOA ranks within the highest quintile (ie, the highest being the best) relative to Greater London.

<sup>iv</sup> 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.

Average life expectancy for both male and female residents ranges from 84.9 to 93.1 years old.

### Lifestyle and deprivation indicators

H.1.19 Vol 4 Table H.4 outlines lifestyle and income deprivation indicators by assessment area, showing that the proportion of households within 250m that do not own cars (35.4%) is broadly in line with the Greater London average (37.5%), however slightly lower than the LB of Ealing average (31.7%).

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

Indicator	Assessment area		
	Immediate area (250m)	Borough wide (LB of Ealing)	Greater London
No car households	35.4%	31.7%	37.5%
Income	38.5%	27.5%	30.8%
Overall	0.0%	17.9%	24.5%

H.1.20 The incidence of deprivation<sup>v</sup> measured by income within 250m (38.5%) is moderately higher than the LB of Ealing (27.5%) and Greater London averages (30.8%). By contrast, there is no overall deprivation recorded within 250m. Overall deprivation within the LB of Ealing (17.9%) is somewhat lower than the Greater London level (24.5%).

<sup>v</sup> 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 Acton Storm Tanks.
- H.2.2 Data is 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 is also provided at the overall borough level (which in this case is the LB of Ealing) and for Greater London.
- H.2.3 Data is sourced from Experian’s National Business Database (2012)<sup>6</sup> which draws primarily on regularly updated records from Companies House<sup>vi</sup>.

### Employment and businesses

- H.2.4 Within approximately 250m of the site there are approximately 4,600 jobs<sup>vii</sup>. Vol 4 Table H.5<sup>viii</sup> below illustrates the breakdown of employment by sector, based on the UK Standard Industrial Classification (SIC) 2007<sup>7</sup>. It shows data for those sectors which account for more than 5% of total employment within approximately 250m. It can be seen that:
- Information and Communication account for 48% of employment within 250m, considerably more than within the LB of Ealing (7%) and Greater London (7%).
  - Professional, Scientific and Technical Activities account for 8% to 11% of employment at all three geographical levels.
  - Administrative and Support Service Activities account for 8% to 10% of employment at all three geographical areas.
  - Arts, Entertainment and Recreation Activities account for 6% of employment within 250m, which is three times that within the LB of Ealing (2%) and double that of Greater London (3%).
  - Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles account for 6% of employment within 250m, which is less than half of that within the LB of Ealing (14%) and Greater London (16%).
  - Manufacturing accounts for 5% of employment within 250m, which is slightly lower than within the LB of Ealing (6%) and somewhat more than within Greater London (3%).

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<sup>vi</sup> 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.

<sup>vii</sup> 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.

<sup>viii</sup> Data in tables rounded to nearest whole percentage and do not always sum due to rounding.

**Vol 4 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 Ealing)	Greater London
Information and Communication	48%	7%	7%
Professional, Scientific and Technical Activities	11%	8%	11%
Administrative and Support Service Activities	8%	10%	8%
Arts, Entertainment and Recreation Activities	6%	2%	3%
Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles	6%	14%	16%
Manufacturing	5%	6%	3%
Other (including unclassified)	16%	53%	52%

H.2.5 Within approximately 250m of the site there are approximately 400 businesses (defined here as business locations<sup>ix</sup>). The split of businesses by sector within 250m generally reflects the breakdown of employment by sector set out in Vol 4 Table H.5, with the largest proportion of businesses being engaged in Information and Communication (15%). Professional, Scientific and Technical Activities (12%), Administrative and Support Service Activities (11%), Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles (11%) and Manufacturing (5%) also account for relatively large proportions of businesses.

H.2.6 Vol 4 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 (1 to 9 employees) account for the majority. Within approximately 250m, 87% of businesses have one to nine employees, similar to within the LB of Ealing (90%) and Greater London (88%). Business units with ten to 24 employees account for 10% of all businesses within 250m of the site, somewhat higher than within the LB of Ealing (7%) and Greater London (8%).

H.2.7 The size of businesses within 250m varies somewhat by sector. For example, within the Information and Communication sector, 95% of businesses have one to nine employees compared to 72% of Administrative and Support Service Activities and an average across all

<sup>ix</sup> 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.

sectors of 87%. Businesses of ten to 24 employees in size account for 21% of businesses within the Administrative and Support Service Activities, compared to 3% of businesses within the Information and Communication sector.

**Vol 4 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)	87%	10%	2%	1%	1%	1%
- <i>Information and Communication</i>	95%	3%	0%	0%	0%	2%
- <i>Professional, Scientific and Technical Activities</i>	84%	12%	0%	2%	0%	2%
- <i>Administrative and Support Service Activities</i>	72%	21%	5%	0%	2%	0%
- <i>Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles</i>	84%	12%	5%	0%	0%	0%
Borough wide (LB of Ealing)	90%	7%	2%	1%	0%	0%
Greater London	88%	8%	2%	1%	1%	0%

## References

- <sup>1</sup> ONS. *Neighbourhood Statistics* (2001). Available at: <http://neighbourhood.statistics.gov.uk/dissemination/>
- <sup>2</sup> Department for Communities and Local Government. *Index of Multiple Deprivation 2010* (2010). Available at: <http://www.communities.gov.uk/communities/research/indicesdeprivation/deprivation10/>
- <sup>3</sup> London Public Health Observatory. *Fair Society, Healthy Lives: The Marmot Review* (2012). Available from: [http://www.lho.org.uk/LHO\\_TOPICS/NATIONAL\\_LEAD\\_AREAS/MARMOT/MARMOTINDICATORS.ASPX](http://www.lho.org.uk/LHO_TOPICS/NATIONAL_LEAD_AREAS/MARMOT/MARMOTINDICATORS.ASPX). Accessed 30 August 2012
- <sup>4</sup> Network of Public Health Observatories. *Health Profiles: London* (2011-2012) Available at: [http://www.apho.org.uk/resource/view.aspx?QN=HP\\_REGION\\_H](http://www.apho.org.uk/resource/view.aspx?QN=HP_REGION_H). Accessed February 2012.
- <sup>5</sup> Office of National Statistics. *Neighbourhood Statistics, Super Output Areas* (2012). Accessed on 17 May 2012. Accessed from: <http://www.neighbourhood.statistics.gov.uk/dissemination/Info.do;jessionid=vtvdPZRWZ3yhT9ShjB6TcwQ00WNTZcPQgyVpGLvZjTzh7nYnBhqL!1624269762!1327075798387?m=0&s=1327075798387&enc=1&page=aboutneighbourhood/geography/superoutputareas/soa-intro.htm&nsjs=true&nsck=true&nssvg=false&nswid=1225>
- <sup>6</sup> Experian. *National Business Database* (Database of employment and enterprise statistics). Accessed: September 2012.
- <sup>7</sup> 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.

**Thames Tideway Tunnel**  
Thames Water Utilities Limited



# Application for Development Consent

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

### **Volume 4: Acton Storm Tanks appendices**

#### **Appendix I: Townscape and visual**

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

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# Thames Tideway Tunnel

## Environmental Statement

### Volume 4 Acton Storm Tanks appendices

#### Appendix I: Townscape and visual

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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

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

**Volume 4: Acton Storm Tanks appendices**

**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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**Thames Tideway Tunnel**  
Thames Water Utilities Limited



# Application for Development Consent

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

**Volume 4: Acton Storm Tanks appendices**

**Appendix K: Water resources - groundwater**

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# Thames Tideway Tunnel

## Environmental Statement

### Volume 4 Acton Storm Tanks appendices

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## Appendix K: Water resources – groundwater

### K.1 Geology

K.1.1 A summary of the anticipated geological succession at the Acton Storm Tanks site is shown in Vol 4 Table K.1.

**Vol 4 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)<sup>1</sup>, is shown in Vol 4 Figure 13.4.1 and Vol 4 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 SR4073 and SA4302. The locations of these boreholes around the site are shown in Vol 4 Figure 13.4.1 (see separate volume of figures). The depths and thicknesses of geological layers encountered is summarised in Vol 4 Table K.2 below.

**Vol 4 Table K.2 Groundwater – anticipated ground conditions**

Formation	Top elevation* (mATD)**	Depth below ground level (m)	Thickness (m)
Made Ground	105.8	0	1.75
Alluvium	104.05	1.75	0.9
River Terrace Deposits	103.15	2.65	6.15
London Clay			
B	97.0	8.8	14.82
A3ii	82.18	23.62	11.73
A3i	70.45	35.35	1.70
A2	68.75	37.05	10.57

\* Based on an assumed ground level of 105.8mATD.

*\*\* 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 combined sewer overflow (CSO) drop shaft and the base slab at the Acton Storm Tanks site would extend to approximately 75.03mATD and 71.03mATD 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 tunnelling excavation and Tunnel Boring Machine (TBM) break-in at the Acton Storm Tanks site would be within the London Clay Formation, unit B. The interception chamber and culvert approximately 7.7m, as assumed for the purpose of this assessment, would extend down to 98.1mATD into the River Terrace Deposits.
- K.1.6 The Made Ground, containing sandy, gravelly clay or gravelly sand with flint, brick, clinker, macadam, plastic, granite, tile, concrete, metal and coal, is expected to be 1.75m thick at the Acton Storm Tanks site.
- K.1.7 The Alluvium, comprises slightly sandy, slightly gravelly clay and is expected to be 0.9m thick at the Acton Storm Tanks site.
- K.1.8 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 6.15m thick at the Acton Storm Tanks site.
- K.1.9 The London Clay, comprises firm to very stiff clay, slightly sandy and slightly gravelly in places and fissured in places. The London Clay Formation 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 London Clay is expected to be 38.8m thick at the Acton Storm Tanks site.

## K.2 Hydrogeology

- K.2.1 A summary of the anticipated hydrogeological conditions at the Acton Storm Tanks is in Vol 4 Table K.3.

**Vol 4 Table K.3 Groundwater – anticipated hydrogeological units**

Group	Formation	Hydrogeology
Superficial deposits	Made ground	Hydraulic continuity with upper aquifer
	Alluvium	
	River Terrace Deposits	Upper aquifer
Thames	London Clay	Aquiclude <sup>i2</sup>

<sup>i</sup> Aquiclude - a geological formation through which virtually no water moves (USGS website, 2012).

- 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 the Made Ground and Alluvium 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 are generally aquifers formerly classified as minor aquifers”.<sup>3</sup>
- 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 Acton Storm Tanks site.
- K.2.5 The CSO drop shaft would pass through the upper aquifer and into the London Clay Formation (B and A3ii sub divisions). The London Clay Formation 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 groundwater inflows. 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. In unit A3ii, the presence of fine sand laminae/lenses at this horizon, may act as horizontal conduits for migration of groundwater from a nearby source.

### 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 two on site monitoring boreholes (displayed in Vol 4 Figure 13.4.3), from which the depths and thicknesses of the geological layers were obtained (see paragraph K.1.3). These on site boreholes have response zones<sup>ii4</sup> and monitor groundwater levels in the River Terrace Deposits or upper aquifer. The response zone depths, the monitored strata and the frequency of monitoring are detailed in Vol 4 Table K.4. The manual dip data collected from these monitoring boreholes is shown in Vol 4 Table K.5.

**Vol 4 Table K.4 Groundwater - monitoring borehole**

Borehole	Response zone depths mATD	Strata	Monitoring
SA4302	103.66-96.96	River Terrace Deposits	Sporadic manual dips

<sup>ii</sup> Response zone -the section of a borehole that is open to the host strata (EA, 2006)

Borehole	Response zone depths mATD	Strata	Monitoring
SA4303	102.98-97.98	River Terrace Deposits	Sporadic manual dips

**Vol 4 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
SA4302	14/12/11-13/07/12	5.45	100.81 (July 2012)	5.60	100.66 (Mar. 2012)	5.55	100.71
SA4303	14/12/11-13/07/12	5.62	100.37 (July 2012)	6.13	99.85 (Mar-2012)	5.82	100.16

K.3.3 The recorded water levels in the River Terrace Deposits at SA4302 range between 100.66 and 100.81mATD. These water levels consistently remain below the top of the formation at 103.15mATD, indicating that the formation is not fully saturated at this location.

K.3.4 The recorded water levels in the River Terrace Deposits at SA4303 range between 99.85 and 100.37mATD. These water levels consistently remain below the top of the formation at 103.15mATD, indicating that the formation is not fully saturated at this location.

K.3.5 The nearest EA groundwater level monitoring borehole is located at High Street Acton (TQ 2037 8002); however, this borehole records water levels in the lower aquifer. The EA network does not include any monitoring boreholes sufficiently close by to provide representative water level in the upper aquifer at the site.

K.3.6 As there are only two monitoring boreholes within the River Terrace Deposits, it is not possible to accurately determine the direction of groundwater flow. However it is likely that the direction of groundwater movement is from northwest to southeast, towards the River Thames, in these shallow deposits.

## **K.4 Groundwater abstractions and protected rights**

### **Groundwater licensing policy**

K.4.1 The London Catchment Abstraction Management Strategy (CAMS), (EA, 2006)<sup>5</sup> 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 construction would not reach to this depth at the Acton Storm Tanks 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 sewer via appropriate settlement tanks.

### Licensed abstractions

- K.4.4 The EA licenses abstractions from groundwater within London for all sources in excess of 20m<sup>3</sup>/d. Groundwater abstractions within 1km around the site have been identified.
- K.4.5 The nearest licensed abstraction within the River Terrace Deposits or upper aquifer is located at approximately 1.6km to the south of the site, close by the River Thames (see Vol 4 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, is approximately 1.4km from the Acton Storm Tanks 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 Acton Storm Tanks site.

**Vol 4 Table K.6 Groundwater - licensed abstractions**

Licence number	Licence holder	Purpose	Aquifer	Licensed volume [m <sup>3</sup> /annum]
28/39/39/0137	Fuller Smith & Turner LTD	Industrial, commercial and public services	River Terrace Deposits	82,000

## K.5 Groundwater Source Protection Zones

- K.5.1 The EA defines Source Protection Zones (SPZ) around all major public water supply abstractions sources and large licensed private abstractions in order to safeguard groundwater resources from potentially polluting activities.
- K.5.2 There are no SPZs delineated within the vicinity of site. The nearest of these lies approximately 6km to the east. This source abstracts from the Chalk (lower aquifer) and would be unaffected due to construction taking place entirely within the upper aquifer and the London Clay.

## K.6 Environmental designations

- K.6.1 There are no environmental designations relevant to groundwater, such as SSSI, SAC or SNCIs within 1km of the Acton Storm Tanks site.

## **K.7 Groundwater quality and land quality assessment**

- K.7.1 Historical mapping undertaken as part of the land quality assessment at the Acton Storm Tanks site has not identified any potentially contaminative land uses or potential contaminant sources (Vol 4 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 4 Table B.1 has been sourced from the ground investigation and monitoring works undertaken as part of the Thames Tunnel project and includes data from a monitoring borehole located on site (SA4302) this location is listed in Vol 4 Figure 13.4.1 (see separate volume of figures). Any exceedances of the UK drinking water standards<sup>6</sup> or relevant Environmental Quality Standards (EQS)<sup>7</sup> are shaded in blue in this table.
- K.7.3 The data shows exceedances of the relevant standards with respect to coliforms, faecal coliforms, nickel, tetrachloroethene and turbidity within the River Terrace Deposits. Tetrachloroethene is a drying cleaning agent and degreasing solvent but degrades rapidly in the environment with no evidence of significant bioconcentration<sup>8</sup>.
- K.7.4 The EA monitors groundwater quality at a number of points across London, mainly the Chalk and Lower London Tertiaries (Lambeth Group) (EA, 2006)<sup>4</sup>. The water quality information provided from this network is not relevant to the Acton Storm Tanks site, where construction would be entirely with the River Terrace Deposits and the London Clay Formation.
- K.7.5 The land quality data from the ground investigation boreholes used in the groundwater quality assessment show exceedances of the human health screening values<sup>9</sup> (soil guideline values designed to be protective of human health). Further detail is provided in the land quality assessment (see Vol 4 Appendix F).

Vol 4 Table K.7 Groundwater – groundwater quality

Source of data*					SI	TT	TT	TT
Name				SA4302	SA4302	SA4302	SA4302	SA4302
Hydrogeological unit**				RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria			146m	146m	146m	146m	146m
Chemical	Value	Units	Source	6/10/2011	11/1/2012	22/3/2012	29/5/2012	
1,1 - Dichloroethane	10	ug/l	WFD 2010	<1	-	-	-	-
1,1 - Dichloroethene	30	ug/l	WHO 2004	<1	-	-	-	-
1,1 - Dichloropropene	-	ug/l	None	<1	-	-	-	-
1,1,1 - Trichloroethane	100	ug/l	SW Regs 98	<1	0.57	-	1.21	-
1,1,1,2 - Tetrachloroethane	-	ug/l	None	<1	-	-	-	-
1,1,2 - Trichloroethane	400	ug/l	SW Regs 98	<1	<0.2	-	<0.2	-
1,1,2,2 - Tetrachloroethane {Acetosan}{Bonaform}{Cas Rn 79-34-5}	-	ug/l	None	<1	-	-	-	-
1,2 - Dibromo - 3 - Chloropropane	0.1	ug/l	DWS 2010	<5	-	-	-	-
1,2 - Dibromoethane	0.1	ug/l	DWS 2010	<1	-	-	-	-
1,2 - Dichlorobenzene	1000	ug/l	WHO 2004	<5.0	-	-	-	-
1,2 - Dichloroethane {Ethylene Dichloride}	3	ug/l	WS Regs 20	<1	<0.12	-	<0.12	-
1,2 - Dichloroethene (Trans)	30	ug/l	WHO 2004	<1	-	-	-	-
1,2 - Dichloropropane	0.1	ug/l	DWS 2010	<1	-	-	-	-
1,2,3 - Trichlorobenzene	-	ug/l	None	<5	-	-	-	-
1,2,3 - Trichloropropane	-	ug/l	None	<1	-	-	-	-
1,2,4 - Trichlorobenzene	-	ug/l	None	<5	-	-	-	-
1,2,4 - Trimethylbenzene	-	ug/l	None	<1	-	-	-	-
1,3 - Dichlorobenzene	-	ug/l	None	<5.0	-	-	-	-
1,3 - Dichloropropane	-	ug/l	None	<1	-	-	-	-
1,3 - Dichloropropene (Trans)	-	ug/l	None	<1	-	-	-	-
1,3,5 - Trichlorobenzene	-	ug/l	None	<0.02	-	-	-	-
1,3,5 - Trimethylbenzene	-	ug/l	None	<1	-	-	-	-
1-Methylnaphthalene	-	mg/l	None	<0.002	-	-	-	-
2 - Chloronaphthalene	-	ug/l	None	<2.0	-	-	-	-
2 - Chlorophenol	50	ug/l	WFD 2010	<20.0	-	-	-	-
2 - Chlorotoluene	-	ug/l	None	<1	-	-	-	-
2 - Methylnaphthalene	-	ug/l	None	<2.0	-	-	-	-
2 - Methylphenol {O-Cresol}	-	ug/l	None	<5.0	-	-	-	-
2 - Nitroaniline	-	ug/l	None	<5.0	-	-	-	-
2 - Nitrophenol	-	ug/l	None	<20.0	-	-	-	-
2-(2,4,5-trichlorophenoxy)propanoic acid	-	ug/l	None	<0.02	-	-	-	-
2,2 - Dichloropropane	-	ug/l	None	<1	-	-	-	-
2,3 - Dimethylphenol {2,3-Xylenol}	-	ug/l	None	-	-	<0.0500	-	-
2,3,5,6 - Tetrachloroaminobenzene {2,...Aniline}	-	ug/l	None	-	-	<0.00500	-	-
2,3,6 - TBA {2,3,6-Trichlorobenzoic Acid}{Cas Rn 50-31-7}	-	ug/l	None	<0.02	-	-	-	-
2,4 - Dichlorophenol	20	ug/l	WFD 2010	<20.0	-	-	-	-
2,4 - Dimethylphenol {2,4-Xylenol}	-	ug/l	None	<20.0	-	-	-	-
2,4 - Dinitrotoluene	-	ug/l	None	<5.0	-	-	-	-
2,4,5 - Trichlorophenol	-	ug/l	None	<20.0	-	-	-	-
2,4,6 - Trichlorophenol	-	ug/l	None	<20.0	-	-	-	-
2,4-D {2,4-Dichlorophenoxyacetic acid}	0.1	ug/l	DWS 2010	<0.02	-	-	-	-
2,4-DB {4-(2,4-dichlorophenoxy)butyric acid}	0.1	ug/l	DWS 2010	<0.02	-	-	-	-
2,4-Dinitrophenol	-	mg/l	None	<0.01	-	-	-	-
2,6 - Dimethylphenol {2,6	-	ug/l	None	-	-	<0.0500	-	-

Source of data*						SI	TT	TT	TT
Name					SA4302	SA4302	SA4302	SA4302	SA4302
Hydrogeological unit**					RTD	RTD	RTD	RTD	RTD
Distance from site					146m	146m	146m	146m	146m
Chemical	Value	Units	Source		6/10/2011	11/1/2012	22/3/2012	29/5/2012	
EQS Criteria									
Xylenol}									
2,6 - Dinitrotoluene	-	ug/l	None		<5.0	-	-	-	-
2,6-Dichlorobenzonitrile	-	ug/l	None		<0.02	-	-	-	-
3 - Nitroaniline	-	ug/l	None		<5.0	-	-	-	-
3,3'-Dichlorobenzidine	-	mg/l	None		<0.02	-	-	-	-
3,4 - Dimethylphenol {3,4 Xylenol}	-	ug/l	None		-	-	<0.0500	-	-
4 - Bromophenylphenyl ether	-	ug/l	None		<5.0	-	-	-	-
4 - Chloro - 3-Methylphenol {P-Chloro-M-Cresol}	40	ug/l	WFD 2010		<5.0	-	-	-	-
4 - Chloroaniline	-	ug/l	None		<5.0	-	-	-	-
4 - Chlorophenol	-	ug/l	None		<20.0	-	-	-	-
4 - Chlorophenyl phenyl ether	-	ug/l	None		<5.0	-	-	-	-
4 - Chlorotoluene	-	ug/l	None		<1	-	-	-	-
4 - Isopropyltoluene	-	ug/l	None		<1	-	-	-	-
4 - Nitroaniline	-	ug/l	None		<5.0	-	-	-	-
4 - Nitrophenol	-	ug/l	None		<50.0	-	-	-	-
4,6-Dinitro-2-methylphenol	-	mg/l	None		<0.05	-	-	-	-
4-CPA	-	ug/l	None		<0.02	-	-	-	-
4-Methylphenol {para-Cresol}	-	ug/l	None		<20.0	-	<0.0600	-	-
Acenaphthene	-	ug/l	None		<2.0	-	-	-	-
Acenaphthylene	-	ug/l	None		<2.0	-	-	-	-
Acenaphthene	-	ug/l	None		-	-	<0.01	-	-
Acenaphthylene	-	ug/l	None		-	-	<0.01	-	-
Aldrin	0.03	ug/l	DWS 2010		<0.02	-	-	-	-
Alkalinity (Carbonate)	-	mg/l as CaCO3	None		-	-	-	-	-
Alkalinity Ph 4.5 - As CaCO3	-	mg/l as CaCO3	None		429	382	-	363	-
Aluminium Dissolved	200	ug/l as Al	DWS 2010		-	-	0.025	-	-
Aluminium Total	200	ug/l as Al	DWS 2010		-	0.38	-	0.019	-
Ametryne	-	ug/l	None		<0.02	-	-	-	-
Ammonia - As N	0.39	mg/l as N	WS Regs 20		-	0.1	-	0.08	-
Ammoniacal nitrogen	-	mg/l	None		0.4	-	-	-	-
Anthracene	0.1	ug/l	SW WFD		<2.0	-	<0.01	-	-
Antimony Total	5	ug/l	DWS 2010		-	-	0.3	-	-
Arsenic Total	10	ug/l as As	DWS 2010		-	3.8	-	< 1.0	-
Atrazine { }	0.1	ug/l	DWS 2010		<0.03	<0.00300	-	<0.00800	-
Azinphos-Ethyl	-	ug/l	None		<0.01	-	-	-	-
Azinphos-Methyl	0.1	ug/l	DWS 2010		<0.01	-	-	-	-
Barium Dissolved	100	ug/l as Ba	SW Regs 96		-	-	250	-	-
Barium Total	100	ug/l as Ba	SW Regs 96		-	-	360	-	-
Benazolin	-	ug/l	None		<0.02	-	-	-	-
Bentazone	0.1	ug/l	DWS 2010		<0.02	<0.00800	-	<0.00800	-
Benz[a]-Anthracene	-	ug/l	None		-	-	<0.01	-	-
Benzene	1	ug/l	DWS 2010		<1	0.32	0.39	< 0.28	-
Benzene (Ethylbenzene)	20	ug/l	FW List II		-	-	<0.06	-	-
Benzene, 1,2,3,4-tetrachloro-	-	ug/l	None		<0.02	-	-	-	-
Benzene, pentachloro-	0.007	ug/l	WFD D 10		<0.02	-	-	-	-
Benzo (a) anthracene	-	ug/l	None		<2.0	-	-	-	-
Benzo[a]Pyrene	0.01	ug/l	DWS 2010		<2.0	<0.00500	<0.01	<0.00500	-
Benzo[b]Fluoranthene	0.03	ug/l	WFD D 10		<2.0	-	<0.01	-	-
Benzo[g,h,i]Perylene	0.002	ug/l	WFD D 10		<2.0	-	<0.01	-	-
Benzo[k]Fluoranthene	0.03	ug/l	WFD D 10		<2.0	-	<0.01	-	-
Benzoic Acid	-	mg/l	None		<0.1	-	-	-	-
Benzyl alcohol	-	mg/l	None		<0.005	-	-	-	-
Bifenthrin	-	ug/l	None		-	-	0.01600	-	-
Biphenyl	25	ug/l	WFD 2010		<2.0	-	-	-	-

Source of data*				SI	TT	TT	TT
Name			SA4302	SA4302	SA4302	SA4302	SA4302
Hydrogeological unit**			RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria		146m	146m	146m	146m	146m
Chemical	Value	Units	Source	11/1/2012	22/3/2012	29/5/2012	
Bis (2 - chloroethoxy) methane	-	ug/l	None	-	-	-	-
Bis (2 - chloroethyl) ether	-	ug/l	None	-	-	-	-
Bis(2-chloroisopropyl)ether	-	ug/l	None	-	-	-	-
Bis(2-ethylhexyl) phthalate	1.3	ug/l	WFD 2010	<5.0	-	-	-
Boron Dissolved	1000	ug/l as B	DWS 2010	-	310	-	-
Boron Total	1000	ug/l as B	DWS 2010	-	300	-	0.32
Bromate	10	ug/l as BrO3	DWS 2010	<100	<0.5	-	< 0.5
Bromobenzene	-	ug/l	None	<1	-	-	-
Bromochloromethane	-	ug/l	None	<1	-	-	-
Bromodichloromethane	100	ug/l	WS Regs 20	<1	-	-	-
Bromoform	100	ug/l	WS Regs 20	<1	-	-	-
Bromomethane	-	ug/l	None	<5	-	-	-
Bromoxynil	0.1	ug/l	DWS 2010	<0.02	-	-	-
Butyl benzyl phthalate	-	ug/l	None	<5.0	-	-	-
Cadmium Total	5	ug/l as Cd	DWS 2010	-	<1.5	< 1.5	-
Calcium Dissolved	250	mg/l as Ca	DWS 2010	149	-	-	-
Calcium Total	250	mg/l as Ca	DWS 2010	-	170	-	160
Carbendazim / Benomyl	0.1	ug/l	FW List II	-	<0.00300	-	<0.00500
Carbetamide	-	ug/l	None	-	<0.00600	-	<0.01000
Carbofenthion	-	ug/l	None	<0.01	-	-	-
Carbon Dioxide	-	ug/l	None	-	-	44000	-
Carbon Organic Dissolved	-	mg/l as C	None	-	-	3	-
Carbon tetrachloride	3	ug/l	DWS 2010	<1	<0.07	-	< 0.070
Chlordane (cis)	0.1	ug/l	DWS 2010	<0.02	-	-	-
Chlorfenvinphos	0.1	ug/l	DWS 2010	<0.03	<0.00900	-	<0.00900
Chloride	250	mg/l as Cl	DWS 2010	90	155	-	80.3
Chlorobenzene	-	ug/l	None	<1	-	-	-
Chloroethane	-	ug/l	None	<5	-	-	-
Chloroform	100	ug/l	WS Regs 20	<5	<0.6	-	< 0.600
Chloromethane	-	ug/l	None	<1	-	-	-
Chlorpyrifos	0.03	ug/l	WFD 2010	<0.02	-	-	-
Chlorpyrifos-Methyl	-	ug/l	None	<0.01	-	-	-
Chlorthalonil	-	ug/l	None	<0.01	-	-	-
Chlortoluron	2	ug/l	FW List II	-	<0.00400	-	<0.01000
Chromium Dissolved	50	ug/l as Cr	DWS 2010	-	14	-	-
Chromium Total	50	ug/l as Cr	DWS 2010	-	15	-	13
Chrysene	-	ug/l	None	<2.0	-	<0.01	-
cis-1,3 - Dichloropropene	-	ug/l	None	<1	-	-	-
cis-1-2-Dichloroethene	-	ug/l	None	2	-	-	-
Clopyralid	-	ug/l	None	<0.02	<0.01900	-	<0.01900
Coliform Bacteria QUANTITRAY (COLILERT)	0	MPN/100ml	WS Regs 20	100000	-	-	-
Copper Total	2000	ug/l as Cu	DWS 2010	-	<5.5	-	< 5.5
Coumaphos	0.1	ug/l	DWS 2010	-	-	0.00590	-
Cresols	-	ug/l	None	1.3	-	-	-
Cyanazine	0.1	ug/l	DWS 2010	-	<0.00700	-	<0.00800
Cyfluthrin	0.1	ug/l	DWS 2010	<0.1	-	-	-
Cyhalothrin	-	ug/l	None	<0.1	-	-	-
Cypermethrin	0.0001	ug/l	WFD 2010	<0.1	<0.1	-	< 0.100
Cypermethrin ID	-	Code	None	-	-	<5	-
Dalapon	-	ug/l	None	-	<0.05000	-	<0.05000
DDD (OP)	0.1	ug/l	DWS 2010	<0.01	-	-	-
DDD (PP)	0.1	ug/l	DWS 2010	<0.01	-	-	-
DDE (OP)	0.1	ug/l	DWS 2010	<0.02	-	-	-
DDE (PP)	0.1	ug/l	DWS 2010	<0.01	-	-	-
DDT (OP)	0.1	ug/l	DWS 2010	<0.01	-	-	-
DDT (PP)	0.1	ug/l	DWS 2010	<0.02	-	-	-
delta.-Lindane	-	ug/l	None	<0.01	-	-	-
Deltamethrin	-	ug/l	None	<0.1	-	-	-
Di - n - octyl phthalate	-	ug/l	None	<2.0	-	-	-
Diazinon	0.1	ug/l	DWS 2010	<0.01	<0.00900	-	<0.00900

Source of data*						SI	TT	TT	TT
Name					SA4302	SA4302	SA4302	SA4302	SA4302
Hydrogeological unit**					RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria				146m	146m	146m	146m	146m
Chemical	Value	Units	Source		6/10/2011	11/1/2012	22/3/2012	29/5/2012	
Dibenz-[A,H]-Anthracene	-	ug/l	None		<2.0	-	<0.01	-	
Dibenzofuran	-	ug/l	None		<5.0	-	-	-	
Dibromochloromethane	100	ug/l	WS Regs 20		<1	-	-	-	
Dibromomethane	-	ug/l	None		<1	-	-	-	
Dicamba {3,6-Dichloro(O-Methoxybenzoic Acid)}	-	ug/l	None		<0.02	-	-	-	
Dichlorodifluoromethane	-	ug/l	None		<1	-	-	-	
Dichloromethane	20	ug/l	WFD 2010		<5	<3	-	<3.0	
Dichloroprop	0.1	ug/l	DWS 2010		<0.02	<0.01100	-	<0.01100	
Dichlorvos	0.1	ug/l	DWS 2010		<0.01	-	-	-	
Diclofop	-	ug/l	None		<0.02	-	-	-	
Dieldrin	0.03	ug/l	DWS 2010		<0.01	-	-	-	
Diethyl phthalate	-	ug/l	None		<5.0	-	-	-	
Dimethoate	0.1	ug/l	DWS 2010		<0.02	-	-	-	
Dimethyl phthalate	-	ug/l	None		<5.0	-	-	-	
Dimethylphenols	-	mg/l	None		<0.5	-	-	-	
Di-n-butyl phthalate	-	ug/l	None		<5.0	-	-	-	
Diphenyl ether	-	mg/l	None		<0.002	-	-	-	
Diuron	0.1	ug/l	DWS 2010		-	0.00500	-	<0.01000	
Endosulphan Alpha	0.1	ug/l	DWS 2010		<0.01	-	-	-	
Endosulphan Beta	0.1	ug/l	DWS 2010		<0.01	-	-	-	
Endosulphan Sulphate	-	ug/l	None		<0.01	-	-	-	
Endrin	0.1	ug/l	DWS 2010		<0.01	-	-	-	
endrin ketone	-	ug/l	None		<0.02	-	-	-	
Enterococci (Species)	-	Nr/100ml	None		-	-	0	-	
Escherichia coli (Confirmed)	0	Nr/100ml	WS Regs 20		-	-	0	-	
Ethion	-	ug/l	None		<0.01	-	-	-	
Ethofumesate	-	ug/l	None		-	-	<0.01	-	
Ethylbenzene	-	ug/l	None		<1	-	-	-	
etrimphos	-	ug/l	None		<0.01	-	-	-	
Faecal Coliforms	0	cfu/100ml	WFD 2010		60	-	-	-	
Fenitrothion	0.1	ug/l	DWS 2010		<0.02	-	-	-	
Fenthion	-	ug/l	None		<0.02	-	-	-	
Fenuron	-	ug/l	None		-	-	<0.01	-	
Fenvalerate	-	ug/l	None		<0.1	-	-	-	
Flamprop	-	ug/l	None		<0.02	-	-	-	
Flamprop-isopropyl	-	ug/l	None		<0.02	-	-	-	
Fluoranthene	0.2	ug/l	EEC MAC		<2.0	-	<0.01	-	
Fluorene	-	ug/l	None		<2.0	-	<0.01	-	
Fluoride	1.5	mg/l as F	DWS 2010		-	0.33	-	0.263	
Glyphosate	-	ug/l	None		-	<0.01400	-	<0.01400	
Hardness Total - As CaCO3	-	mg/l as CaCO3	None		-	-	529	-	
HCH Alpha	-	ug/l	None		<0.1	-	-	-	
HCH Beta	-	ug/l	None		<0.02	-	-	-	
HCH Gamma (Lindane)	2	ug/l	WHO 2004		<0.02	-	-	-	
Heptachlor	0.03	ug/l	DWS 2010		<0.02	-	-	-	
Hexachloro 1,3 Butadiene	0.1	ug/l	WFD 2010		<5.0	-	-	-	
Hexachlorobenzene	0.01	ug/l	WFD 2010		<0.02	-	-	-	
Hexachlorocyclopentadiene	-	ug/l	None		<5.0	-	-	-	
Hexachloroethane	-	ug/l	None		<5.0	-	-	-	
Indeno-[1,2,3-Cd]-Pyrene	0.002	ug/l	WFD D 10		<2.0	-	<0.01	-	
Iodide Ion	-	ug/l as I	None		-	-	29	-	
Ioxynil	0.1	ug/l	DWS 2010		<0.02	-	-	-	
Irgarol 1051	-	ug/l	None		-	-	<0.00500	-	
Iron Dissolved	200	ug/l as Fe	DWS 2010		-	-	0.43	-	
Iron Total	200	ug/l as Fe	DWS 2010		-	-	11	-	
Isodrin	0.1	ug/l	DWS 2010		<0.02	-	-	-	
Isophorone	-	ug/l	None		<5.0	-	-	-	
Isopropylbenzene (Cumene)	-	ug/l	None		<1	-	-	-	
Isoproturon (Diip1,3Dithiolan-2-Ylidenemalonate)	0.1	ug/l	DWS 2010		-	<0.00300	-	<0.00800	

Source of data*						SI	TT	TT	TT
Name					SA4302	SA4302	SA4302	SA4302	SA4302
Hydrogeological unit**					RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria				146m	146m	146m	146m	146m
Chemical	Value	Units	Source		6/10/2011	11/1/2012	22/3/2012	29/5/2012	
Lambda Cyhalothrin	-	ug/l	None		-	-	<5.00	-	-
Lead Total	10	ug/l	WS Regs 20		-	<5	-	<5	
Lithium Dissolved	-	ug/l as Li	None		-	-	<0.0006	-	
Lithium Total	-	ug/l as Li	None		-	-	<0.0006	-	
Magnesium Dissolved	50	mg/l as Mg	EEC MAC		-	-	22	-	
Magnesium Total	50	mg/l as Mg	EEC MAC		16	24	-	21	
Malathion	-	ug/l	None		<0.02	-	-	-	
Manganese Dissolved	50	ug/l as Mn	DWS 2010		-	-	0.63	-	
Manganese Total	50	ug/l as Mn	DWS 2010		-	-	1.3	-	
MCPA {2-methyl-4-chlorophenoxyacetic acid }	0.1	ug/l	DWS 2010		<0.02	<0.00900	-	<0.00900	
MCPB	10	ug/l	WHO 2004		<0.02	-	-	-	
Mecoprop { }	0.1	ug/l	DWS 2010		<0.02	<0.01000	-	<0.01000	
Mercury Total	1	ug/l Hg	WS Regs 20		-	<0.002	-	<0.002	
Metazachlor	-	ug/l	None		-	<0	-	<0	
Methane	-	ug/l	None		-	-	49	-	
methocrifos	-	ug/l	None		<0.01	-	-	-	
Methoxychlor	0.1	ug/l	DWS 2010		<0.01	-	-	-	
Mevinphos	0.1	ug/l	DWS 2010		<0.02	-	-	-	
Molybdenum Total	0	ug/l	GW Regs 98		-	-	<5	-	
Multi Residual Scan	-	ug/l	None		-	-	-	<0.10000	
n - Butylbenzene	-	ug/l	None		<1	-	-	-	
n - Propylbenzene	-	ug/l	None		<1	-	-	-	
Naphthalene	1.2	ug/l	WFD D 10		<2.0	-	0.07	-	
Nickel Total	20	ug/l as Ni	DWS 2010		-	24	-	20	
Nitrate - N	11.3	mg/l as N	WS Regs 20		0.9	2.24	-	4.83	
Nitrobenzene	-	ug/l	None		<5.0	-	-	-	
Nitrogen Total Oxidised	11.3	mg/l as N	WS Regs 20		-	-	2.15	-	
N-nitrosodi-n-propylamine	-	ug/l	None		<5.0	-	-	-	
N-Nitrosodiphenylamine	-	ug/l	None		<5.0	-	-	-	
Orthophosphate	-	mg/l as P	None		-	-	<0.18	-	
Oxamyl	-	ug/l	None		-	-	<0.00500	-	
o-Xylene	-	ug/l	None		<1000	-	-	-	
PAHs Total	0.1	ug/l	DWS 2010		-	-	0.07	-	
Parathion {Parathion Ethyl}	1	ug/l	SW Regs 96		<0.01	-	-	-	
Parathion-Methyl { }	1	ug/l	SW Regs 96		<0.02	-	-	-	
Pendimethalin	0.1	ug/l	DWS 2010		<0.02	-	-	-	
Pentachlorophenol	9	ug/l	WHO 2004		<50.0	-	-	-	
Permethrin (Cis + Trans)	0.01	ug/l	WFD D 10		<0.1	<0.10000	-	-	
Permethrin, Cis	0.01	ug/l	WFD D 10		<0.01	-	-	-	
pH	10	pH units	DWS 2010		7.7	-	-	-	
Phenanthrene	-	ug/l	None		<2.0	-	<0.01	-	
Phenol	0.5	ug/l	EEC MAC		<0.5	-	-	-	
Phenol (Pentachlorophenol (PCP))	-	ug/l	None		-	<0.00900	-	<0.00900	
Phenols Total For SWAD (7 Compounds)	-	ug/l	None		-	27.0	-	<8.0	
phosalone	-	ug/l	None		<0.01	-	-	-	
phosfamidon	-	ug/l	None		<0.02	-	-	-	
Pichloram	-	ug/l	None		<0.02	-	-	-	
Pirimiphos Methyl {Methyl Pirimiphos}	0.015	ug/l	FW List II		<0.02	-	-	-	
Pirimiphos-Ethyl	-	ug/l	None		<0.02	-	-	-	
Potassium Dissolved	-	mg/l as K	None		5	-	5.4	-	
Potassium Total	-	mg/l as K	None		-	5	-	5.3	
Promethryn	-	ug/l	None		<0.03	-	-	-	
Propazine	0.1	ug/l	DWS 2010		<0.03	<0.00400	-	<0.00500	
Propetamphos	0.1	ug/l	DWS 2010		<0.02	<0.00500	-	<0.00500	
Propyzamide	-	ug/l	None		<0.02	-	-	-	

Source of data*					SI	TT	TT	TT
Name				SA4302	SA4302	SA4302	SA4302	SA4302
Hydrogeological unit**				RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria			146m	146m	146m	146m	146m
Chemical	Value	Units	Source	6/10/2011	11/1/2012	22/3/2012	29/5/2012	
Pyrene	-	ug/l	None	<2.0	-	<0.01	-	-
Resmethrin	-	ug/l	None	<0.1	-	-	-	-
Salmonella	0	ct/100ml	WFD 2010	<0	-	-	-	-
SECB	-	ug/l	None	<1	-	-	-	-
Selenium	10	ug/l as Se	DWS 2010	-	-	1.6	-	-
Silicate Reactive Dissolved - As SiO2	-	mg/l	None	-	-	14	-	-
Simazine	0.1	ug/l	DWS 2010	<0.03	<0.00900	-	<0.00400	-
Sodium Total	200	mg/l as Na	DWS 2010	52	67	-	57	-
Strontium Dissolved	-	ug/l as Sr	None	-	-	0.46	-	-
Strontium Total	-	ug/l as Sr	None	-	-	0.52	-	-
Styrene	-	ug/l	None	<1	-	-	-	-
Sulphate	250	mg/l as SO4	DWS 2010	<3	77.8	-	110	-
Sulphide	-	ug/l	None	-	-	<29.0	-	-
Sulphite Reducing Clostridia	-	ug/l	None	7	-	-	-	-
Tecnazene	0.1	ug/l	DWS 2010	<0.01	-	-	-	-
Terbutryn	0.1	ug/l	DWS 2010	<0.03	<0.00300	-	<0.00500	-
terbutylazine	7	ug/l	WHO 2004	<0.1	-	-	-	-
tert - Butylbenzene	0.1	ug/l	DWS 2010	<1	-	-	-	-
Tetrachloroethene (Per/Tetrachloroethylene)	10	ug/l	DWS 2010	213	-	-	-	-
Tetrachloroethylene	-	ug/l	None	-	84.3	-	132	-
Tetrachloroethioanisole	-	ug/l	None	-	-	0.00600	-	-
Tetramethrin	-	ug/l	None	<0.1	-	-	-	-
Tin Total	0	ug/l as Sn	GW Regs 98	-	-	<5	-	-
Titanium	0	ug/l as Ti	GW Regs 98	-	-	0.06	-	-
Toluene (Methylbenzene)	50	ug/l	WFD 2010	<1	-	<0.55	-	-
Trans Chlordane	-	ug/l	None	<0.01	-	-	-	-
trans-Permethrin	-	ug/l	None	<0.01	-	-	-	-
Triadimefon	-	ug/l	None	<0.02	-	-	-	-
Triallate	0.25	ug/l	FW List II	<0.02	-	-	-	-
Triazophos	0.1	ug/l	DWS 2010	<0.01	-	-	-	-
Trichloroethene (Trichloroethylene)	10	ug/l	DWS 2010	<5	2.7	-	1.77	-
Trichlorofluoromethane	-	ug/l	None	<1	-	-	-	-
Triclopyr	-	ug/l	None	<0.02	-	-	-	-
Trietazine	-	ug/l	None	<0.02	<0.00600	-	<0.00800	-
Trifluralin	0.1	ug/l	DWS 2010	<0.02	<0.01000	-	<0.01000	-
Trimethylphenols	-	mg/l	None	<0.0005	-	-	-	-
Turbidity	1	FTU	WS Regs 20	29.71	40.2	-	5.67	-
Uranium	0	ug/l as U	GW Regs 98	-	-	0.6	-	-
Vinyl Chloride	0.5	ug/l	DWS 2010	<1	-	-	-	-
Xylene (Meta & Para){1,3+1,4-Dimethylbenzene}	30	ug/l	WFD 2010	<1	0.11	<0.180	-	-
Xylene (ortho)	30	ug/l	SW Regs 98	-	-	<0.09	-	-
Zinc Total	50	ug/l as Zn	DWS 2010	-	5	-	<5	-

**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

## 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)<sup>10</sup> shows no groundwater body designation for either the upper or lower aquifers within the area in which the Acton Storm Tanks 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)<sup>10</sup>.
- 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):
- a. The control of pollution to groundwater that may arise from any development which takes place on 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 Acton Storm Tanks assessment is given in Vol 4 Table K.8.

**Vol 4 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	Land quality data	February 2011	

Source	Data	Date received	Notes
project			
Individual licence holders	Letters sent out to 30 licence holders	December 2011 (last updated 15 <sup>th</sup> October 2012)	

\* LBs – London Boroughs

## References

- <sup>1</sup> British Geological Survey. *British geology onshore digital maps 1:50 000 scale*. Received from Thames Tunnel (February 2009).
- <sup>2</sup> USGS. *Glossary of Hydrologic Terms in The Federal Glossary of Selected Terms: Subsurface-Water Flow and Solute Transport*. Department of Interior, U.S. Geological Survey, Office of Water Data Coordination (August 1989).
- <sup>3</sup> Environment Agency. Environment Agency Website. Available at: <http://www.environment-agency.gov.uk/homeandleisure/117020.aspx>. Accessed April 2012.
- <sup>4</sup> 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.
- <sup>5</sup> 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.
- <sup>6</sup> *The Water Supply (Water Quality) Regulations* (2000). Available at: <http://www.legislation.gov.uk/ukxi/2000/3184/contents/made>. Accessed April 2012.
- <sup>7</sup> *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.
- <sup>8</sup> Department of Environment, Food and Rural Affairs & Environment Agency. *Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Tetrachloroethene* (2004). Available [http://www.environment-agency.gov.uk/static/documents/Research/percold\\_2029065.pdf](http://www.environment-agency.gov.uk/static/documents/Research/percold_2029065.pdf). Accessed April 2012.
- <sup>9</sup> Environment Agency. *Soil Guideline Value Reports* (2009). Available at: <http://www.environment-agency.gov.uk/research/planning/64015.aspx>. Accessed April 2012.
- <sup>10</sup> 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.

**Thames Tideway Tunnel**  
Thames Water Utilities Limited



# Application for Development Consent

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

### **Volume 4: Acton Storm Tanks appendices**

#### **Appendix L: Water resources - surface water**

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

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# Thames Tideway Tunnel

## Environmental Statement

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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

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

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#### **Appendix M: Water resources - flood risk**

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## Appendix M: Water resources – flood risk

### M.1 Policy considerations

#### Planning policy

- 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)<sup>1</sup> 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, NPS) have been reviewed within Volume 2 Environmental assessment methodology. A summary of local and regional policy relevant to flood risk at Acton Storm Tanks is provided below.

#### Local policy

##### Strategic Flood Risk Assessment

- M.1.4 The Acton Storm Tank site lies within the London Borough (LB) of Ealing. The LB of Ealing has produced a Strategic Flood Risk Assessment (SFRA) (Capita Symonds Ltd, 2008)<sup>2</sup>. This reviews existing information on flood risk, outlines the current level and identifies the significant sources of flood risk in the borough.
- M.1.5 Despite the River Thames not flowing through the LB of Ealing, the SFRA confirms that the Thames Tidal Defence network defends the south eastern corner of the borough against a 0.1% AEP for tidal events up to 2030. However there remains a residual risk of flooding from tidal inundation as a result of a breach or overtopping of the flood defences.
- M.1.6 According to the SFRA:
- a. The site lies within the Environment Agency (EA) Flood Zone 3.
  - b. Acton is shown to sit on a thin layer of Lyndon Hill Gravel and Langley Silt. A thick layer of London Clay underlies the whole borough.
  - c. The natural flood plain of the River Thames extends into the south eastern corner of the LB of Ealing, including Acton Green and Bedford Park and the site lies just within this floodplain.
  - d. The site is within an area benefiting from the Thames Tideway Defences.
  - e. Acton lies within an area classified as ebbing at risk from foul water sewer flooding. The majority of surface water flooding also occurs in Acton. There have been a total of two properties flooded from overloaded foul sewers between 1997 and 2007 within close proximity to the site.
  - f. The site is located in an area with a medium groundwater risk.

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 Council, in partnership with the Greater London Authority (GLA), Thames Water and the EA has produced a Surface Water Management Plan (SWMP) (Capita Symonds and Scott Wilson, 2011)<sup>3</sup> as part of the Drain London project. The SWMP sets out the preferred surface water management strategy for the borough.

M.1.9 According to the SWMP:

- a. The site lies within the Group1\_007 (High Street, Acton) Critical Drainage Area<sup>i</sup>.
- b. The site lies along an identified flow path for the 1% AEP<sup>ii</sup> plus climate change rainfall event.
- c. The surface water flood hazard rating for sections of the site range from very low to extreme for the same rainfall event.
- d. There have been 51-100 recorded sewer flood incidents in the area surrounding the site.

### **Regional policy**

#### **Thames Estuary 2100**

M.1.10 The Acton Storm Tanks site lies within the Hammersmith Policy Unit which has been assigned the flood risk management policy 'P5' within the Thames Estuary 2100 (TE2100) Plan (EA, 2012)<sup>4</sup>, meaning that further action will 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 flooding from the River Thames
- b. surface water (heavy rainfall) and urban drainage sources
- c. a risk of groundwater flooding.

M.1.12 Flood mitigation from these sources include:

- a. the Thames Barrier and secondary tidal defences along the Thames frontage (both making up the Thames Tidal Defences)
- b. combined sewer overflows (CSOs) for mitigation of urban drainage
- c. 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

---

<sup>i</sup> Area susceptible to surface water flooding

<sup>ii</sup> A flood with a 1% Annual Exceedance Probability (AEP) has a one in 100 year probability of occurring in a given year.

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 an aspiration increase flood risk awareness within the area.

### **London Regional Flood Risk Appraisal**

- M.1.14 For the reach between Teddington Lock and Hammersmith Bridge (West London Reach) the London Regional Flood Risk Appraisal (RFRA) (GLA, 2009)<sup>5</sup> encourages developments to be designed in such a way as to take opportunities to reduce flood risk and include resilience.
- M.1.15 The RFRA indicates that SuDS should be included within developments to reduce surface water discharge.

## **M.2 Environment Agency comments**

Mr P Stride  
Thames Water  
The Point  
37 North Warf Road  
Paddington  
London  
W2 1AF

19 April 2012

Dear Phil,

On 25 October last year I wrote to you in response to your memorandum of the 24 June 2011 (Doc. Ref 100-CN-MDL-ENVIR-000004-AB), in which the control and performance of the Recommended Phase 2 Thames Tunnel Consultation Scheme is summarised.

In the memorandum you sought commitment or acknowledgement by the Environment Agency on several topics. At the time discussions between the Environment Agency and the Thames Tunnel team were on-going in two areas:

- The proposed operation of the storm tanks at Acton site during the construction period
- The System Operating Strategy with reference to the control of discharges at Abbey Mills to an agreed frequency.

I provide an update on discussions on each of topics below.

#### Acton Storm Tanks

At the CSO Performance meeting, held on 3 October 2011, it was agreed that the London Tideway Tunnels team would provide a written statement to the Environment Agency on its proposals to actively manage the operation of the storm tanks at Acton, to maximise the use of the available storage during construction of the tunnel.

Subsequently the Environment Agency has received and reviewed several documents in relation to the Acton storm tanks site. These include:

- the Memorandum "Acton storm tanks performance during operation" (Doc. Ref. 100-CN-MDL-ENVIR-000005)
- 12<sup>th</sup> January 2012 email from David Crawford with attachment of three maps showing the position at Acton Storm tanks for current conditions, with construction conditions with two tanks removed, and a comparator. The 'nodes' that are affected by the tanks were identified on these maps.
- proposals within the PEIR as part of the Thames Tunnel Phase 2 consultation.

We provided the advice below on the 19<sup>th</sup> January 2012 via an email to the Thames Tunnel team (from Isobel Bain to Alan Lewis, David Crawford):

"We understand that the tanks on site will be managed to minimise the frequency and volume of spillage from the Acton CSO during construction as a result of removing two tanks from operation. We support the active management of the four remaining storm tanks so as to minimise spills to the river. This should involve using all four tanks at all times, unless a large storm (> 25 mm rainfall over 2 hours or a day) is predicted to coincide with a spring high tide (elevation > 4 m AOD), when two tanks should be reserved to protect the site from flooding. The tanks should be pumped out as soon as possible after the storm and the tanks kept clean at all times when not full. The tanks should be filled in a way that maximises the available storage in each tank, such that the available freeboard is utilised. A plan detailing the techniques for operating the storm tanks should be drawn up and agreed with the

Environment Agency. The proposal is acceptable in terms of CSO operation, however we must caveat and advice that this must not cause unacceptable impact on flood risk.

With regards to flood risk the proposal should be carefully explained in the Flood Risk Assessment and Environmental Statement to enable a decision by the appropriate authority. For river flooding and riparian matters the Environment Agency is the primary adviser to the planning process and also regulator (through flood defence consents). In such instances for proposals to be acceptable to us we would usually require that flood risk should not be increased and ideally reduced. On this site any changes in flood risk would be due to sewer flooding. In such cases our roles are a, to ensure that flood risk in all its forms is adequately reported and b, working with developers to find solutions to any problems and make the best of opportunities, but without making a judgement on the outcome and mitigation measures. The Local Authority/IPC are the appropriate authority with respect to sewer flooding”.

We then offered further advice regarding the content of the ES and the FRA in this respect.

#### System Operating Strategy

The proposed system operating strategy within your memo. assumed that Abbey Mills PS discharges must be limited to 1 in 10 years on average. This would require that some storage be reserved in the Thames Tunnel, by redirecting CSOs along the River Thames to the river before the Thames Tunnel is full and starting bypass pumping, to capture flows from Abbey Mills. This results in some storage being left unused in the Tunnel during larger storm events.

In our response we noted that we need to understand which individual CSOs may discharge as a consequence, and the potential impacts of this. Further discussion is still required before we can confirm our position on this proposed CSO performance target. Notwithstanding we understand that the system operating strategy does not affect the design of the Tunnel or the sites required, and we have agreed with you that these discussions can be concluded prior to finalising the initial system operating strategy and reviewed as necessary thereafter.

Yours sincerely,

A handwritten signature in blue ink, appearing to be 'D. Wardle', written over a vertical line.

Dave Wardle  
London Environment Manager

cc David Crawford

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## References

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

<sup>2</sup> Capita Symonds Ltd. *LB of Ealing Strategic Flood Risk Assessment Final Report*. (March 2008).

<sup>3</sup> Capita Symonds and Scott Wilson. *LB of Ealing Surface Water Management Plan Final Report*. (Aug 2011).

<sup>4</sup> Environment Agency. *Thames Estuary 2100 Plan* (November 2012).

<sup>5</sup> Greater London Authority. *London Regional Flood Risk Appraisal*. (October 2009).

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**Thames Tideway Tunnel**  
Thames Water Utilities Limited



# Application for Development Consent

Application Reference Number: WWO10001

## Environmental Statement

Doc Ref: **6.2.04**

**Volume 4: Acton Storm Tanks appendices**

**Appendix N: Development schedule**

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# Thames Tideway Tunnel

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### Volume 4 Acton Storm Tanks appendices

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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 4 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 4 Table N.1 Development schedule for Acton Storm Tanks**

Category types:

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

Develop ment 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		2018 (Site Year 1 of construction)	2019 (peak construction traffic year)	2023 (Year 1 of operation)		
The Oaks Shopping Centre	Approx 1km northwest	PP/2012/3154	Acton Regeneration Company Ltd	Partial refurbishment, demolition and redevelopment of shopping centre to provide two storey residential accommodation fronting Hoopers Mews, five storey accommodation fronting Churchfield Road (retail on ground floor with residential above), 11 storey tower to the corner of Churchfield Road former burial ground and part 5, part 7 and part 8 storey residential accommodation with a basement level across the remainder of the site. New foodstore to baseline level (4,606sqm) together with two new retail units (91sqm and 14sqm), seven refurbished units (2,425sqm), 146 residential units (55 x 1 bed, 59 x 2 bed and 32 x 3 bed) and ancillary service yard, storage, plant, circulation space, amenity space and play space, provision of 227 car parking spaces, including 22 disabled spaces (193 retail and 34 residential), 262 cycle parking spaces (82 retail and 180 residential), with vehicular access from Churchfield Road and access to the residential units off Churchfield Road, Hoopers Mews and former burial ground. Provision of two pedestrian links between High Street and former burial ground (previous applications for The Oaks site have been withdrawn) Conservation Area Consent Application also received (Ref PP/2012/3155) – demolition of western wall to St Mary's Burial Ground.	C	100% complete & operational	100% complete & operational	100% complete & operational	Environmental assessment documents in application documentation assume opening year of 2015.	Base case (all years)
South Acton Estate	Approx 1km west (closest part of dev)	P/2012/0708	Acton Gardens LLP, joint venture between Countryside Properties Ltd and London and Quadrant Housing Trust	Dwellings at Anstey Ct; 1-66 Arlington Ct; 1-22 Arundel House; 98-100 (inclusive) Avenue Rd; Barrington Ct; Barwick Hse; Beaumaris Tower; Bennett Ct; 347-371 Bollo Lane; Bollo Brook Youth Club; 81-95 Brouncker Rd; Buchan House and commercial units (Hanbury Rd commercial units); Caine Hse; Carisbrooke Ct; Carroll Ct; Charles Hocking House; Chesterton Ct; Cheltenham Pl; Blocks at 81-139 Church Rd; 1-20 Clandon Cl; Conrad Tower; Corfe Tower; Doyle House; 2-16 Enfield Rd; 79-83 Enfield Rd; Frampton Ct (Belgrave Close); Galsworthy Ct; 1-16 Glamis Ct; Grahame Tower; Hardy Ct (and commercial units at 96-118 Bollo Bridge Road); Harlech Tower, Harleyford Manor; Jerome Tower; Ludlow Ct; Meredith Tower; Oak Tree Community Centre; 32 and 274-292 Osborne Rd; The (former) Osborne Public House; Pembroke House; 1-16 Pevensey Ct; 1-40 Ragley Cl (commercial units at 1-3 Ragley Cl); St Margaret's Lodge; 1-6 Telfer Cl; Webb Ct; Wodehouse Ct; Woolfe Ct; and Acton Working Mens Club; public open spaces including Bollo	C	Phases 1-5 completed. Phases 6 & 7 under construction.	Phases 1-5 completed. Phases 6, 7 & 8 under construction.	Phases 1-7 completed. Phase 8, 9 & 10 under construction.	Environmental Statement (February 2012). ES states that: Phases 1-5 will be complete by 2017 Phase 6 = 2016-2019 Phase 7 = 2017-2021 Phase 8 = 2019-2023 Phase 9 = 2022-2025 Phase 10 = 2023-2026 Phase 11 = post 2026 This has been used as the basis of the	<b>2018:</b> Base case = Phases 1-5 Cumulative = Phases 6 & 7 <b>2019:</b> Base case = Phases 1-5 Cumulative = Phases 7, 8 & 9 <b>2023:</b> Base case = Phases 1-7 Cumulative = Phases

Develop- ment within 1km (IPC or Mayoral referral unless otherwis e 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		2018 (Site Year 1 of construction)	2019 (peak construction traffic year)	2023 (Year 1 of operation)		
							Brook Park, South Park, Avenue Rd Recreation Ground and allotments at Jerome Tower and Enfield Rd.  Outline planning application for the continued regeneration of the South Acton Estate comprising of the demolition of buildings locations specified in the site address (including residential units, 521sqm of retail shops, 2,434sqm of community/ office facilities, hotel, garages and associated areas) and the erection of a maximum of 2,350 residential units, a maximum of 1,050sqm of flexible A1 (retail) / A3 (restaurant and cafe) / B1 (office) / D1 (community) uses, of which 450sqm is to be A1 (retail) use, a further 2,348sqm of D1 (community) / B1 (office) space (to include a minimum of 926sqm for provision of a community centre and youth club), energy centre, alterations to allotments, re-sited and enhanced open space and play facilities, landscaping, highway works and car parking.			

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

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DCO-DT-000-ZZZZZ-060204

