Thames Tideway Tunnel
Thames Water Utilities Limited

Development Consent Order

Application Reference Number: WWO10001

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

Thames Tideway Tunnel

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

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Environmental Statement

Doc Ref: **6.2.15**

Volume 15: Heathwall Pumping Station appendices

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Appendix A: Introduction

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Appendix A: Introduction

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Appendix A: Introduction

A.1 Summary

A.1.1 This document presents the appendices that accompany the *Environmental Statement* Volume 15 Heathwall Pumping Station site assessment.

A.1.2 Figures associated with the appendices are provided within a separate volume of figures.

A.1.3 For consistency and ease of use Volumes 3 to 27 of the *Environmental Statement* all utilise the same appendices contents and labelling protocol. For these volumes the appendices are as follows:

a. Appendix A: Introduction
b. Appendix B: Air quality and odour
c. Appendix C: Ecology – aquatic
d. Appendix D: Ecology – terrestrial
e. Appendix E: Historic environment
f. Appendix F: Land quality
g. Appendix G: Noise and vibration
h. Appendix H: Socio-economics
i. Appendix I: Townscape and visual
j. Appendix J: Transport
k. Appendix K: Water resources – groundwater
l. Appendix L: Water resources – surface water
m. Appendix M: Water resources – flood risk
n. Appendix N: Development schedule.

A.1.4 Where a topic has not been assessed the associated appendix does not include any supporting information. Also, if a topic has been assessed but does not need to present any supporting information then the appendix is intentionally empty.

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Appendix B: Air quality and odour

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Appendix B: Air quality and odour

B.1 Model verification

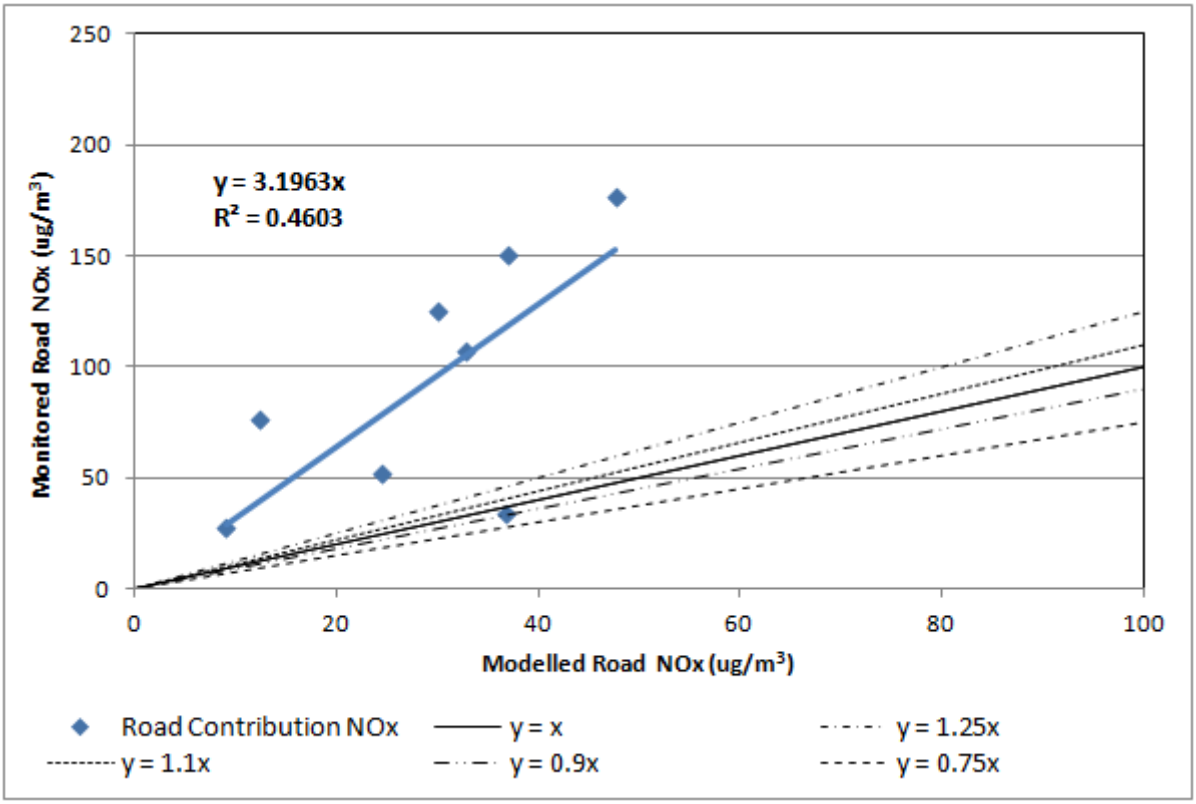
B.1.1 Modelled NO_2 concentrations have been plotted against monitored concentrations at the eight diffusion tube sites (KSTM1-KSTM5, HEAM1-HEAM2 and W3) shown in Vol 15 Figure 4.4.1 (see separate volume of figures).

B.1.2 This showed that the modelled results underestimated NO_2 concentrations by between -2% and 37%. As the model has been optimised and no further improvement of the model was considered feasible (such as reducing vehicle speeds or using different pollutant backgrounds, etc), a model adjustment factor was therefore deemed necessary.

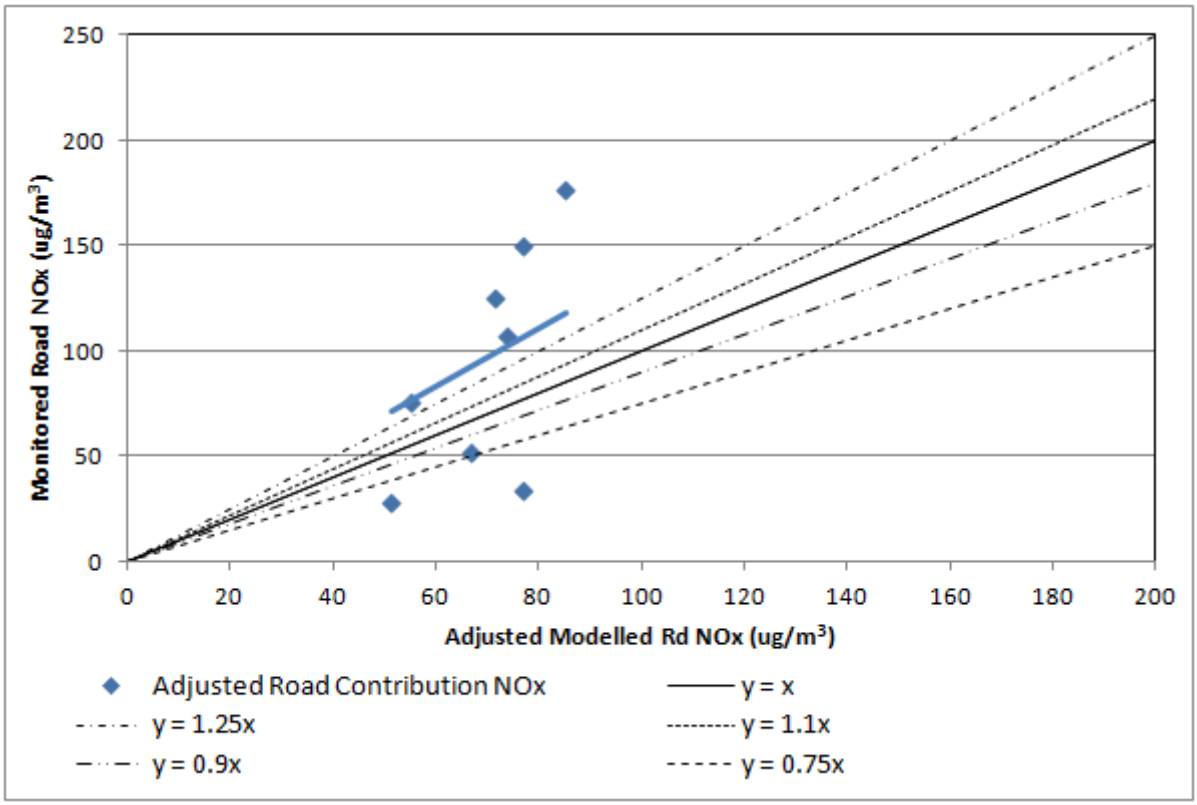
B.1.3 To derive the adjustment factor, modelled road NO_X concentrations were plotted against calculated monitored road NO_X concentrations - see Vol 15 Plate B.1 below. An adjustment factor of 3.20 was calculated to adjust modelled roadside NO_X concentrations, in accordance with LAQM.TG(09) (Defra, 2009) [1] and was subsequently applied – see Vol 15 Plate B.1. This factor was also applied to the PM_{10} results as the PM_{10} monitoring sites were more than 1km away from the site and traffic data were not available, so model verification could not be carried out.

B.1.4 Applying the NO_X adjustment factor and then calculating NO_2 concentrations, as shown in Vol 15 Plate B.2, provides better overall agreement between actual and predicted data. The subsequent linear regression calculation for monitored versus modelled total NO_2, as shown in Vol 15 Plate B.3, indicated that five of the eight modelled concentrations were within 10% of the measured value and that two the other three were within 25% of the modelled value.

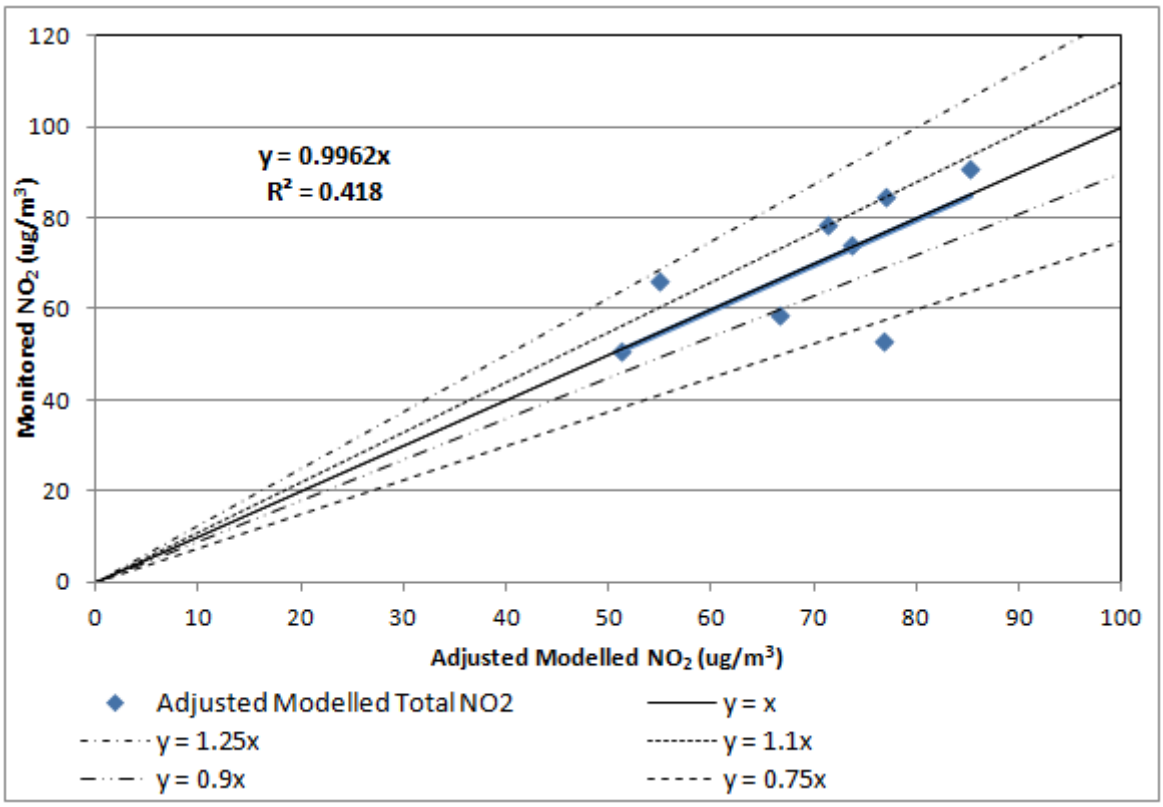
Vol 15 Plate B.1 Air quality - monitored road NO_X vs. modelled road NO_X



Vol 15 Plate B.2 Air quality – monitored road NO_X vs. adjusted modelled road NO_X



Vol 15 Plate B.3 Air quality – total monitored NO_2 vs. total adjusted modelled NO_2



B.2 Traffic data

B.2.1 The traffic data used in the air quality modelling for the Heathwall Pumping Station site are shown in Vol 15 Table B.1.

Vol 15 Table B.1 Air quality - traffic data modelling inputs

Source	Road link	2010 baseline AADT*	Baseline % HGV >3.5t	Speed limit (mph)	Model input speed (mph)	Growth factor % (2009 - 2018)	Peak const-ruction year AADT	Peak construction year AADT scheme construction HGV (HGV >3.5t)	Peak construction year development case (total AADT)	Peak construct-ion year develop-ment case AADT % HGV (>3.5t)
ATC** 'Indirect'	Battersea Park Road	29180	9.7%	30	30.2	8.3%	31609	42	31664	9.8%
Speed Limit	Kirtling Street	994	19.4%	30	30.0	8.3%	1077	44	1121	22.5%
ATC 'Indirect'	Nine Elms Lane west of Cringle Street	27295	8.8%	30	30.2	8.3%	29568	33	29613	8.9%
Speed Limit	Cringle Street	1166	25.4%	30	30.0	8.3%	1263	44	1307	28.0%
ATC 'direct'	Nine Elms Lane east of Cringle Street	28140	18.6%	30	30.2	8.3%	30482	33	30528	18.7%

** AADT – annual average daily traffic. ** ATC – automatic traffic counter.*

B.3 River tug emission factors

B.3.1 Emissions of NO_X and PM_{10} from tugs pulling the barges were calculated using the data shown in Vol 15 Table B.2 for the Heathwall Pumping Station site.

Vol 15 Table B.2 Air quality - tug assessment model inputs

Parameter	Value	Units
Total tugs	216	Tugs/year
Time per tug*	20	minutes
NO_X base emission factor	10.2	g/kWhr
PM_{10} base emission factor	0.9	g/kWhr
Average tug engine size	984	kW
Manoeuvring and hotelling** load factor	0.2	No units
Total tug area***	3091	m2
NO_X emissions per tug	1.8×10^{-04}	$g/s/m^2$
PM_{10} emissions per tug	1.6×10^{-05}	$g/s/m^2$

** Time that tug is at the site.*
*** Hotelling refers to when the tug is securely moored or anchored.*
**** Area of the mooring and manoeuvring of tugs*

B.4 Construction plant emission factors

B.4.1 For the purpose of the assessment, the following listed equipment (Vol 15 Table B.3) has been modelled for the peak construction year at the Heathwall Pumping Station site.

Vol 15 Table B.3 Air quality - construction plant assessment model inputs

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time	Power (kW)	NO_X emission rate ($g/s/m^2$)	PM_{10} emission rate ($g/s/m^2$)
Site set up and general site	Ground level behind hoarding	Compressor 250cfm*	1	50	104	3.2×10^{-7}	2.0×10^{-8}
	Ground level behind hoarding	Generator - 200kVA	1	100	160	1.0×10^{-6}	6.2×10^{-8}
	Ground level behind hoarding	JCB with hydraulic breaker	1	50	67	2.1×10^{-7}	1.3×10^{-8}
	Ground level behind hoarding	Cutting equipment (diamond saw)	2	10	2.3	7.3×10^{-9}	1.6×10^{-8}
	Ground level behind hoarding	Telescopic handler / FLT**	1	30	60	1.1×10^{-7}	7.0×10^{-9}
	Ground level behind hoarding	Hiab*** lorry/crane	1	5	56	1.7×10^{-8}	1.1×10^{-9}
Cofferdam construction	Ground level behind hoarding	400cfm compressor	2	50	104	6.5×10^{-7}	4.0×10^{-8}
	Ground level behind hoarding	150t crawler crane	1	60	240	9.0×10^{-7}	5.6×10^{-8}
	Ground level behind hoarding	Generator	1	100	28	2.8×10^{-6}	2.6×10^{-7}

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time	Power (kW)	NO_X emission rate ($g/s/m^2$)	PM_{10} emission rate ($g/s/m^2$)
	Ground level behind hoarding	Jack-up barge	1	100	104	6.5×10^{-7}	4.0×10^{-8}
Cofferdam construction	Ground level behind hoarding	25t excavator	1	80	125	6.2×10^{-7}	3.9×10^{-8}
	Ground level behind hoarding	Plate compactors	2	10	3	9.5×10^{-9}	2.1×10^{-8}
	Ground level behind hoarding	Vibrating rollers	2	50	145	9.0×10^{-7}	5.6×10^{-8}
Shaft sinking by caisson or underpinning	Ground level behind hoarding	100t crawler crane	1	50	240	7.5×10^{-7}	4.7×10^{-8}
	Ground level behind hoarding	40t crawler crane	1	50	132	4.1×10^{-7}	2.6×10^{-8}
	Ground level behind hoarding	Long reach excavator	1	80	178	8.9×10^{-7}	5.5×10^{-8}
	Within shaft	12t excavator with breaker	1	50	73	2.3×10^{-7}	1.4×10^{-8}
	Ground level behind hoarding	25t excavator	1	80	125	6.2×10^{-7}	3.9×10^{-8}
	Ground level behind hoarding	Dumper	1	50	81	2.5×10^{-7}	1.6×10^{-8}
Connection tunnel - pipejack	Ground level behind hoarding	100t crawler crane	1	50	240	7.5×10^{-7}	4.7×10^{-8}
	Ground level behind hoarding	Service crane 40t mobile crane	1	25	275	4.3×10^{-7}	2.7×10^{-8}
	Ground level	Dumper	1	25	81	1.3×10^{-7}	7.9×10^{-9}

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time	Power (kW)	NO_X emission rate ($g/s/m^2$)	PM_{10} emission rate ($g/s/m^2$)
	behind hoarding						
	Ground level behind hoarding	Loading shovel	1	30	63	1.2×10^{-7}	7.3×10^{-9}
Shaft secondary lining	Ground level behind hoarding	100t crawler crane	1	50	240	7.5×10^{-7}	4.7×10^{-8}
	Ground level behind hoarding	Service crane 40t mobile crane	1	25	275	4.3×10^{-7}	2.7×10^{-8}
	Ground level behind hoarding	Concrete deliveries (discharging)	1	20	223	2.8×10^{-7}	1.7×10^{-8}
	Ground level behind hoarding	Concrete pump	2	20	223	5.5×10^{-7}	3.5×10^{-8}
Culvert works	Ground level behind hoarding	Service crane – 100t mobile crane	1	50	280	8.7×10^{-7}	5.4×10^{-8}
	Ground level behind hoarding	25t excavator	1	50	125	3.9×10^{-7}	2.4×10^{-8}
	Ground level behind hoarding	Dumper	1	50	81	2.5×10^{-7}	1.6×10^{-8}
	Ground level behind hoarding	Concrete deliveries (discharging)	1	20	223	2.8×10^{-7}	1.7×10^{-8}
	Ground level behind hoarding	Concrete boom pump	1	20	223	2.8×10^{-7}	1.7×10^{-8}

** 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. The appointed Contractor may vary the method and plant to be used. * cfm – cubic feet per minute. ** FLT – fork lift truck. ***Hiab – loader crane.*

References

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

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Appendix C: Ecology - aquatic

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Appendix C: Ecology - aquatic

C.1 Introduction

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

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Appendix D: Ecology - terrestrial

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Appendix D: Ecology – terrestrial

D.1 Notable species survey report

Introduction

D.1.1 A Phase 1 Habitat Survey was carried out on 7 December 2010 at the Heathwall Pumping Station site and is shown in Vol 15 Figure 6.4.2 (see separate volume of figures). Based on this, surveys for the following species have been undertaken:

a. bats;

b. wintering birds; and

c. black redstart *(Phoenicurus ochruros)*.

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.1.11). The results from the surveys are then presented (paras. D.1.12 to D.1.20). The final section provides an interpretation of the results (paras. to D.1.21 to D.1.28). Figures referred to in this report are contained within Vol 15 Heathwall Pumping Station 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, which comprise buildings, trees and the adjacent River Thames, and their potential to support foraging, commuting or roosting bats, one location was chosen for the installation of the remote recording devices shown on Vol 15 Figure 6.4.3 (see separate volume of figures).

D.1.7 Location one is to the north side of the pumping station building. This location was selected to record potential bat activity associated with

foraging and commuting along the adjacent River Thames and to record the movement of bats entering and leaving the site along this boundary.

D.1.8 The bat activity recorded during the remote recording surveys triggered the need for an additional dawn survey (see Vol 2 for bat triggering criteria). Therefore, a second stage of bat surveying was undertaken, comprising one dawn survey visit by two ecologists to assess the usage of the site and immediate surrounds by bats. The survey area for the bat activity (dawn) surveys, is shown in Vol 15 Figure 6.4.3 (see separate volume of figures).

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. The survey area, as shown in Vol 15 Figure 6.4.4 (see separate volume of figures) comprises intertidal foreshore, jetties, moored house boats and the River Thames. The foreshore mainly consists of stones and silt.

D.1.10 The Kirtling Street (Vol 14) proposed development site is located nearby to Heathwall Pumping Station, and as such the foreshore survey area for the wintering bird surveys has been combined with the foreshore survey area for Kirtling Street wintering bird surveys, resulting in one large survey area and a combined set of results.

Black redstart

D.1.11 Black redstart nest on and within buildings and structures (mostly those that are derelict), and forage on sparsely-vegetated open areas. The survey area is shown in Vol 15 Figure 6.4.5 (see separate volume of figures) and includes those buildings, areas of hard standing and other features which lie in the immediate vicinity of Heathwall Pumping Station and the section of foreshore and river which lie adjacent to the site.

Results

D.1.12 In this section, the results of the desk study and notable species surveys are presented. The results are then interpreted in paras. D.1.21 to D.1.28.

Desk Study

D.1.13 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 15 Table D.1.

Vol 15 Table D.1 Terrestrial ecology – species recorded within 500m of the site between 2001 - 2011

Common name	Latin name	Record count
Mammals		
Bat species	*Vespertilionidae*	1

Common name	Latin name	Record count
Common pipistrelle	*Pipistrellus pipistrellus*	7
Birds		
Peregrine falcon	*Falco peregrinus*	6
Common tern	*Sterna hirundo*	1
Greater scaup	*Aythya marila*	1
Herring gull	*Larus argentatus*	4
Black redstart	*Phoenicurus ochruros*	8
Common kingfisher	*Alcedo atthis*	1
Common starling	*Sturnus vulgaris*	6
Hedge accentor	*Prunella modularis*	4
House sparrow	*Passer domesticus*	15
Invertebrates		
Stag beetle	*Lucanus cervus*	1
Plants		
Stinking goosefoot	*Chenopodium vulvaria*	1

Bat surveys

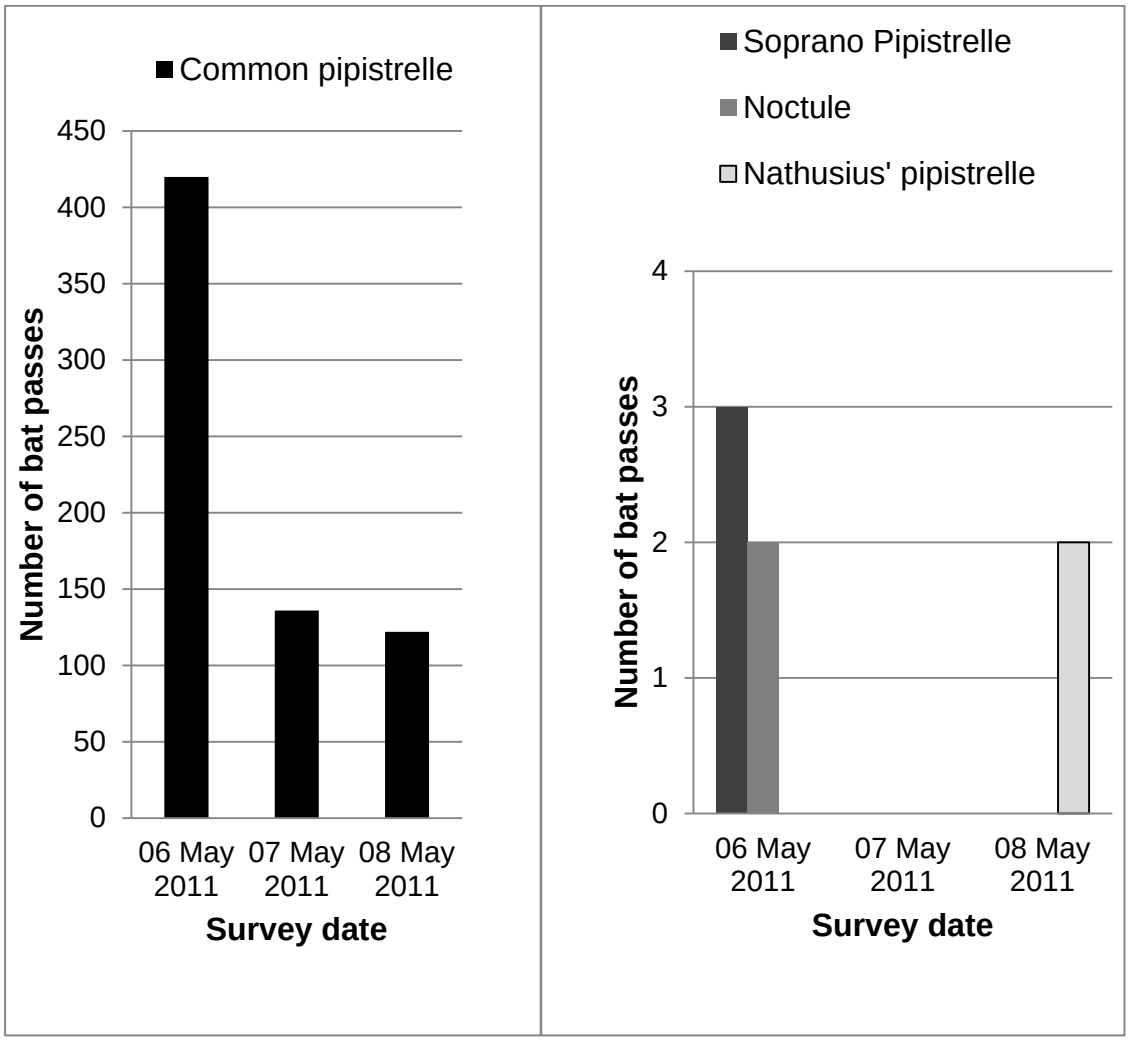
Bat triggering (remote recording) surveys

D.1.14 The bat triggering (remote recording) surveys were undertaken over three nights between 6 and 8 May 2011 in suitable weather conditions (see Vol 15 Table D.2). The remote recording surveys undertaken at this site recorded four species of bats using the site, common pipistrelle (*Pipistrellus pipistrellus)*, soprano pipistrelle (*Pipistrellus pygmaeus),* Nathusius' pipistrelle (*Pipistrellus nathusii)* and noctule (*Nyctalus noctula)*. The maximum number of common pipistrelle bat passes recorded on any one night was 420, recorded on 6 May (see Vol 15 Plate D.1). Soprano pipistrelle, noctule and Nathusius' pipistrelle bat passes were recorded in low numbers, with each species only present on one survey night.

Vol 15 Table D.2 Terrestrial ecology – bat survey weather conditions

Survey visit	Weather conditions
6 May 2011	10°C, gentle breeze, 0% cloud cover, dry
7 May 2011	16°C, calm, 25% cloud cover, dry
8 May 2011	15°C, gentle breeze, 25% cloud cover, dry

Vol 15 Plate D.1 Terrestrial ecology – bat passes recorded during remote recording surveys at one location at Heathwall Pumping Station



Bat activity (dawn) surveys

D.1.15 As there were high numbers of common pipistrelle recorded during the remote recording survey and more than two species were recorded, 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 28 June 2011 in suitable weather conditions (20^{o}C, gentle breeze, 50% cloud cover, dry). No bat activity was recorded during the dawn activity survey.

Wintering bird survey

D.1.16 A total of six survey visits were undertaken at monthly intervals during January, February, March, October, November and December 2011 by an experienced ornithologist (bird specialist). The survey visits were undertaken in suitable weather conditions (see Vol 15 Table D.3). The main foraging and resting areas for wintering birds are indicated on Vol 15 Figure 6.4.4 (see separate volume of figures). The numbers of individuals of each species recorded in each month are provided in Vol 15 Table D.4.

D.1.17 A total of 12 waterbird[i] species were recorded on the foreshore on and adjacent to the site. Of these, six species are of nature conservation importance and are included on the Birds of Conservation Concern 3 (RSPB, 2009)[1] Red or Amber List[ii] and/or UK and London BAP as priority species.

D.1.18 The six species of nature conservation importance are gadwall *(Anas strepera)*, mallard (*Anas platyrhynchos)*, black-headed gull (*Larus ridibundus)*, common gull (*Larus* canus*)*, lesser black-backed gull (*Larus fuscus* ssp. *Graellsii)* and herring gull (*Larus argentatus* ssp. *argenteus*). Gadwall and mallard were recorded foraging on the muddy foreshore and along the water's edge as the tide receded. Four species of gull were recorded resting on the jetty and moored house boats to the west of the site.

Vol 15 Table D.3 Terrestrial ecology – wintering bird survey weather conditions

Survey visit	Weather conditions
25 January 2011	3^{o}C, calm, 100% cloud cover, dry
24 February 2011	10^{o}C, light breeze, 75% cloud cover, dry
25 March 2011	5^{o}C, light breeze, 100% cloud cover, dry
18 October 2011	14^{o}C, light breeze, 75% cloud cover, dry
29 November 2011	13^{o}C, light breeze, 100% cloud cover, dry
13 December 2011	11^{o}C, light breeze, 25% cloud cover, dry

[i] A waterbird is a species which is listed in the Wetland Bird Survey (WeBS) methodology – British Trust for Ornithology, Royal Society for the Protection of Birds, Joint Nature Conservation Committee and Wildfowl and Wetlands Trust.

[ii] The conservation status of all regularly occurring British birds has been analysed in cooperation with the leading governmental and non-governmental conservation organisations, including the Royal Society for the Protection of Birds (RSPB), British Trust for Ornithology (BTO) and Birdlife International Birds of Conservation Concern 3 (RSPB, 2009). The basis of species ongoing population trends are assigned to one of three lists of Conservation Concern. These are the UK Red, Amber and Green lists. Although the lists confer no legal status in themselves, they are useful in evaluating the conservation significance of bird assemblages, and for assessing the potential significance of impacts and informing appropriate levels of mitigation with respect to bird populations.

Birds of Conservation Concern (BoCC) Red List criteria for breeding birds are those which have experienced a severe decline of more than 50% of population and / or range over the last 25 years, as measured by the number of 10km squares occupied by breeding birds of the species concerned. Species listed as globally threatened by Birdlife International and those with a historical decline in the UK between 1800 and 1995 (without evidence of recovery) are also included. BoCC Amber List criteria for breeding birds are those which have experienced a moderate decline of between 25% and 49% of population and / or range over the last 25 years. Species of European conservation concern and those with a historical decline but which are currently recovering are also included.

Vol 15 Table D.4 Terrestrial ecology – species and numbers of wintering waterbirds recording during monthly wintering bird surveys

Species name	Latin name	Conservation designation[iii]	Monthly wintering waterbird counts					
			25 January 2011	24 February 2011	25 March 2011	18 October 2011	29 November 2011	13 December 2011
Cormorant	*Phalacrocorax carbo*	Green List	6	22	2	-	4	3
Grey heron	*Ardea cinerea*	Green List	1	1	-	-	2	-
Canada goose	*Branta canadensis*	Green List	7	3	4	-	-	-
Mandarin	*Aix galericulata*	Green List	-	-	1	-	-	-
Gadwall	*Anas strepera*	Amber List	4	-	-	-	-	-
Mallard	*Anas platyrhynchos*	Amber List	1	7	7	4	6	4
Moorhen	*Gallinula chloropus*	Green List	2	3	3	-	-	-
Coot	*Fulica atra*	Green List	2	1	3	-	1	-
Black-headed gull	*Chroicocephalus ridibundus*	Amber List	83	78	8	20	68	62
Common gull	*Larus canus*	Amber List	4	5	2	6	14	4
Lesser Black-	*Larus fuscus*	Amber List	-	5	4	3	1	2

[iii] A species that is listed in the following publications:

Batten, L.A., Bibby, C.J., Clement, P., Elliot, G.D. & Porter, R.F. (1990). *Red Data Birds in Britain*. T. & A.D. Poyser, London.

Commission of the European Communities (1979). Council Directive 79/409/EEC on the Conservation of Wild Birds. *Official Journal of European Communities, L103*.

Holliday, M & Rare Breeding Bird Panel (2011). Rare Breeding Birds in the United Kingdom in 2009. *British Birds*, 104, 9, 476-537.

Royal Society for the Protection Birds (2009). *Birds of Conservation Concern 3*. RSPB, Sandy.

United Kingdom Biodiversity Action Plan Steering Group (2011). *United Kingdom Biodiversity Action Plan* http://jncc.defra.gov.uk/page-5163 [10.11].

Species name	Latin name	Conservation designation[iii]	Monthly wintering waterbird counts					
			25 January 2011	24 February 2011	25 March 2011	18 October 2011	29 November 2011	13 December 2011
backed gull								
Herring gull	*Larus argentatus*	Red List UK BAP Priority List	3	4	2	35	16	7

Black redstart survey

D.1.19 A total of five back redstart surveys were undertaken between 20 May and 12 July 2011 by an experienced ornithologist, for a minimum of three hours each during the early morning period and when weather conditions were suitable, as detailed below in Vol 15 Table D.5. Black redstart was not recorded on or in close proximity to the site during the five survey visits.

D.1.20 Desk study records include a pair of black redstart breeding at Battersea Power Station. This was recorded on 5 June 2007 (London Natural History Society, 2007)[2].

Vol 15 Table D.5 Terrestrial ecology – weather conditions for black redstart surveys

Date	Weather conditions
20 May 2011	11°C, light breeze, 25% cloud cover, dry
10 June 2011	9°C, light breeze, 100% cloud cover, dry
21 June 2011	15°C, light breeze, 100% cloud cover, dry
28 June 2011	20°C, light breeze, 50% cloud cover, dry
12 July 2011	27°C, calm, 75% cloud cover, dry

Interpretation

Bats

D.1.21 The survey area is used by a large number of common pipistrelle that are likely to be commuting along the River Thames and occasionally foraging around mature trees in close proximity to the site. Other bat species are also using the site although much less frequently.

D.1.22 The maximum number of passes of common pipistrelle was recorded on 6 May with 420 bat passes recorded. The majority of bat passes occurred later in the night between midnight and dawn, with only a small number of bat passes within an hour of dawn. From the number of bat passes recorded within an hour of sunrise and sunset, and as no bat activity was recorded during the dawn activity surveys there are unlikely to be any bats roosting on or in close proximity to the site.

D.1.23 Soprano pipistrelle was recorded three times, and noctule and Nathusius' pipistrelle were both recorded twice. Each of the three species were only recorded on one survey night each. These records were not close to sunrise or sunset, and therefore it is unlikely that any of these species are roosting on or in close proximity to the site. Due to the low numbers of bat passes recorded, it is likely that this was the result of individuals foraging and/or commuting through the survey area.

D.1.24 There was a noticeable difference in the level of activity on the first survey night and the two subsequent survey nights. The most noticeable difference is seen with common pipistrelle with maximum number of bat passes in one night at one location of 420 on 6 May compared to 122 on 8

May. The weather conditions were suitable on both nights and there is no clear reason for this difference. This could be the result of localised variations in the availability of insect prey, which may have resulted in a higher level of movement of bats between foraging areas on the 6 May than on the 8 May.

Wintering birds

D.1.25 Of the 12 waterbird species that were recorded within the survey area, six are of nature conservation importance because they are included in the Birds of Conservation Concern Red or Amber List and/or UK BAP Priority Species: gadwall, mallard, black-headed gull, common gull, lesser black-backed gull and herring gull.

D.1.26 The survey results demonstrate that the foreshore is used for foraging and resting by a range of wintering bird species, and the jetties and moored house boats are used as resting sites by gulls and cormorants.

Black redstarts

D.1.27 Black redstart was not recorded on site during the black redstart survey. Therefore, the Heathwall Pumping Station site is not considered to be used by black redstart for foraging or nesting purposes.

D.1.28 This is likely to be due to the buildings on site providing sub-optimal nesting locations in comparison to the more optimal habitat around Battersea Power Station to the west of the site where black redstart are known to nest (Battersea Power Station, 2009)[3].

References

[1] Royal Society for the Protection Birds. *Birds of Conservation Concern 3*. RSPB, Sandy (2009).

[2] London Natural History Society. *London Bird report.* London Natural History Society (2007).

[3] Battersea Power Station. *Battersea Power Station – A new energy for London: Environmental Statement for Outline Planning Application.* Battersea Power Station (July 2009).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.15**

Volume 15: Heathwall Pumping Station appendices

Appendix E: Historic environment

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

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 15 Heathwall Pumping Station 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 15 Table E.1 below, with their location shown on the historic environment features map (Vol 15 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 15 Table E.1 Gazetteer of known heritage assets within the site and study area

HEA Ref no.	Description	Site code/ GLHER ref/ List entry number
1A	Thames foreshore, to the north of Middle Wharf: a pile or post in the northern part of the site recorded on Seazone (SZ) database.	SZID 4860000061 49153
1B	Thames foreshore, to the north of Middle Wharf: a pile or post in the northern part of the site.	SZID 4860000061 49316
1C	Thames foreshore: a pontoon within the western part of the site (formerly known as Manor House Wharf). The Battersea Barge, an early 20th century ship, converted into a bar and restaurant, is moored against it.	SZID 4860000061 47284
1D	Thames foreshore, Nine Elms riverbank, northeast part of the site. The remains of two timber piles possibly associated with a former slipway, close to the edge of the foreshore (partially submerged), observed during the site survey walkover.	---
1E	Thames foreshore, Nine Elms riverbank: a layer of sand, in the northeastern part of the site beside Middle Wharf and Prescot Wharf.	FWW17 A117
1F	The public garden and 19th century river wall adjacent and to the east of the site	---
1G	Site of the chance find of two Roman coins recorded by the Portable Antiquities Scheme (PAS).	LON-720153 LON-004E96

HEA Ref no.	Description	Site code/ GLHER ref/ List entry number
1H	Jetty, comprising a rough concrete base on the Thames foreshore with a suspended concrete deck on timber and steel piled foundations with concrete and metal walkways extending further out over the Thames channel. Built between 1947 and 1952. Used to facilitate the transportation of bulk building materials.	529565 177650
2	Post Office Way, Ponton Road, Nine Elms Lane. Archaeological watching brief by Pre-Construct Archaeology (PCA) on a geotechnical investigation in 2008. Alluvium above natural gravels or brickearth in the south of the site was overlain by 16th/17th century agricultural soil. Towards the centre of the site the foundations and a basement or cellar, probably part of the 19th century brewery that was situated in the area, were recorded above the earlier deposits. On the northeast edge of the site was an undated structure cut into the natural gravel and sealed by a layer of 18th/19th century made ground, whilst towards the north side an 18th/19th century well or cesspit was recorded. Modern made ground sealed the site.	PNO08 MLO100457 MLO100463
3	Eastern Triangle, Wandsworth Road An archaeological watching brief was carried out on the site by Southwark and Lambeth Archaeological Excavation Committee (SLAEC) in 1981. The remains of a post-medieval ditch were discovered.	L436/81 091861
4	Sainsbury's, 66–68 Wandsworth Road An evaluation was carried out by Museum of London Archaeology Service (MoLAS, now MOLA) in 1993. Natural gravels were not reached and the deep sequence of mid to late 19th century deposits discovered were probably the infill of quarry pits.	SNE93
5	The former Southwark and Vauxhall Water Works Company pumping station (Battersea Water Works), Cringle Street, SW8. Standing building recording carried out here by CgMs Consulting in 2003 on buildings dating from 1839–40 to 1856, with additions to c. 1930. The engine house (**HEA 23**) is Grade II Listed. See also **HEA 17**.	BWK03
6	Battersea Power Station and South Lambeth Goods Yard. Archaeological evaluation of 37 test pits and 4 archaeological test pits, and monitoring of geotechnical work, by Sutton Archaeological Services in 1997. Construction of the former reservoirs and subsequent power station had removed	KTS97

HEA Ref no.	Description	Site code/ GLHER ref/ List entry number
	archaeological remains in most areas but significant exceptions lay to the south and southeast of the power station where the natural gravel terraces were found to have survived up to 103m above tunnel datum (ATD), the equivalent of 3m above Ordnance Datum (OD). The eastern test pits revealed worked alluvial soils probably derived from the pre-1862 market gardens of the area. Boreholes produced evidence for a possible ancient river channel running west-east, parallel to the Thames, that silted up and allowed peat formation or the maximum southern extent of the River Thames at this point. Environmental evidence of the prehistoric to late-Saxon period was recovered.	
7	Pimlico School, Lupus Street During a watching brief carried out by PCA in 2008 natural brickearth was recorded, cut by a number of natural features which were overlaid by the remnants of a possible soil horizon. Above lay an 18th century dumped layer which was cut in the west and southwest corners of the site by various 18th century postholes, pits, a timber drain and an east-west aligned ditch, running parallel with modern day Lupus Street. The ditch was truncated by a north-south orientated construction cut, probably part of the foundation for an 18th century building, and by an 18th–19th century pit.	PIM08
8	A building known as Manor House is shown on the Ordnance Survey 1st edition map of 1874, and the site of a 'Manor House Wharf' is shown on subsequent Ordnance Survey maps and noted in the Greater London Historic environment Record (GLHER): no further details are given, and no medieval house has been identified from other sources.	MLO3284 020779
9	Former burial ground and site of St. George's Church, Nine Elms Lane. The church was built in 1828, altered and extended in 1874 and seriously damaged during World War II. It was closed in 1953 following bomb damage in 1940 and destroyed by fire in 1960. The burial ground of the church was noted in Mrs Basil Holmes's 1896 survey of London's Burial Grounds as closed, and very neglected, with few gravestones (Holmes, 1896)[1].	---
10	T. & W. Farmiloe's Nine Elms Lead Works, established in 1886 which became a paint works in the early 20th century.	MLO64086 800014
11	The location of a 17th century windmill or post mill, recorded as demolished by 1828.	MLO12012 031474

HEA Ref no.	Description	Site code/ GLHER ref/ List entry number
12	Thames Channel, the approximate findspot, probably in the early 20th century, of a Neolithic flint axe.	MLO14603 100063
13	Thames Channel, off Pimlico The remains of a Mesolithic axe were discovered within the foreshore, to the northeast of the site.	MLO14575 112010
14	Thames Channel, off Pimlico. The remains of a Mesolithic axe were discovered by chance on the opposite foreshore, to the north of the site.	MLO26771 100018
15	Thames Foreshore, Nine Elms The metal detector findspot on the south side of the London Thames foreshore at William Henry Wharf, Battersea of an undated finger ring recorded by the Portable Antiquities Scheme (PAS).	MLO100036
16	Chance find of a medieval tile recorded by the PAS.	SUR-5E97E1
17	Battersea Water Pumping Station (Southwark and Vauxhall Water Works). Operational c. 1839–1925. The boiler house, stores and workshops, standpipe tower and chimney stood to the rear of the pumping station. The reservoir and filter beds of the waterworks were sold by the Metropolitan Water Board for Battersea Power Station.	MLO65779–83 MLO 19935 800111
18	Thames bank, adjacent to Nine Elms Lane, east of the site towards Vauxhall. The GLHER includes the location of the mouth of a ditch or stream, possibly with an associated bank, known as ‘Hesewall’ or ‘Hetheswall’. It was later known as the Battersea Ditch or the Heath Brook Sewer.	MLO4158 090149
19	Thames bank, adjacent to Nine Elms Lane, east of the site towards Vauxhall. The GLHER includes the site of a late 17th century windmill named Randall’s Mill, possibly the ‘colour mill’ referred to in a documentary source of 1684. Later cartographic references to a mill in Battersea in 1688 and 1751 show it as a stone built tower mill on a wharf on the Thames foreshore. It may have been used for corn-grinding or for cement production in the early 19th century, and was last recorded in 1845.	MLO11398 090055
20	Wandsworth Road. The site of Wood Bridge, known to have existed in 1592. Date of construction unknown.	090135

HEA Ref no.	Description	Site code/ GLHER ref/ List entry number
21	Wandsworth Road. The site of a well, also known as Fauxwell or Foxhall Well, still in use in 1856.	090072
22	Battersea Power Station. Grade II* listed.	1357620
23	Battersea Water Pumping Station. Grade II listed. Water pumping station originally for the Southwark and Vauxhall Water Works and Metropolitan Water Board until 1925, subsequently for Battersea Power Station, now disused. Extended two bays in 1846, and lower west end 1856 by John Aird, for the Southwark and Vauxhall Water Company.	1226087
24	105 Grosvenor Road, SW1. Grade II listed.	1066734
25	106–109 Grosvenor Road, SW1. Grade II listed.	1214346
26	A post or pile located on the Thames foreshore c. 430m to the west of the site.	SZID 486000006149420
27	An unspecified obstruction located on the Thames foreshore, c. 200m to the east of the site.	SZID 637000001135744
28	A pontoon with a navigation light adjacent to the river bank to the west of the site.	SZID 486000006147117
29	A pontoon with a navigation light adjacent to the river bank at the east end of Nine Elms Pier.	SZID 486000006147423
30	Thames foreshore, to the west of the site: three pontoons or boats within the site of the former Nine Elms Tide Mill Dock.	SZID 486000006148599/9006/6424
31	A pontoon adjacent to the Pimlico river bank on the north Thames foreshore, c. 140m to the north of the site.	SZID 486000006148962
32	Two pontoons or boats moored in the Thames Channel, adjacent to Nine Elms riverbank, near Vauxhall, c. 150m to the east of the site.	SZID 486000006148257/7747
33	Thames foreshore, north Thames riverbank at Pimlico: a possible riverfront defence or cofferdam consisting of a line of large, squared, close-set piles which appear to predate the 19th century river wall and may be associated with the	FWM01 Alpha Survey

HEA Ref no.	Description	Site code/ GLHER ref/ List entry number
	construction of the embankment. Recorded by the Thames Archaeological Survey (TAS) during its 'Alpha' survey of the foreshore in the 1990s.	No A116
34	Thames foreshore, north Thames riverbank at Pimlico: a post-medieval dock entrance.	Alpha No A115
35	Thames foreshore, north Thames riverbank at Pimlico: a possible post-medieval tide gauge (a metal marker on a timber and concrete platform) and a possible barge bed consisting of a double line of small stakes, high on the foreshore.	Alpha No A117
36	Thames foreshore, north Thames riverbank at Pimlico: 19th century brick landing steps contemporary with the river wall.	FWM02 Alpha No A101
37	Thames foreshore, north Thames riverbank at Pimlico: a possible barge bed, consisting of a large squared timber lying horizontal and almost parallel to the river wall.	Alpha No A102
38	Thames foreshore, north Thames riverbank at Pimlico: a covered dock entrance, with a packed-timber raft forming its base.	Alpha No A103
39	Thames foreshore, north Thames riverbank at Pimlico; a brick-built flood defence with a straight joint visible between two phases of building.	Alpha No A105
40	Thames foreshore, north Thames riverbank at Pimlico: a possible causeway of timber and concrete with no associated stair.	Alpha No A106
41	Thames foreshore, north Thames riverbank at Pimlico: a possible barge bed consisting of a rubble surface and mooring chain.	Alpha No A107
42	Thames foreshore, north Thames riverbank at Pimlico: a hard, possible barge bed consisting of close set, vertical planks at an angle to the river wall, with one large squared pile adjacent.	FWM03 Alpha No A101
43	Thames foreshore, north Thames riverbank at Pimlico: a possible barge bed, consisting of a line of small vertical piles and stone rubble.	Alpha No A102
44	Thames foreshore, north Thames riverbank at Pimlico: the remains of a timber-revetted barge bed. Appears to be a later addition to A104 (**HEA 45**).	Alpha No A103

HEA Ref no.	Description	Site code/ GLHER ref/ List entry number
45	Thames foreshore, north Thames riverbank at Pimlico: the remains of a timber-revetted barge bed (**HEA 44**).	Alpha No A104
46	Thames foreshore, north Thames riverbank at Pimlico: the remains of a timber-revetted barge bed, probably part of A106 (**HEA 47**).	Alpha No A105
47	Thames foreshore, north Thames riverbank at Pimlico: the remains of a timber-revetted barge bed, probably part of A105 (**HEA 46**), with A107 (**HEA 48**) added to it.	Alpha No A106
48	Thames foreshore, north Thames riverbank at Pimlico: the remains of a sheet-piled barge bed, an addition to A106 (**HEA 47**).	Alpha No A107
49	Thames foreshore, north Thames riverbank at Pimlico: the remains of a timber-revetted barge bed.	Alpha No A108
50	Thames foreshore, north Thames riverbank at Pimlico: the remains of a buried vessel or fallen barge bed.	Alpha No A109
51	Thames foreshore, north Thames riverbank at Pimlico: a brick-built outfall drain, with a timber mooring block at its entrance.	Alpha No A111 A114
52	Thames foreshore, Nine Elms riverbank, c. 490m to the east of the site: an unclassified structure with large, vertical squared posts exposed by barge scour.	FWW17 Alpha No A101
53	Thames foreshore, Nine Elms riverbank, c. 340m to the east of the site: the remains of a timber-shuttered box with concrete, possibly a crane base or mooring feature.	Alpha No A103
54	Thames foreshore, Nine Elms riverbank, c. 320m to the east of the site: a mooring block of three vertical squared posts.	Alpha No A104
55	Thames foreshore, Nine Elms riverbank, c. 300m to the east of the site: a consolidation layer of concreted gravel.	Alpha No A105
56	Thames foreshore, Nine Elms riverbank, c. 350m to the east of the site: the remains of an unspecified structure, probably a crane base or mooring feature comprising four vertical posts.	Alpha No A106
57	Thames foreshore, Nine Elms riverbank, c. 250m to the east of the site: a timber shuttered box with concrete, possibly a crane base or mooring feature.	Alpha No A107
58	Thames foreshore, Nine Elms riverbank, c. 230m to the east of the site: a timber shuttered box with concrete and stone slabs, possibly a crane base or mooring feature.	Alpha No A108

HEA Ref no.	Description	Site code/ GLHER ref/ List entry number
59	Thames foreshore, Nine Elms riverbank, c. 220m to the east of the site: a possible consolidation deposit of cobble-sized rocks.	Alpha No A109
60	Thames foreshore, Nine Elms riverbank, c.200m to the east of the site: a post-medieval dock with a sheet-piled entrance.	Alpha No A110
61	Thames foreshore, Nine Elms riverbank, c. 220m to the east of the site: a post-medieval mooring block of two joined vertical posts.	Alpha No A111
62	Thames foreshore, Nine Elms riverbank, c. 150m to the east of the site. Two post-medieval riverfront defences, one brick-built with buttresses and the other consisting of a line of vertical timbers: reused to form shuttering for concrete.	Alpha No A112 A113
63	Thames foreshore, Nine Elms riverbank, c. 130m to the east of the site: a post-medieval outfall drain.	Alpha No A114
64	Thames foreshore, Nine Elms riverbank, c. 150m to the east of the site: a post-medieval drain of stone rubble and wire.	Alpha No A115
65	Thames foreshore, Nine Elms riverbank, c. 30m to the east of the site: a post-medieval sheet-piled dock entrance (Newcastle Wharf).	Alpha No A116
66	Thames foreshore, Nine Elms riverbank, immediately adjacent to the northeast of the site: part of an (Early) Saxon fish trap comprising a group of six upright, wooden stakes standing at an approximate height of 0.1–0.2m.	---
67	Thames foreshore, Nine Elms riverbank, c. 25m to the east of the site: small exposures of a peat and clay deposit.	FWW17 Alpha No A118
68	Thames foreshore, Nine Elms riverbank, c. 45mto the east of the site: a post-medieval consolidation layer of concreted gravel.	Alpha No A119
69	Thames foreshore, Nine Elms riverbank, c. 170m to the east of the site: a stone mooring block.	Alpha No A120
70	Thames foreshore, Nine Elms riverbank, c. 160m to the east of the site: a post-medieval timber flood defence below concrete.	Alpha No A121
71	Thames foreshore, Nine Elms riverbank, c. 180m to the east of the site: small exposures of a peat and clay deposit.	Alpha No A122

HEA Ref no.	Description	Site code/ GLHER ref/ List entry number
72	Thames foreshore, Nine Elms riverbank, c. 200m to the east of the site: a consolidation layer of compacted chalk.	Alpha No A124
73	The river wall and remains of the former entrance to the Nine Elms Tide Mill Dock, noted during the site visit carried out as part of the Thames Tideway Tunnel project in 2011.	---
74	Line of the Bazalgette Southern Low Level Sewer, constructed c. 1865–68.	---
75	Chance find of a post-medieval vessel recorded by the PAS.	LON-460412
76	Chance find of a post-medieval mould recorded by the PAS.	LON-D23BF7
77	Chance find of a Roman coin recorded by the PAS.	LON-E96487
78	Chance find of a post-medieval coin recorded by the PAS.	LON-E13B96
79	Chance find of a medieval coin weight recorded by the PAS.	SUR-EED5C4
80	Chance find of a Roman coin recorded by the PAS.	LON-FC5155
81	Chance find of a medieval token recorded by the PAS.	LON-D97713
82	Nine Elms Pier: Built between 1947 and 1952, c. 20m to the west of the site. Concrete deck suspended above Thames foreshore with piled foundations of steel and concrete and similar materials with boats moored against it.	529400 177640
83	Thames foreshore jetty, c. 240m to the west of the site: late 20th century raised concrete deck above foreshore with mainly steel and concrete piled foundations and fenders and dolphins. Linked to riverside by a concrete and metal walkway and conveyor belt. Used for the transportation of building industry materials such as cement and aggregates.	529500 177645

E.2 Site location, topography and geology

Site location

E.2.1 The site is on the south bank of the Thames, bounded by Nine Elms Lane to the south, a warehouse building to the west, and a paved riverside area belonging to Elm Quay Court, a block of residential flats, to the east. The

site extends north over the Thames foreshore. It is located in the northeastern corner of the London Borough of Wandsworth: it was previously part of the county of Surrey within the parish of St. Mary Battersea.

Topography

E.2.2 The ground level of the site is generally flat at c. 104.3–104.6m ATD, (above Tunnel Datum; the equivalent of 4.3–4.6m above Ordnance Datum), although it is lower in the southeastern corner, at the site entrance from Nine Elms Lane, at c. 103.5 ATD. Nine Elms Lane, which borders the southern edge of the site, slopes gently up towards the southwest from 103.1m ATD, c. 10m to the southeast of the site, to c. 103.9m ATD, c. 35m to the southwest, and higher beyond that to the southwest. On the foreshore, the ground slopes quite steeply downwards, from south to north, from c. 101.7m ATD adjacent to the river wall, to c. 96.8m ATD at the edge of the foreshore at low tide. At the northern boundary of the site the river bed lies at c. 94.0m ATD.

Geology

E.2.3 The site is located on a wide area of fine-grained alluvium on the southern side of the Thames floodplain (British Geological Survey digital data)[2], above Shepperton floodplain gravels. In the southwestern part of the assessment area is a remnant of river terrace that survived erosion within the floodplain at the end of the last cold stage, and is one of two outcrops of Kempton Park Gravels that lie within the floodplain of the Thames in this area. These together formed the 'Battersea Eyot', on which Battersea Park is situated. This large 'island' of high gravel was dissected by former channels of the Thames, carved out at the end of the last Glacial Period cold stage. The site lies at the confluence of two of these channels, of which the largest is known as the Battersea Channel. Alluvium fills the former valleys of both channels which are aligned from southwest to northeast.

E.2.4 In the confluence area the mouths of the channels are wide and merge into one another and into the main channel floodplain of the Thames. The course of a third channel or 'lost river' crossing the river terrace to the east joins the floodplain of the Thames in the extreme eastern part of the mouth of the Battersea Channel, c. 450m to the east of the site. This is the River Effra, a major tributary of the Thames, once comparable in size to the Fleet in the City of London (Barton, 1992)[3] but now diverted into sewers and culverts (Barton, 1992)[4].

E.2.5 These rivers eroded the Kempton Park gravels during the latter stages of the last Ice Age (Devensian), sculpting the subsurface topography of the floodplain area. The Kempton Park Gravels river terrace, which forms the sides of the Battersea Channel, lies 350m to the southwest and 480m to the southeast of the site.

E.2.6 The Thames would have been fresh water until the late prehistoric period when it became brackish and tidal due to the knock-on effects of rising relative sea levels. As these rose the floodplain became increasingly wet and peat developed across former dry landsurfaces as wetland

environments expanded across the valley floor. Evidence for the timing and nature of the transition from a freshwater to estuarine environment, and from dry soils to wetland, are likely to be preserved in waterlogged conditions in deeper parts of the floodplain. In contrast, the higher, well-drained river terrace probably remained largely dry throughout the Holocene, from the Mesolithic period onwards, and could have been utilised as arable land, with pasture and farms during and after the Neolithic period.

E.2.7 There are five boreholes spread across the site which are modern and detailed for the most part. The most southerly borehole[5] indicates that the (Shepperton) gravels that underlie the floodplain area are at 96.8m ATD, overlain by < 3.7m of alluvium to 100.5m ATD, which in turn is sealed by 3.3m of made ground to 103.8m ATD at the surface. The most northerly borehole nearest to the Thames[6], indicated that the surface of the underlying terrace gravel lay at similar levels, at 96.9m ATD, although it was overlain by a thicker deposit of alluvium, c. 5.4m thick, to 102.2m ATD, above which was c. 2.0m of made ground to 104.2m ATD. All other boreholes showed similar levels except for one in the southwest of the site [7], where gravels lay at 98.4m ATD overlain by 3.7m of alluvium to 102.0m ATD beneath 3.2m of made ground at 105.2m ATD.

E.2.8 These levels suggest that there will be little survival of archaeological deposits in the northern foreshore and riverbed part of the site, as here the modern foreshore and riverbed are likely to lie below the level of the Early Holocene topography. This topography will have roughly equated to the surface of Pleistocene gravel, which is recorded as lying at c. 96.0–97.0m ATD, whilst the modern riverbed lies significantly below this in the northern part of the site at c. 94.0m ATD. This low level will be the result of modern dredging of the riverbed

E.2.9 The isolated area of higher gravels in the southwest of the site[8] is probably due to the naturally undulating nature of the topography within the Thames floodplain, as shaped in the late Devensian period when the river was characterised by numerous, shifting braided channels. Sand and gravel bars accumulated within the river, forming an irregular, hummocky topography. Such a landscape would have existed when the earliest Mesolithic people colonised the area utilising the natural resources provided by the freshwater Thames and its tributaries.

E.2.10 Over the gravel high areas, remnant prehistoric land surfaces and soils might still exist, sealed beneath the alluvium. The alluvium is commonly described in the borehole logs as having plant remains throughout, which implies slow accumulation of sediment and good palaeoenvironmental preservation and would be useful for plant macro- and microfossil evidence to track the changing vegetation environment through the late prehistoric, Roman and medieval periods.

E.2.11 As sea levels rose after the prehistoric period and the Thames became wider and the floodplain wetter, alluvial deposits accumulated which could preserve evidence for Roman and later medieval activities. This alluvium could also contain well-preserved organic artefactual material associated with rivers, such as timber structures, boats and fish traps. The borehole

logs frequently describe the alluvium as mixed with chalk and wood in the upper levels, typically in the first 2.0m, which is suggestive of barge beds and boat repairs, characteristic of the working, post-medieval foreshore environment.

E.3 Past archaeological investigations within the assessment area

E.3.1 No past archaeological investigations have been carried out within the site itself, although several have been carried out within the assessment area. The Thames Archaeological Survey (TAS) undertook walkover, or 'Alpha', surveys on the foreshore to the east of the site during the 1990s. These recorded mainly post-medieval remains, including flood defences, barge beds, former dock entrances and foreshore consolidation deposits, reflecting the commercial use of the foreshore in the vicinity of the site in the 19th century. In 2010, the Thames Discovery Programme (TDP) recorded a Saxon fish trap very close to the northeastern edge of the site (**HEA 66**). The site walkover survey carried out in 2011 as part of the present study confirmed that the feature was still present.

E.3.2 Understanding of the site and its immediate surroundings in the prehistoric, Roman and medieval periods is relatively limited in comparison with the post-medieval period, although the historic landscape of the early periods may be better understood taking into account available geoarchaeological information.

E.3.3 The number of archaeological excavations or watching briefs carried out in the assessment area is relatively small and, apart from environmental evidence, only post-medieval remains have been recorded. A watching brief on geotechnical boreholes at Post Office Way on Ponton Road (**HEA 2**), c. 170m to the southeast of the site, recorded evidence of 16th–17th century soils, a 18th–19th century well or cess pit and a basement or cellar which probably belonged to a 19th century brewery. At Battersea Power Station and South Lambeth Goods Yard (**HEA 6**), c. 520m to the southwest of the site, archaeological test pits and boreholes revealed extensive truncation by the construction of reservoirs and filtering beds belonging to the Southwark and Vauxhall Waterworks (**HEA 17**).

E.3.4 A standing building survey was carried out in 2003 (**HEA 5**) at the Southwark and Vauxhall Water Works, c. 440m to the southwest of the site, recorded the remains of the Battersea Waterworks pumping station.

E.3.5 The results of these investigations, along with other known sites and finds within the study area, are discussed by period, below.

E.4 Archaeological and historical background of the site

E.4.1 The following section provides a detailed archaeological and historical background for the site. It should be read alongside Volume 3 Project wide assessment, which sets the overall Thames Tideway Tunnel project, and the individual site-specific assessments, within a broader historic

environment context (i.e. past landscapes and human activity within such landscapes). It identifies the main route-wide heritage themes, of which the built and buried heritage assets identified within this assessment form a part.

Prehistoric period (700,000 BC–AD 43)

E.4.2 The low-lying confluence area on which the site is located would have provided rich natural resources of food and raw materials for prehistoric people, with the drier high ground of the terrace nearby an attractive position for settlement or occupation. Peat found below 98.7m ATD within the Battersea channel area c. 900m to the southwest of the site represents a swampy marshland which would have constituted a useful area for exploitation. The peats were dated to the early Mesolithic when the channel and other areas of low ground away from the Thames began to silt up (Morley, 2009)[9].

E.4.3 The possible use of the area for hunting, fishing, the gathering of building materials and pottery manufacture is supported by prehistoric tools recovered from the vicinity of the site (Rippon, 2000)[10]. It is possible that there were wooden trackways in the vicinity of the site, used to provide access from the high ground into the marsh, as found in other parts of the Lower Thames Estuary. The deep alluvial deposits on which the site lies have the potential to preserve similar organic remains.

E.4.4 Although there are no recorded remains dating to the prehistoric period within the site, within the wider assessment area remains dating to the Mesolithic and Neolithic have been recovered from the Thames. Two Mesolithic axes (**HEA 13** and **14**) were found c. 230m to the northwest and c. 115m to the north of the site, presumably during dredging. A Neolithic flint axe (**HEA 12**) was also recovered close to the present foreshore, c. 195m to the northwest of the site. This suggests possible hunting activity in the vicinity.

E.4.5 The wetland location may also have been a focus for ritual activity. Just outside the assessment area, c. 610m northeast of the site, recording and monitoring of erosion on the southern Thames foreshore in 1993 revealed a wooden structure and a sequence of sediments being actively eroded out of the bank at low water. The structure comprised the bases of substantial timber piles set in two irregular rows extending down the foreshore. The timbers were radiocarbon dated to approximately 1770–1260 BC. Two copper alloy side-looped spearheads of Middle Bronze Age date and several pieces of worked red deer antler were also found between two of the piles, which may have been part of a jetty or platform for ceremonial offerings (Sidell *et al.*, 2002)[11].

Roman period (AD 43–410)

E.4.6 The town of *Londinium* was established within a decade of the arrival of the Romans in AD 43 on the north bank of the Thames c. 4.2km to the northeast of the site, with a river crossing to a settlement at Southwark, c. 3.9km to the northeast. The nearest known Roman road to the site lay 1.4km to the southeast. Following the late prehistoric period, a rise in relative sea level led to the Thames becoming brackish and tidal, which

would have made the site and the dry ground immediately adjacent less suitable as a settlement area.

E.4.7 The only known remains dating to the Roman period within the site or its immediate vicinity are four coins found on the foreshore recorded on the Portable Antiquities Scheme (PAS) database. Two of the coins (**HEA 1G**) were recovered from within the site, one (**HEA 77**) was found 250m to the north, and the fourth (**HEA 80**) was found 250m to the east. It is not known how far these might have moved from their original place of deposition.

E.4.8 In Battersea Fields, outside the assessment area c. 1.5km to the southwest of the site, a Roman coffin was found in the late 18th century. A possible Roman anchor, iron spearhead, javelin head or dart, the soles of several shoes, and a sword sheath were also found during the construction of Chelsea Bridge, approximately 950m to the west of the site. The general lack of finds within the immediate assessment area, however, and its unsuitability for occupation suggests that it was not close to Roman settlement. The intertidal marshes may have been exploited for a range of typical resources, although there is currently no evidence for this in the area of the site.

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

E.4.9 During this period, as in the late prehistoric and Roman periods, the site lay within the low-lying floodplain: although it would not have been suitable for settlement, the marshes would have continued to provide valuable resources of food and building materials. In 2010, the TDP identified a group of six wooden stakes in a line and standing to an approximate height of 0.1–0.2m (**HEA 66**; Vol 15 Plate E.9), immediately adjacent to the northeast of the site; their presence was confirmed by the site walkover survey for the present study. The stakes are thought to be the remains of a fish trap, and three of the timbers have been radiocarbon-dated to the Saxon period, within a two-sigma probability date-range of AD 550-670. This location at the mouth of a tributary of the Thames may have been ideal for fishing, and other fish traps could potentially survive in this area but might be obscured by the foreshore silts and mud.

E.4.10 A bank or revetment possibly constructed in the Saxon period may be indicated by the name of ‘Hesewall’ or ‘Hetheswall’ recorded in the GLHER (**HEA 18**), c. 510m to the east of the site. Flood defences may have been built in this period to protect a settlement or nearby farmland.

E.4.11 Battersea have derived its name from St. Patrick (as ‘Patrick-sey’) or from St. Peter, as it formerly belonged to the Abbey of St. Peter at Westminster. St. Mary’s Church at Battersea, approximately 2.6km to the west of the site, is known to have existed by the beginning of the 9th century, and archaeological evidence of settlement c. AD 750–800 has been found near the church (Cowie and Blackmore, 2008)[12]. There was also possible Saxon settlement centred on Vauxhall, approximately 1.1km to the northeast of the site. The site therefore lay outside the areas of likely occupation in this period and was probably marshland, although it may have been used for pasture.

Later medieval period (AD 1066–1485)

E.4.12 The only known find dated to this period within the site or assessment area is a token (**HEA 81**) recorded on the PAS database as being recovered from the Thames 300m to the east of the site. The marshes on which the site was situated probably began to be reclaimed in stages, with the construction of successive river walls, earthen banks, and drainage ditches, enabling the fertile land to be used for pasture and cultivation. Activity associated with the river, including boat use and fishing, would gradually have spread along the riverfront. The site probably continued to lie within open undeveloped land but may have been used for access to the river.

E.4.13 The manor or estate of Battersea, sometimes known as the Manor of Battersea and Wandsworth, had been acquired by the abbey of Westminster by the time of Domesday Book (1086)[13], and in 1225 Battersea was assigned to the monks of Westminster for their maintenance in bread and ale. From an account of the steward of the manor in 1303, it appears that the land was directly farmed by the monks (Victoria County History, 1912)[14].

E.4.14 The site of a manor house (**HEA 8**) is noted in the GLHER but no further details are given and the location may be derived from Ordnance Survey maps of the late 19th century onwards, which show a building called 'Manor House' and subsequently marked as the site of Manor House Wharf. No medieval documentary sources make reference to it. Rocque's map of 1746 (Vol 15 Plate E.1) shows several large buildings at what was then the western end of Nine Elms Lane, but does not identify them. 'Manor House Wharf' is marked on the riverside in the western edge of the site on Ordnance Survey maps from the early 20th century onwards and covered the length of quayside between Nine Elms Dock and the Heathwall dock between Mill Pond Wharf and Middle Wharf to the east (Vol 15 Plate E.5 and Vol 15 Plate E.6).

Post-medieval period (AD 1485–present)

E.4.15 In the 16th and 17th centuries, the land northeast of the main settlement of Battersea was a well-known cultivation area because of its fertile soils. Corn mills were established in Battersea Fields by the late 17th century (Victoria County History, 1912)[15], and the GLHER notes the site of a 17th century windmill or post mill (**HEA 11**) c. 240m to the southwest of the site.

E.4.16 The remains of buildings associated with several post-medieval industries have been discovered within the study area and geotechnical information mentions chalk and wood deposits from within the site, possibly indicative of barge beds and boat repairs. During the site walkover survey, three structures were observed in the northeastern part of the site (**HEA 1A**, **1B** and **1D**). One structure consisted of two timber piles, which may be the remains of a slipway (**HEA 1D**; Vol 15 Plate E.10).

E.4.17 Rocque's map of 1746 (Vol 15 Plate E.1) indicates areas of settlement, isolated farms and main roads. The site lay on the north side of Nine Elms Lane at the northeastern corner of Battersea Common Field, a large area of drained and reclaimed open land which may have been used for

pasture. Along Nine Elms Lane were riverside buildings, possible docks and landing areas, which would have been used to transport produce grown in the area. The land to the south of Nine Elms Lane was subdivided into market gardens supplying produce to the rapidly growing urban population of London. Lysons, writing in 1792, commented that 'above 300 acres of land in Battersea is occupied by market gardeners' (Lysons, 1792)[16]. There were several buildings alongside the river, and part of the site may have comprised reclaimed ground raised above the level of the foreshore by this time.

E.4.18 In 1771–1772 a wooden bridge which became known as Old Battersea Bridge was constructed approximately 950m to the west of the site (outside the assessment area). This replaced a ferry between Chelsea and Battersea and helped to stimulate development in the area during the late 18th and 19th centuries. The area between Vauxhall and Nine Elms to the east and the town of Battersea to the west became a centre of industry and trade (Weinreb *et al.*, 2002)[17]. A watching brief carried out at Eastern Triangle, Wandsworth Road (**HEA 3**), c. 485m to the southeast of the site, uncovered a post-medieval ditch, whilst an evaluation at 66–68 Wandsworth Road, c. 520m to the southeast of the site (**HEA 4**) revealed mid-late 19th century infill in old quarry pits, reflecting the development of the area in the post-medieval period.

E.4.19 Greenwood's map of 1824–1826 (Vol 15 Plate E.2) shows the southern part of the site occupied by a number of buildings associated with the 'Stone Wharf' and Factory, with the northern part lying on the undeveloped foreshore. The site is located just to the east of the inlet for the Nine Elms Mill Pond, constructed in the 1820s to the south of the site and Nine Elms Lane, with a tidal mill on the riverfront. Further west are four 'Timber Docks' constructed for the transportation of local grain and timber. Battersea New Town, which began to be constructed in the 1790s for the housing of the expanding labour force in the area, is shown as a scatter of houses aligned along a small street network, c. 400m to the southeast of the site.

E.4.20 The Southwark and Vauxhall Water Works (**HEA 17**), c. 500m to the southwest of the site, was built in 1839 and its filter beds and reservoirs occupied much of the western part of the assessment area. The now disused Battersea Water Pumping Station (**HEA 23**) formed part of the water works. The mill pond to the south of the site was gradually filled in during the 19th century, with part of it being converted into a dock for the London Gas Works, which was constructed by the Gas Light and Coke Company in 1833.

E.4.21 Stanford's map of 1862 (Vol 15 Plate E.3) shows the timber docks to the west of the site filled in, and the southern part of the site occupied by the 'Whiting and Lime Works', which had an open dock at its centre and part of a line of wharves, mills and docks fronting the Thames. The map shows the areas of greatest change to the south and east of the site, with the construction of the South Western Railway Goods Depot, c. 300m to the east. Although an area of market gardens is still shown existing to the south of the site, the beginnings of residential building in the area bounded

by Nine Elms Lane and the railway are evident, with two rows of terraced houses located c. 65m to the southeast.

E.4.22 Bazalgette's Southern Low Level Sewer (**HEA 74**) was constructed beneath Nine Elms Lane outside the southeastern edge of the site in c. 1865–68.

E.4.23 The Ordnance Survey (OS) 1st edition 25":mile map of 1874 (Vol 15 Plate E.4) shows the southwestern part of the site still occupied by the Whiting and Lime Works and its dock, with a row of cottages and gardens called 'Jordan Cottages' and a pottery located in the southeastern part. The northern part of the site is on the open foreshore. Further to the east, along the riverbank, the number of docks and wharves has increased, with most of the available riverside space occupied. To the south, terraced houses are shown occupying the majority of the land bounded by the Water Works, the London Gas Works, the railway line, and the docks and wharves fronting the Thames bank.

E.4.24 Remains related to 19th century commercial docks to the east of the site were recorded by the TAS, including a dock entrance (**HEA 60**) c. 215m to the east of the site, at the location of the former Nine Elms Coal Wharf, which is marked on the OS map of 1874. Another dock entrance (**HEA 65**) was observed c. 35m to the east, opposite the former Newcastle Wharf, constructed between 1874 and 1894. Two post-medieval riverfront defences, one of brick and the other consisting of a line of vertical timber posts (**HEA 62**), were observed c. 150m to the east of the site, adjacent to the former Palace Wharf, which is also shown on the OS map of 1874. Consolidation layers or possible barge beds (**HEA 68** and **HEA 72**) of uncertain post-medieval date were also noted along the foreshore, c. 50m and 200m to the east of the site respectively.

E.4.25 The OS 2nd edition 25" mile map of 1894–1896 (Vol 15 Plate E.5) shows the northern part of the site still located on the undeveloped Thames foreshore, with a small channel running to the Thames from the open dock in the centre of the site, now known as Middle Wharf, with White Swan Wharf to the east and Manor House Wharf to the west. The southern part of the site continues to be occupied by industrial or warehouse buildings. The areas occupied by cottages in the eastern part of the site have become part of the factory and wharf buildings.

E.4.26 The OS 3rd edition 25" mile map of 1916 (Vol 15 Plate E.6) shows the site continuing to be occupied by dockside warehouse buildings, although these are fewer in number than on the previous map. The dock in the centre of the site has Mill Pond Wharf to the west and is labelled as Middle Wharf and a jetty has been constructed within the northwestern part of the site. The London County Council's Heathwall Sewage Pumping Station is shown located adjacent to the southwest edge of the dock with a culvert outlet leading directly into it. To the south of the site land continues to be occupied by the London Gas Works and the much expanded railway. The waterworks (**HEA 17**) and its pumping station (**HEA 23**) to the west of the site were no longer in use and the filtering beds and reservoir to the north had been filled in and replaced with a goods depot leading from the railway line to the west.

E.4.27 The London County Council's Bomb Damage Maps 1939–1945 show no damage to the majority of the site, although Jackson's Wharf, lying partially within the eastern site boundary, is marked as seriously damaged.

E.4.28 The OS 25" mile map of 1947 (Vol 15 Plate E.7) shows that smaller buildings had replaced the former dockside warehouses, although the presence of hoppers (chutes) on the edge of the river bank to the east and a weighing machine along the western side of the dock show that it was still used for the transportation of goods to and from the London Gas Works. The jetty in the northwestern part of the site is shown extended to the current northern site boundary. No major changes are shown to the east of the site. To the west, a major development had taken place in the construction of 'Station A' of the Battersea Power Station (**HEA 22**), c. 510m to the west of the site, marked 'Electricity Works' on the map. Station B, located to the east of Station A, was not completed until 1953.

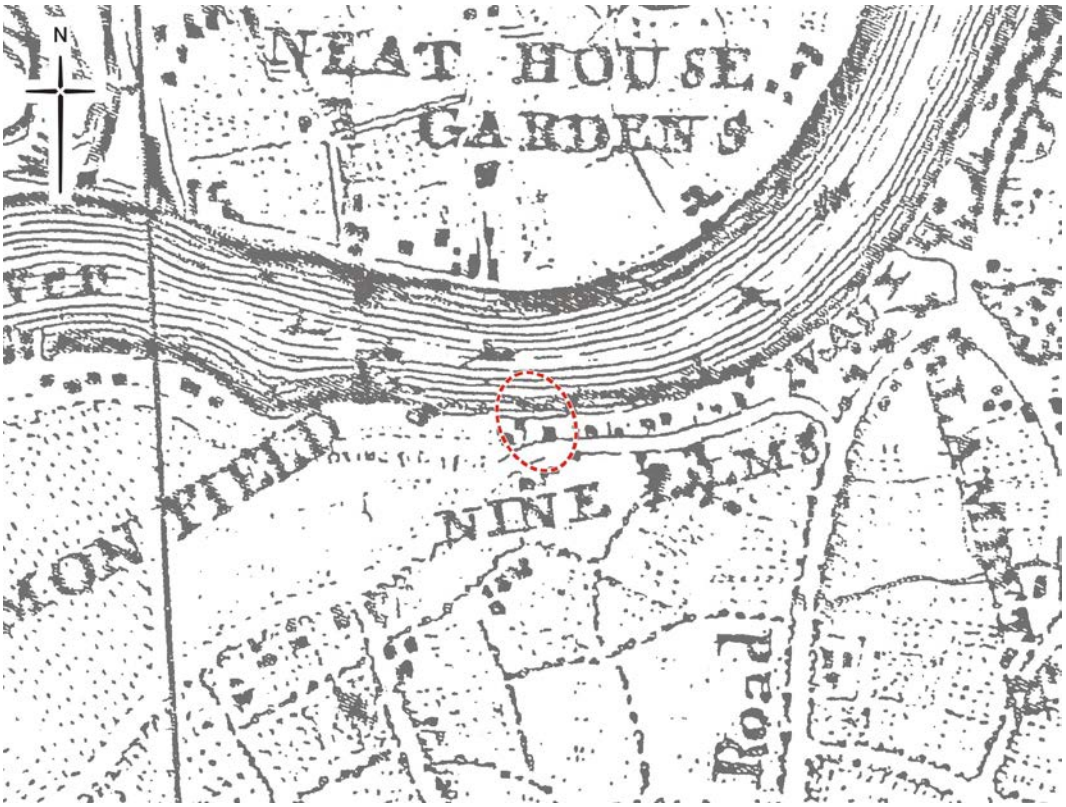
E.4.29 The OS 1:1250 scale map of 1952 (Vol 15 Plate E.8) shows the site largely in its current layout. The Heathwall Pumping Station (Vol 15 Plate E.11), occupying the centre of the site, was constructed over the infilled, enclosed Heathwall Dock in the early 1960s to lift foul water from the Heathwall Sewer into the Southern Low Level Sewer and storm sewage overflow to the river. The former dockside buildings and goods-handling structures were removed and a tank and three small buildings constructed in the eastern part of the site. The former jetty in the northwestern part was demolished. Middle Wharf was constructed with a jetty and crane in the northeastern corner of the site and an outfall sewer tunnel across the foreshore in the northwestern part. Later OS maps show no significant changes to the site.

The current site

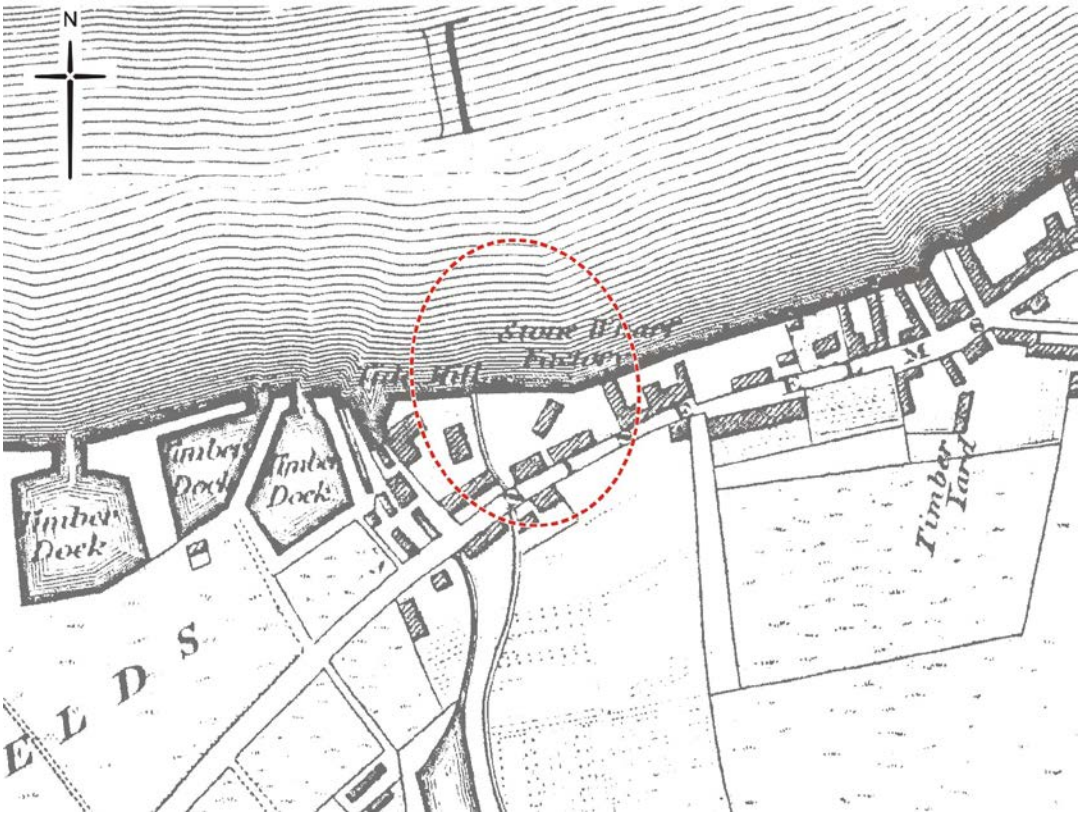
E.4.30 The southern part of the site is occupied by Heathwall Pumping Station, with the current structure on the site being no more than 50 years old. The eastern part of the site is occupied by a compound (Vol 15 Plate E.12) which was formerly an RMC-Cemex concrete batching works but is now owned by Thames Water, with an associated crane and jetty located at the northeastern corner of the site (Vol 15 Plate E.15 and Vol 15 Plate E.16) extending from the foreshore into the Thames. The foreshore to the west of the site is occupied by piers and wharves for delivery and loading of materials. The riverbank is characterised by a mix of light industrial buildings and residential flats.

E.5 Plates

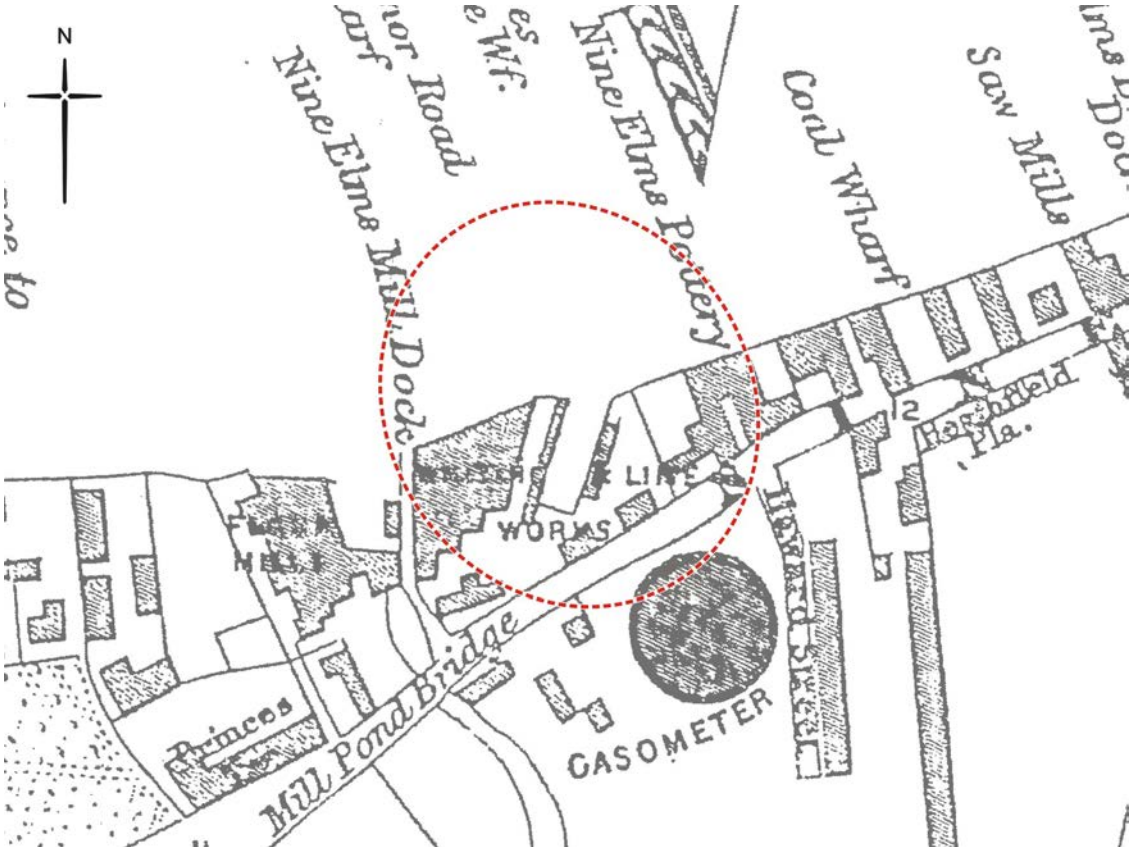
Vol 15 Plate E.2 Historic environment – Rocque's map of 1746



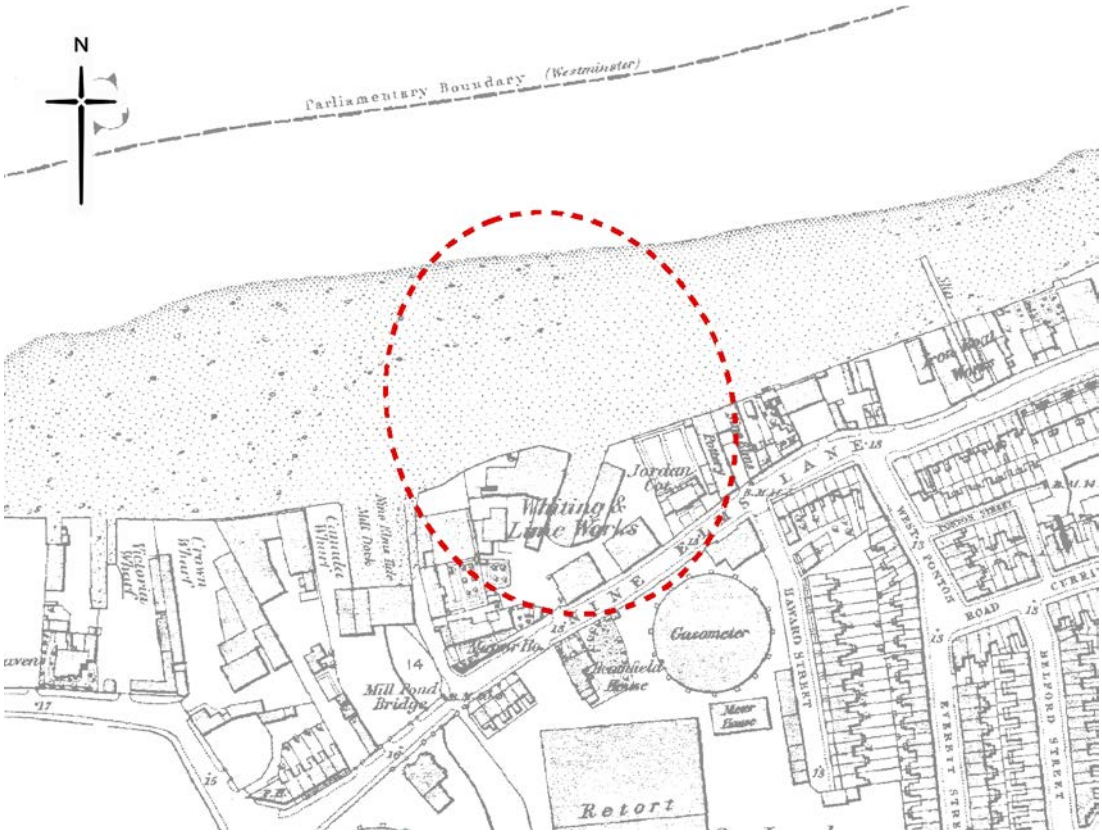
Vol 15 Plate E.3 Historic environment – Greenwood's map of 1824–1826



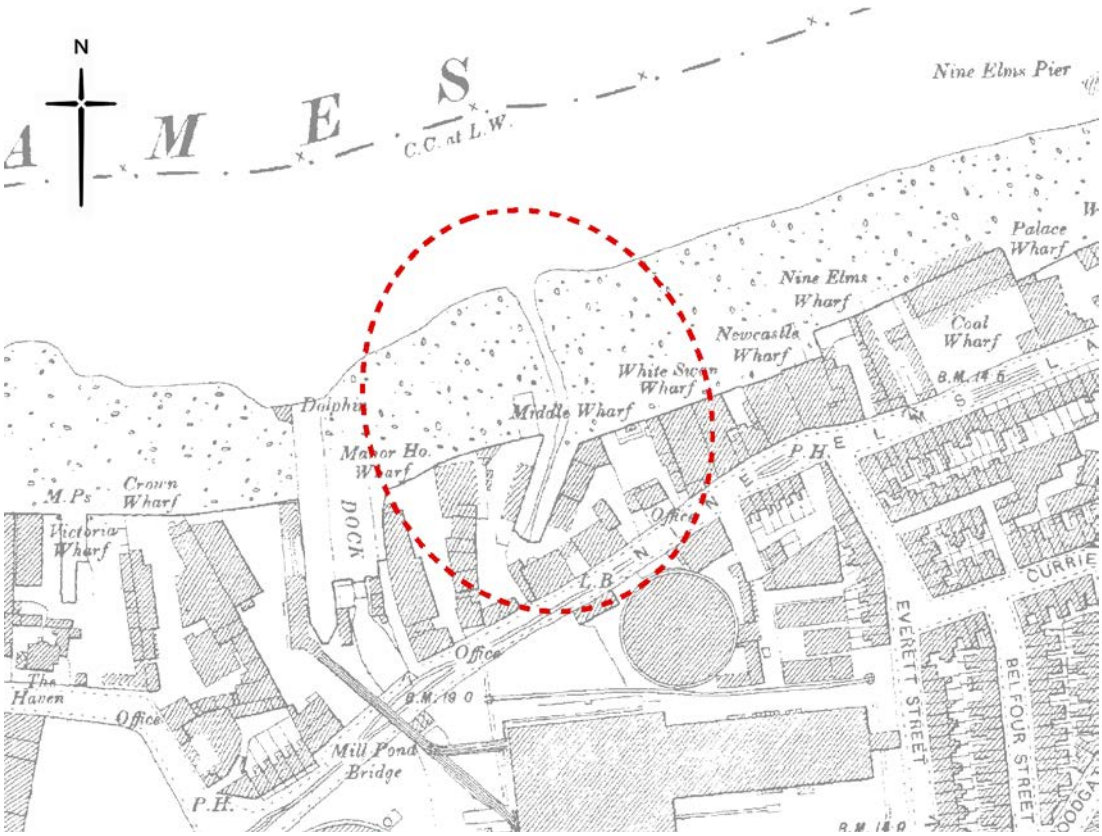
Vol 15 Plate E.4 Historic environment – Stanford's map of 1862



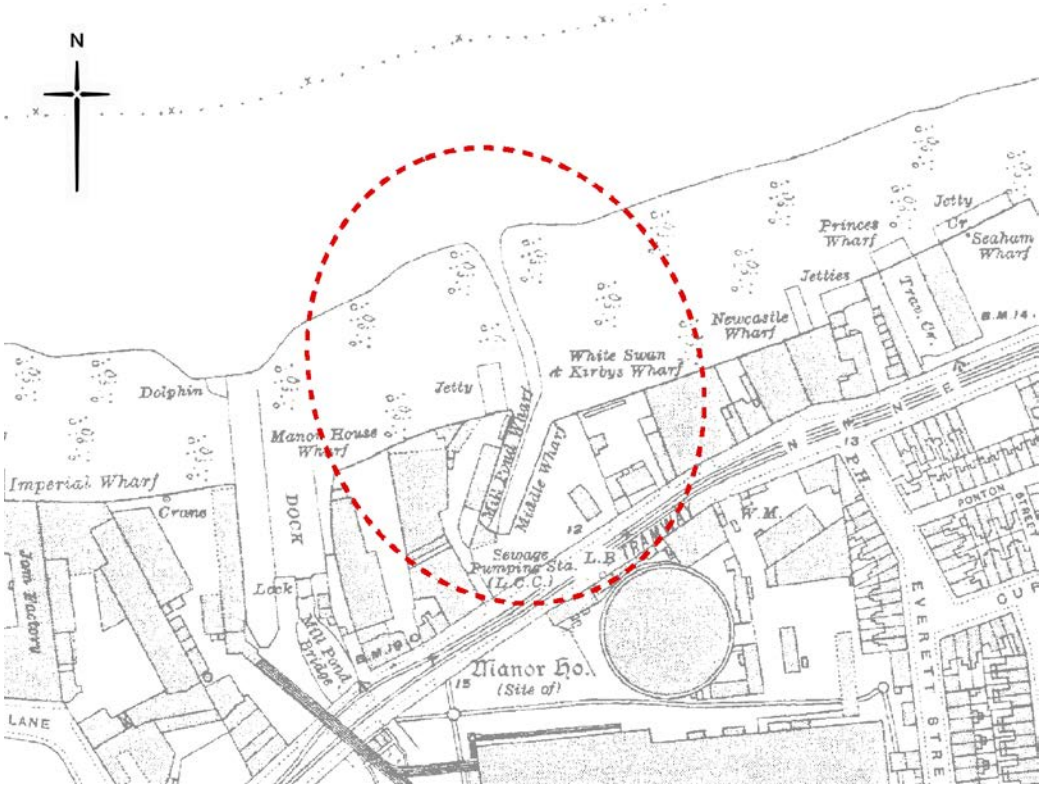
Vol 15 Plate E.5 Historic environment – OS 1st edition 25":mile map of 1874 (not to scale)



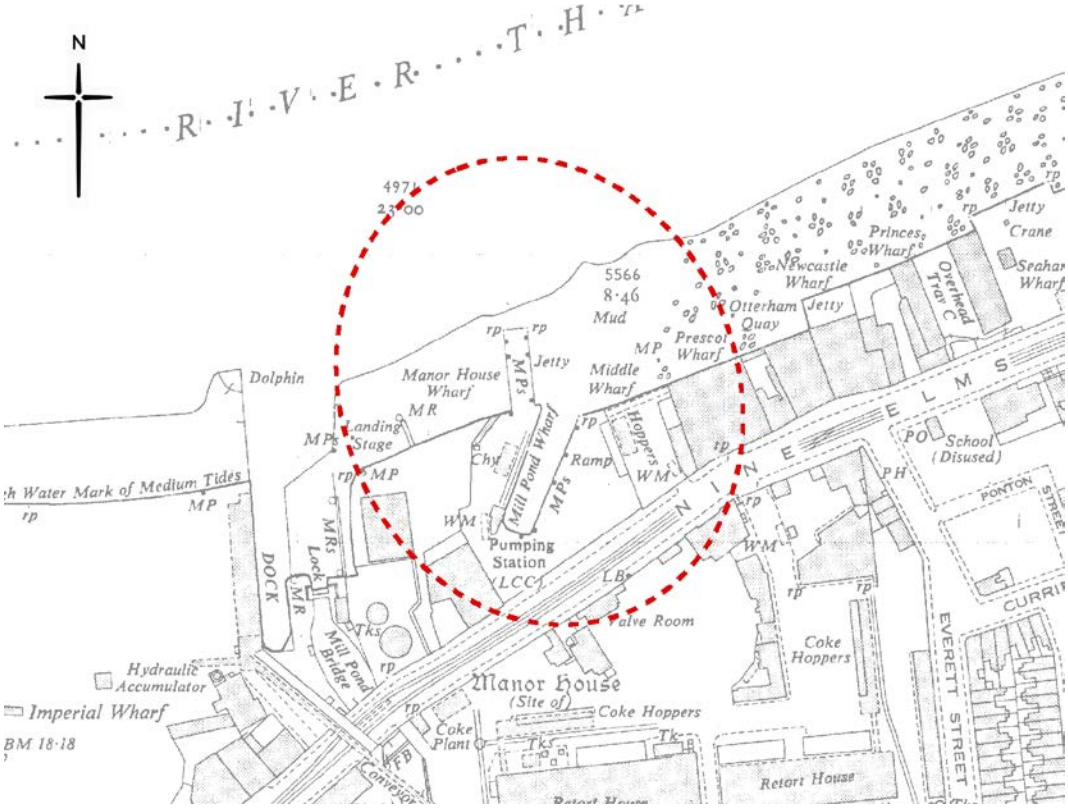
Vol 15 Plate E.6 Historic environment – OS 2nd edition 25":mile map of 1894–1896 (not to scale)



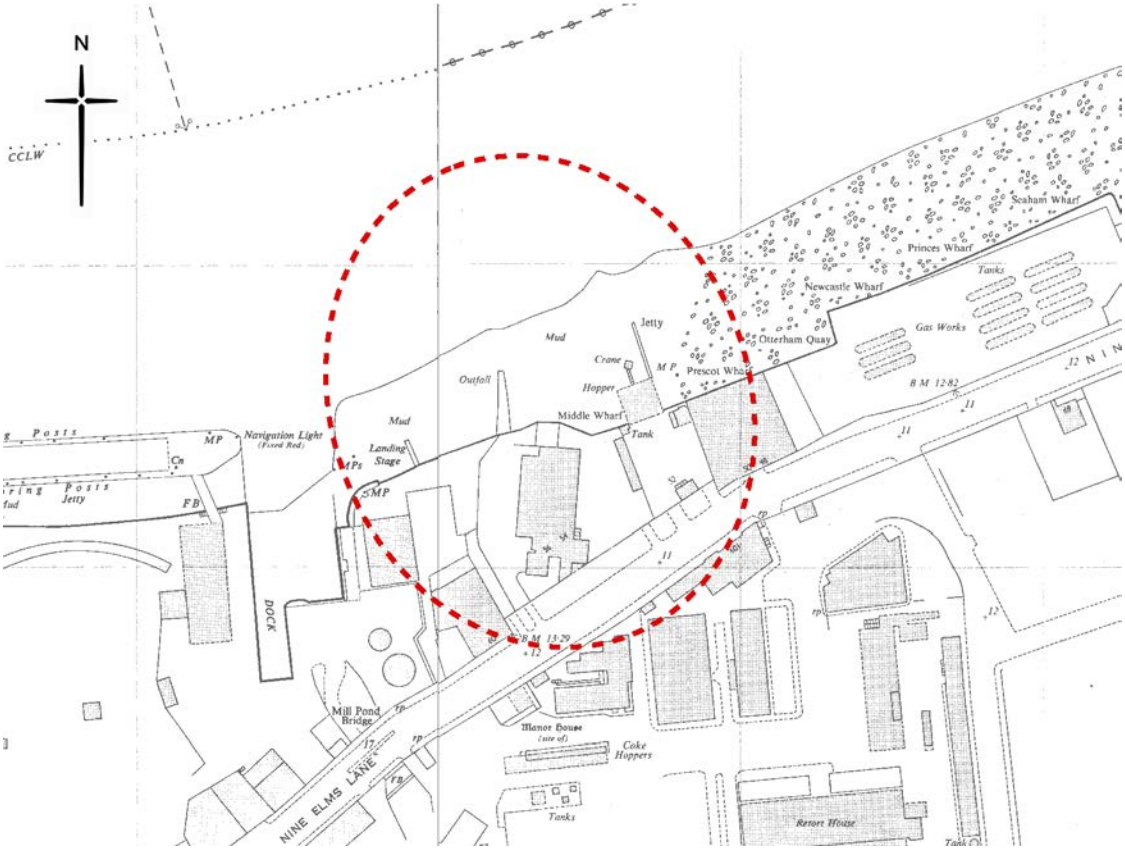
Vol 15 Plate E.7 Historic environment – OS 3rd edition 25":mile map of 1916 (not to scale)



Vol 15 Plate E.8 Historic environment – OS 25”:mile map of 1947 (not to scale)

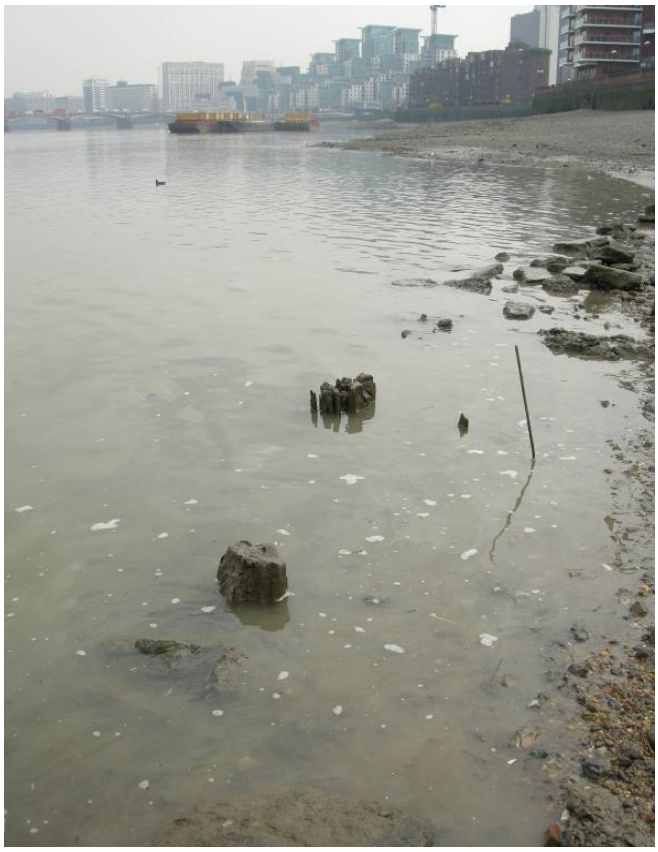


Vol 15 Plate E.9 Historic environment –OS 1:1250 scale map of 1952 (not to scale)



Vol 15 Plate E.10 Historic environment – remains of a fish trap of Saxon date the foreshore to the northeast of the site (HEA 66); standard lens, looking west.

Vol 15 Plate E.11 Historic environment – remains of a post-medieval slipway (HEA 1D) on the foreshore in the northeast of the site; standard lens, looking east



Vol 15 Plate E.12 Historic environment – Heathwall Pumping Station within the site viewed from Nine Elms Lane; standard lens, looking north

Vol 15 Plate E.13 Historic environment – the Cemex compound within the site, looking through the gate entrance east of Heathwall Pumping Station; standard lens, looking northwest

Vol 15 Plate E.15 Historic environment – structures on the foreshore and outlets to Thames in the northeastern part of the site; standard lens, looking west

Vol 15 Plate E.16 Historic environment – site viewed from the east, with public garden and river wall (HEA 1F); standard lens, looking west

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.15**

Volume 15: Heathwall Pumping Station appendices

Appendix F: Land quality

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

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 15 Heathwall Pumping Station 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. a walkover survey

b. the Landmark Information Group database, which includes historic maps and environmental records

c. British Geological Survey (BGS) mapping[1]

d. stakeholder consultation.

Site walkover

F.1.2 A site walkover survey of Heathwall Pumping Station was undertaken on 25th May 2011.

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 historical or ongoing contamination sources, as well as any nearby sensitive receptors.

F.1.4 The proposed site currently comprises Heathwall Pumping Station, Middle Wharf and a disused jetty area housing a crane, hopper and tank. The contents of the tank are currently unknown.

F.1.5 Middle Wharf, located adjacent to the east of Heathwall Pumping Station, is a safeguarded wharf which is currently unoccupied. A double skinned fuel storage tank and a chemical storage area were observed in this area. It is understood that the Middle Wharf site is sub-let to a liquid waste disposal operator.

F.1.6 No access to the pumping station of Middle Wharf was available during the walkover survey and all observations were made from publicly accessible areas.

F.1.7 Detailed site walkover notes are provided in Vol 15 Table F.1 below.

Vol 15 Table F.1 Land quality – site walkover report

Item (Site ref: PWH10, Heathwall Pumping Station)		Details
Date of walkover	25th May 2011	
Site location and access	Thames Water operated Heathwall Pumping Station, Nine Elms Lane, Wandsworth. Restricted access viewed from publicly accessible areas.	
Size and topography of site and surroundings	Record elevation in relation to surroundings, any hummocks, breaks of slope etc	Site is flat in relation to the surrounding areas. The northern section of the site is within the foreshore of the River Thames.

Item (Site ref: PWH10, Heathwall Pumping Station)		Details
Neighbouring site use (in particular note any potentially contaminative activities or sensitive receptors)	North	River Thames
	South	Commercial and industrial properties, the Royal Mail Sorting Office and warehouses.
	East	Closest residential properties are at Elm Quay.
	West	Tideway Industrial Estate which houses storage sheds. In addition there are moored river boats adjacent to the sites western boundary.
Site buildings	Record extent, size, type and usage. Any boiler rooms / electrical switchgear	The proposed site is currently utilised by Heathwall Pumping Station, a jetty area housing a crane, hopper and tank.
Surfacing	Record type and condition	Hardstanding and river foreshore
Vegetation	Any evidence of distress, unusual growth or invasive species such as Japanese Knotweed	No vegetation observed
Services	Evidence of buried services	None observed
Fuels or chemicals on-site	Types/ quantities	None observed
	Tanks (above ground or below ground)	The eastern side of Heathwall Pumping Station is currently in use by a waste operative. A double skinned fuel storage tank and a chemical storage area are also present in this area.
	Containment systems (eg, bund, drainage interceptors). Record condition and standing liquids	None observed
	Refill points located inside bunds or on impermeable surfaces etc	None observed
Vehicle servicing or refuelling on-site	Record locations, tanks and inspection pits etc	None observed
Waste	Adequate storage and	None observed

Item (Site ref: PWH10, Heathwall Pumping Station)		Details
generated/stored on-site	security. Evidence of fly tipping	
Surface water	Record on-site or nearby standing water	The River Thames is situated within the northern section of the site.
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		Jetty area Waste operation area to the east Double skinned fuel storage tank Chemical storage area
Any other comments	Eg access restrictions/ limitations	Access restricted, site observed through security gates.

Review of historical contamination sources

F.1.8 Historical mapping (dating between 1875 and 1987) has been reviewed in order to identify potentially contaminating land-uses at the site and within the 250m assessment area.

F.1.9 Vol 15 Table F.2 tabulates the potentially contaminating land-uses, inferred dates of operation and typical contaminants associated with the land-uses in question. Information on the potential contaminants are sourced from CLR8: *Potential contaminants for the assessment of land* (Defra and EA, 2002)[2] and former Department of the Environment industry profiles (Department of the environment, 2011)[3].

F.1.10 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.1.11 Items listed in the table below are also shown in Vol 15 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 15 Appendix E.

Vol 15 Table F.2 Land quality – potentially contaminating land-uses

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[2,3]
On-site			
1	(a) Lime works and dock	Prior to c1875-c1896	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, polyaromatic hydrocarbons (PAHs), sulphide, sulphates
	(b) Sewage pumping station including dock	c1916–c1951	Heavy metals, arsenic, free cyanide, nitrates, ammonium, phosphates, sulphates, sulphides, asbestos, oil/fuel hydrocarbons, chlorinated aliphatic hydrocarbon, chlorinated aromatic hydrocarbons, polychlorinated biphenyls (PCBs), pathogens
	(c) Existing sewage pumping station	c1951-present	
2	Manor House Wharf and other various wharves	c1896-c1975	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
Off-site			
3	(a) London Gas Works (15m south)	Prior to c1875-c1976	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds, cyanides, ammonia, phenols, heavy metals, asbestos
	(b) Sorting office and warehouses (15m south)	c1976-onwards	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
4	Railway (225m southeast)	Prior to c1875-c1975	PAHs, heavy metals, phenols, sulphates, fuel oil,

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item2,3
			lubricating oil, greases, PCBs, solvents, asbestos, chlorinated aliphatic hydrocarbons, sulphates
5	(a) Unspecified industrial/commercial buildings (145m west)	c1896-c1916	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
	(b) Paint and colour works (145m west)	c1916-c1952	Heavy metals, boron, asbestos, nitrate, sulphate, phenol, acetone, oil/fuel hydrocarbon, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, dieldrin, PCBs
	(c) Various works and depots (145m west)	c1952-present	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds, heavy metals and asbestos
6	(a) Unspecified industrial/commercial buildings (200m southwest)	c1896-c1916	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
	(b) Paint and colour works (200m southwest)	c1916-c1952	Heavy metals, boron, asbestos, nitrate, sulphate, phenol, acetone, oil/fuel hydrocarbon, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, dieldrin, PCBs
	(c) Various works and depots (200m southwest)	c1952-present	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds, heavy metals and asbestos

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item2,3
7	(a) Various wharves including Imperial Wharf and Jam Factory (5m west)	Prior to c1875-c1975	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
	(b) North Thames Gas Board offices (5m west)	c1975-c1987	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
	(c) Nine Elms/Tideway Industrial Estate and depot (5m west)	c1987-present	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
8	Dock - including lock and Brine Mill pond (adjacent west)	Prior to c1875-c1986	Heavy metals, arsenic, asbestos, phenols, oil/fuel hydrocarbon, PAHS, sulphides, sulphates, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, hexachlorocyclohexane
9	Tanks associated with gas works (35m east)	c1966	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds, cyanides, ammonia, phenols, heavy metals, asbestos
10	(a) Brewery (185m southeast)	Prior to c1875-c1976	Volatile organic compounds, total petroleum hydrocarbons, heavy metals, ethanol/methanol, ammonia, chlorinated alkalis, benzene, toluene, ethylbenzene and xylenes

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item2,3
	(b) Warehousing (185m southeast)	c1976-c1984	Use unknown
11	Warehousing and sorting office (60m southeast)	c1984 to present	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons
12	Garage (125m north)	c1952-c1984	Heavy metals, paints, asbestos, TPH, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, solvents, de-greasers, cutting oils, mineral oil
13	Various wharves and embarkation sheds (125m north)	c1875-c1984	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons

On-site

F.1.12 The Heathwall Pumping Station site was formerly developed as a whiting and lime works and a dock, before being used as a sewage pumping station.

F.1.13 The earlier (pre-1960s) pumping station is shown to have included a chimney. An unspecified tank is also shown at the site in the 1950s.

Off-site

F.1.14 Within the 250m assessment area, the historical mapping shows that the surrounding area around Heathwall Pumping Station was predominantly industrial and commercial. Notably, there was an extensive gas works (Nine Elms) located approximately 15m south of the site, between c1875 and c1976.

F.1.15 Historical mapping has also indicated the presence of a former dock, lock and mill pond located adjacent to the west of the Heathwall Pumping Station site. The mill pond and lock were not present by c1961 and the dock was not present by c1990, indicating that a degree of infilling may have taken place in this area. This is further supported by the presence of artificial ground in this area on the British Geological Survey (BGS) mapping (British Geological Survey, 1998)1.

Geology

F.1.16 Data from the Thames Tideway Tunnel project ground investigation indicates the anticipated geological succession, as summarised in Vol 15 Table F.3 below.

Vol 15 Table F.3 Land quality – anticipated site geology

Geological unit/ strata	Description	Approximate depth below ground level (m)
Made Ground	Granular fill comprising sand and gravel or brick with some fragments of timber. Locally clay soils predominate.	0.0-4.9
Alluvium/ River Terrace Deposits	Medium dense to dense sand and gravel (predominantly quartz sand and flint gravel). Medium dense to dense sand and gravel (predominantly quartz sand and flint gravel).	4.9-10.5
London Clay Formation	Slightly sandy clay.	10.5-39.2
Harwich Formation	Slightly sandy clay.	39.2-39.9
Lambeth Group (Upper Shelly Beds)	The Lower and Upper Mottled Beds comprise mottled or multicoloured, stiff or very stiff fissured clay, compact silt, and dense or very dense sand Upnor Formation is a fine grained glauconitic sand.	39.9-41.5
Lambeth Group (Upper Mottled Beds)		41.5-44.9
Lambeth Group (Laminated Beds)		44.9-47.3
Lambeth Group (Lower Shelly Beds)		47.3-47.4
Lambeth Group (Lower Mottled Beds)		47.4-53.4
Lambeth Group (Lower Mottled Beds, Gravel)		53.4-54.6
Lambeth Group (Upnor Formation)		54.6-55.7

Geological unit/ strata	Description	Approximate depth below ground level (m)
Thanet Sand Formation	Generally dense glauconitic silty fine sand with occasional rounded flint gravel. The Bullhead Beds which mark the base of the formation comprise green stained gravel and cobbles of flint.	55.7-66.0
Chalk Group	Weak fine grained limestone with nodular and tabular flints.	66.0-unproven

Unexploded ordnance

F.1.17 During both World War 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.1.18 A desk based assessment for UXO threat was previously undertaken by specialists for previous ground investigation works (boreholes SR1085 and PR1086) on part of the proposed development site (Vol 15 Section F.3).

F.1.19 The report established that no damage from WWII bombing was recorded in the immediate vicinity of the boreholes, but that one bomb was reported within the exploratory site and numerous bombs were reported within a 100m radius.

F.1.20 It is considered that there is an overall low to medium threat from UXO within a 25m radius of the exploratory holes at the 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 Two boreholes (reference SR1086 and PR1085) have been drilled at the proposed site as shown on Vol 15 Figure F.1.2 (see separate volume of figures). One borehole (SA1082) was also drilled approximately 50m to the southwest of the site. Boreholes SR1086 and SA1082 were tested for the presence of contaminants in soils and groundwater. The results are summarised in paras. F.1.24 to F.1.34.

F.1.23 Additional boreholes have also been excavated in the vicinity of Heathwall Pumping Station and are illustrated on Vol 15 Figure F.1.2, these are not considered relevant to the contamination status of the site either due to their distance from the shaft location or because certain boreholes were excavated purely for geotechnical purposes.

Soil contamination testing

F.1.24 Nine soil samples of Made Ground and River Terrace Deposits were taken from two boreholes (SR1086 and SA1082) and sent for laboratory analysis.

F.1.25 The samples were tested for a wide range of common contaminants including heavy metals, PAHs, TPH, VOCs, PCBs, cyanide and phenols as well as pH and organic matter.

F.1.26 The testing showed that no contaminants above the light industrial/commercial human health screening values (Defra/EA, 2009)[4], (Land Quality Management/Chartered Institute of Environmental Health, 2009)[5] were present in the samples tested.

F.1.27 Refer to Volume 2 Environmental assessment methodology for full guidance on the criteria used.

F.1.28 On the basis of this limited testing, no gross soil contamination is present on the site.

Soil gas testing

F.1.29 Gas monitoring installations in borehole SR1086 were screened at depth and below the groundwater level. No soil gas testing results were available for shallow soils or wells screened above or across the water level.

F.1.30 No soil gas testing results were available for borehole SA1082.

Groundwater contamination testing

F.1.31 Groundwater samples were taken from borehole SR1086 and borehole SA1082. The groundwater data shows exceedances with respect to contaminants, ammonia, chloride, heavy metals and PAHs.

F.1.32 Refer to Section 13 Water resources – groundwater of this volume for further information.

Sediment quality testing

F.1.33 Four samples of sediment taken from the foreshore of the River Thames at the Heathwall Pumping Station were sent for laboratory analysis. The testing results show that no PCBs, volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), Methyl tertiary-butyl ether (MTBE), asbestos or organotin were found within the foreshore sediments. Concentrations of metals, and petroleum hydrocarbons were not elevated in terms of risks to human health but slightly elevated concentrations of PAHs were encountered. A number of heavy metals (including mercury) and PAHs were elevated over the Port of London Authority (PLA) approved sediment quality guidelines.

F.1.34 Sediment samples also exceeded the bathing water limit for total coliforms.

F.1.35 Refer to Volume 2 Environmental assessment methodology for full guidance on the criteria used.

Third party ground investigation data

F.1.36 No third party ground investigation was available for review at the Heathwall Pumping Station site.

Other environmental records

F.1.37 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 15 Table F.1. Pertinent records are discussed in further detail below.

F.1.38 The location of these records is shown on Vol 15 Figure F.1.3 (see separate volume of figures).

Vol 15 Table F.1 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	1	2
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*	1	2
Registered waste transfer site	0	0
Registered waste treatment or disposal site	0	0

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

F.1.39 Inspection of the data has identified one local authority pollution prevention and control within the site boundary, adjacent to the north of the pumping station at the jetty on Middle Wharf. This is associated with blending, backing and use of bulk cement.

F.1.40 A further two are located within 250m of the Heathwall Pumping Station site. The first within a garage compound, 140m southeast of the site

relates to the respraying of road vehicles and the second on the northern bank of the river relates to a petrol filling station.

F.1.41 Three pollution incidents to controlled water have been recorded within a 250m radius of the site; one is located within the site boundary. All incidences were located in the River Thames.

F.1.42 The proposed development site at Heathwall Pumping Station is identified as being within an area of past potential contaminated industrial use. It could be inferred that the past uses relate to the various industries highlighted in the historical map review. This includes former paint and colour works and gas works and other various wharf and depot areas, in addition to the sewage pumping station as highlighted on Vol 15 Figure F.1.1(see separate volume of figures). Contaminants typically associated with these types of industries are identified in Vol 15 Table F.2.

Land quality data from local authority

F.1.43 The London Borough (LB) of Wandsworth has been consulted with respect to land quality information held in relation to the site and the wider assessment area.

F.1.44 The Council confirmed that the site is located in an industrial/commercial area and the land use in the surrounding area is as described above.

F.1.45 The response concluded that there may be soil and groundwater impacted by contaminants in the area of the proposed development, as a result of the historical industrial land uses and infill materials. The response from the council is provided in full in Section F.2.

Summary of contamination sources

F.1.46 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. potential ongoing contamination of underlying soil and groundwater from current industrial land uses including the existing sewage pumping station and waste storage on adjacent land. Contaminants may include heavy metals, free cyanide, nitrates, ammonium, phosphates, sulphates, oil/fuel hydrocarbons, PCBs and pathogens.

b. historical contamination of underlying soils and groundwater as a result of former industrial use (pumping station and previous lime works and possible coal fired boilers and former tanks). Contaminants may include: heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, chlorinated hydrocarbons, PAHs, PCBs, sulphide, sulphates.

c. historical shallow contamination of foreshore sediments – elevated PAHs and heavy metals/metalloids.

d. potentially elevated land gas within the Made Ground (including infilled ground) and Alluvium.

e. potential for UXO.

F.1.47 Off-site sources of contamination which may impact on the construction and operation of the proposed development could arise from shallow groundwater contamination from existing industries around the site including most notably the gas works and wharves (possible mobile contamination with VOCs, SVOCs, cyanide, phenols, ammoniacal liquors, PAHs and TPH).

F.2 Local authority consultation

WANDSWORTH COUNCIL
Technical Services Department
Environmental Services & Community Safety Division
PO Box 47095
London SW18 9AQ

Please ask for/reply to: Roy Fox
Telephone: 020 8871 7874
Fax: 020 8871 7661
Email:rfox@wandsworth.gov.uk
Minicom: 020 8871 8403

Our Ref: SR155929
Your ref:
Date: 19 May 2011

Lorna Brooks
Mott MacDonald Ltd
8-10 Sydenham Road
Croydon, CR0 2EE

Dear Ms Brooks

Re: Heathwall Pumping Station, London, SW8

I refer to your e-mail enquiry regarding the potential for land contamination at the above site. In order to respond to you I have examined our environmental data for the area, including historical mapping, aerial photographs, geological, hydrogeological and other environmental data, our premises database, the London Fire Brigade petroleum records and the Planning Register.

- The site is located within a current commercial/ industrial area. To the east is a wharf and adjoining this is a residential block. To the west and south are business parks comprising warehousing, distribution depots, post office sorting office, vehicle repairs, and other commercial uses. A small dock off the River Thames is located 65m to the west. However, the whole area is subject to considerable planned changes through redevelopment. The business park to the west has planning permission for redevelopment as housing and mixed commercial uses (Tideway Wharf, planning reference 2011/3735). The business park to the south east has permission for its redevelopment for a new embassy for the USA (planning reference 2009/1506) and the remainder of its area is being considered for redevelopment for mixed residential/commercial use (reference 2010/1893), as is the sorting office reference 2010/4215). Full details of the planning applications can be obtained from the Wandsworth Planning Web pages by entering the reference numbers into the register search at: http://www.wandsworth.gov.uk/gis/search/Search.aspx. These sites all require ground investigations, but only Tideway Wharf's is done (e-mailed to you).
- The 1869 OS mapping shows a whiting & lime works to be located on the site. A dock is contained within the site area. A pottery is located 50m to the east and a large gasworks site is to the south. The gas works are served by an inlet off the River Thames extending 330m into the gas works site. There are gasometers at 50m & 200m southeast and 140m southwest. Tideway Wharf adjoining to the west is made up of small wharves and warehouses.
- The 1896 OS mapping shows the pottery to have become a wharf with warehouse. Beyond this at 170m northeast is a coal wharf. The gas works have expanded and are served by a coal conveyor from a dock at the inlet on

the eastern boundary of Tideway Wharf, west of the site of concern. Paint & colour works are operating from sites at 230m west and 240m southwest.

- The 1916 mapping shows a number of changes to the 1896 epoch. A jam factory is operating at 170m west on the Tideway Wharf site and a sewage pumping station is operating from the area of preference. The other industries continue to operate.
- By the 1930s the riverbank to the east/north of the site consists of wharves and warehouses. The jam factory to the west has also become a wharf and warehousing. The gasworks and paintworks continue to operate. The inlet/dock to the gasworks has been partially infilled such that it extends only 180m south from the Thames.
- In 1947 the gasometer at 50m southeast has been removed. There is still a dock on the preferred area leading to the pumping station. There are large tanks sited on the land adjacent to the west, which may have been storage for the gas works that had started to use oil in its process by this time. Old areas of housing to the southeast have been demolished. Earlier industry continues in place. This situation is maintained into the 1950s and 1960s, but only a single gasometer remained, at 140m southwest.
- Aerial photography from 1971 shows that the dock within the site has been infilled as has the inlet serving the gas works. The latter forms the dock that is currently present 65m to the west, but was slightly larger at that time. Tideway Wharf to the west was used as a coal wharf serving a conveyor into the gas works.
- The land in the area has alluvium as superficial deposits overlying a London Clay solid geology. The alluvium is classified as a minor aquifer but no abstractions are taken from it. In the area of old docks and across Tideway Wharf is made ground. It is not known what material was used to infill the docks.
- There were a number of high explosive bombs and V1 rockets that were recorded to have fallen in the southern parts of the wider area of interest during the Second World War.

Based on the information within our possession we conclude that there may be soils and groundwater impacted by contaminants in the area of interest, resulting from the variety of historical industrial uses and infill materials. This is likely to be widespread over the area.

I trust that this information is useful to you. If you would like to discuss any matter raised in this letter, please do not hesitate to contact me. I acknowledge the payment of the fee payable for carrying out this search. A receipt for the payment is being sent to you by our administration team (including five other search areas).

Yours sincerely,

R G Fox
Area Environmental Health Officer
Environmental Services and Community Safety Division

F.3 Detailed Unexploded Ordnance (UXO) risk assessment

Detailed Unexploded Ordnance (UXO) Risk Assessment

Study Site: Work Area PWH6X
Client Name: Thames Water
6 Alpha Project Number: P2278_R76_V1.0
Date: 14th January 2011

Originator: Gary Hubbard (14th January 2011)
Quality Review: Lee Gooderham (14th January 2011)
Released by: Simon Cooke (14th January 2011)

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Figures

EXECUTIVE SUMMARY

Study Site	Defined as Work Area PWH6X. For the purposes of this study, a 50m assessment radius will be applied to the work area, to provide flexibility should there need to be any works relocation.		
Potential Threat Source	The threat is predominately posed by Second World War (WWII) German High Explosive (HE) bombs and to a lesser extent, British Anti-Aircraft Artillery (AAA) projectiles used to defend against German bombing raids.		
Risk Pathway	If Unexploded Ordnance (UXO) is encountered by a site investigation (or subsequent construction method), that generates significant kinetic energy (e.g. of the sort generated by bore-holing or drilling activities), then it could be initiated.		
Key Findings	• The study site is located within an area of London that experienced a high bomb density rate during WWII, and bomb damage is consistently recorded across the region. • Throughout the war years the site is shown to have been occupied by a collection of buildings surrounding wharf and docks with associated basins. Much of the land was open ground, assumed to have been covered in hard standing. A proportion of the basins have been in filled after WWII. • As the site was occupied by a number of buildings during the war and was an operational wharf, it is therefore highly likely that if any UXBs landed within the confines of this site, they would have been witnessed and dealt with accordingly. However there were specific areas of the site where bombs may have fallen leaving little evidence of a bomb entry hole such as within basins or in the curtilage of bomb damaged buildings. • In light of the varying site usage during the war, 6 Alpha believes there is a corresponding risk profile with the site history and therefore the required risk mitigation measures will vary accordingly.		
Final Risk Level	**Area A**	Areas of open ground (hard standing on the wharf) during WWII and/or where there has been post War redevelopment.	**Low/Medium**
	Area B	Footprint of buildings damaged during WWII or areas within basins existing during WWII	**Medium/High**
Risk Mitigation	**Area A (All Works)**	1. Documentary procedures to be taken in the event of a suspicious find; 2. Brief all personnel involved with the intrusive works on the potential risk of an associated UXO discovery; 3. Engage an UXO Specialist to be “on-call” should a suspect item be discovered.	
	Area B	3. In addition to above, any deep excavations (greater that 1.2m) within these areas should be supervised by an Explosive Ordnance Disposal Engineer.	

ASSESSMENT METHODOLOGY

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

STAGE ONE – SITE LOCATION AND DESCRIPTION	
Study Site	Defined as Work Area PWH6X. For the purposes of this study, a 50m assessment radius will be applied to the work area, to provide flexibility should there need to be any works relocation.
Location Description	The work area is situated within Battersea, approximately 100m east of the disused Battersea Power Station, within the boundary of an industrial unit. Approximately 100m south of the site there is considerable railway infrastructure running in a west to east orientation. Beyond the site to the south is the A3205, which is a busy commuter arterial road. The majority of the surrounding area is mainly industrial or commercial property.
Proposed Works	The following works will be conducted at this location, please note that this may not represent the full scheme but are those activities that may be affected by UXO Risk: • A 30 metre diameter main tunnel drive shaft, 48 metres deep. It is anticipated that the shaft will be constructed by diaphragm wall techniques. • Construction of the main tunnel to Kings Stairs Gardens. • An interception chamber constructed in the foreshore. • A culvert will be constructed from the interception chamber to the main tunnel shaft. A flap valve chamber will be constructed on the culvert adjacent to the main shaft. • The main tunnel shaft will be surrounded by hard standing area for crane access to the shaft for operational requirements. • An additional 7.5 metre diameter drop shaft, 27 metres deep. There will be a flap valve chamber between the new drop shaft and the existing siphon chamber. • A ventilation building including a 15m ventilation column. • The 7.5 metre diameter drop shaft will be provided with a separate ventilation column 10m high. The main shaft, valve chambers, drop shaft, odour control building, vent columns and control kiosks will all be incorporated into two compounds either side of the existing TWUL Heathwall Pumping Station. The total working area is 24,910m^2 including the existing pumping station.
Ground Conditions	Thames Water have informed 6 Alpha that the ground conditions for this preferred site are expected to be: • **Made Ground (MG)** – Ground Level to 4.50m below ground level (bgl); • **Alluvium** – 4.50m to 6.00m bgl; • **River Terrace Deposits** – 6.00m to 7.80m bgl; • **London Clay** – 7.80m to 39.17m bgl. MG/fill may comprise of locally available materials (eg Alluvium and Terrace Deposits together with waste materials such as building rubble, clinker or ash). It may also comprise a range of inert materials and/or domestic refuse. The presence of ferrous metal is not known (but is considered likely), as is the presence of red brick (both of which can interfere with magnetometry). However, all MG/fill It is likely to be heterogeneous and may also contain buried sub–structures and foundations.

STAGE TWO – REVIEW OF HISTORICAL DATASETS		
Sources of Information Consulted	The following primary information sources have been used in order to establish the background UXO threat. 1. London County Council WWII Bomb Damage Mapping; 2. Home Office WWII Bomb Census Maps; 3. WWII & post-WWII Aerial Photography; 4. Official Abandoned Bomb Register; 5. National Archives in Kew; 6. 33 Engineer Regiment (Explosive Ordnance Disposal) at Carver Barracks, Wimbish.	
WWII Historical Data	**WWII Site Usage**	The site is shown to be occupied by a collection of buildings surrounding wharfs and docks. Much of the land was open ground assumed to have been covered by hard standing. A proportion of the basins have been in filled following WWII.
	Bombing Targets	All around this site were numerous potential bombing targets including a number wharfs, storage facilities, gas works and Battersea Power Station.
	HE Bomb Strikes (*Figure 3*)	At least four HE bombs are recorded within the work area, a further bomb is recorded within the extended search boundary.
	WWII HE Bomb Density (*Figure 4*)	The site is covered by the administrative district of Battersea Metropolitan Borough – 214 HE bombs per 1,000 acres.
	WWII Bomb Damage (*Figure 5*)	Bomb damage is recorded on numerous properties across the site and within the general region. Two large facilities on site are shown to have been "Seriously Damaged; Doubtful if repairable", others are shown to have been damaged by minor blast damage. The bomb damage mapping also indicates that two V1 (Flying Bombs) landed to the south of the site at the gas works. Many buildings and structures across the gas works were seriously damaged.
	Abandoned Bombs	There are no abandoned bombs recorded at this location.

STAGE THREE – DATA ANALYSIS	
Is there a reason to suspect that the immediate area was a bombing target during WWII?	There are many commercial and industrial sites in this part of London. The work site incorporates a number of wharfs and docks that run along the banks of the River Thames. Perhaps the most notable target in local vicinity was Battersea Power Station, this was located to the west of the site. Moreover a gas works was situated immediately to the south.
Is there firm evidence that ordnance landed on site?	Yes there is clear evidence that bombs landed within the work area.
Would an UXB entry hole have been observed and reported during WWII?	The site was occupied by a number of buildings during the war and therefore it is highly likely that if any UXBs landed within the confines of this site, they would have been witnessed and dealt with accordingly. However there were various areas of the site such as the docks and wharfs where bombs may have fallen unnoticed.
Was the ground undeveloped during WWII?	No, the site was developed and occupied by a number of buildings.
Is there any reason to suspect that Live Firing or military training may have occurred at this location?	There is no evidence to support that live firing took place on the site.
Is there any reason to suspect that other activities on site may have resulted in ordnance and / or explosives being present?	No, there is no evidence to support other activities on site involved ordnance or explosives of any type.
Would previous earthwork have removed the potential for UXO to be present?	There has been significant redevelopment on this site post WWII, and accordingly there is the potential for this work to have encountered any UXO on site if present. Therefore in areas where there has been extensive earthworks or installation of piles the UXO threat can be considered lower than areas undeveloped.

STAGE FOUR – RISK ASSESSMENT	
Threat Items	The threat is predominately posed by Second World War (WWII) German High Explosive (HE) bombs and to a lesser extent, British Anti-Aircraft Artillery (AAA) projectiles used to defend against German bombing raids.
Maximum Penetration	After reviewing the site-specific geotechnical data, the maximum Bomb Penetration Depth (BPD) is assessed to be 7m below ground level (m bgl).
Risk Pathway	Given the type of munitions that may be present on site, all types of aggressive intrusive engineering activities may generate a significant risk pathway.
Consequence	Consequences of a UXB initiation include: 1. Kill and/or critically injure personnel; 2. Severe damage to plant and equipment; 3. Blast damage to nearby buildings; 4. Rupture and damage underground services. Consequences of UXO discovery include: 1. Delay the project; 2. Disruption to local community/infrastructure; 3. Incurring of additional costs.

UXO RISK CALCULATION (Note using the site history and evidence for WWII it has been possible to subdivide the area based on the UXO threat)			
Activity	**Probability** (SHxEM=P)	**Consequence** (DxPSR=C)	**Risk Rating** (PxC=RR)
Area A - Areas of open ground (hard standing on the wharf) during WWII and/or where there has been post War redevelopment.			
Enabling Works	1x1=1	3x2=6	1x6=6
Shaft Installation	1x2=2	2x2=4	2x4=8
Shallow Excavations	1x2=2	2x2=4	2x4=8
Deep Excavations	1x2=2	2x2=4	2x4=8
Area B - Footprint of buildings damaged during WWII or areas within basins existing during WWII			
Enabling Works	2x1=2	3x2=6	2x6=12
Shaft Installation	2x2=4	2x2=4	4x4=16
Shallow Excavations	2x1=2	2x2=4	2x4=8
Deep Excavations	2x2=4	2x2=4	4x4=16
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?	**Non-Intrusive Methods of Mitigation** – Not possible, as any magnetometer results would be affected by ferro-magnetic contamination within the fill material. Moreover any UXBs are expected to be out of range given the thickness of the fill material. **Intrusive Methods of Mitigation** – It is likely that intrusive magnetometry would be limited on this site, given the expected thicknesses of fill material on site especially within the in filled basins.

MITIGATION MEASURES TO REDUCE RISK TO 'ALARP'

Site Area	Risk Mitigation Measures	Final Risk Rating (Post Mitigation)
Area A	1. Documentary procedures to be taken in the event of a suspicious find; 2. Brief all personnel involved with the intrusive works on the types of UXO that might be encountered and the potential risks of an associated UXO discovery, as well as the actions to be taken in all cases; 3. Engage an UXO Specialist to be "on-call" should a suspect item be discovered.	LOW = ALARP
Area B	4. In addition to above, any deep excavations (greater that 1.2m) within these areas should be supervised by an Explosive Ordnance Disposal Engineer.	

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

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Report Figures

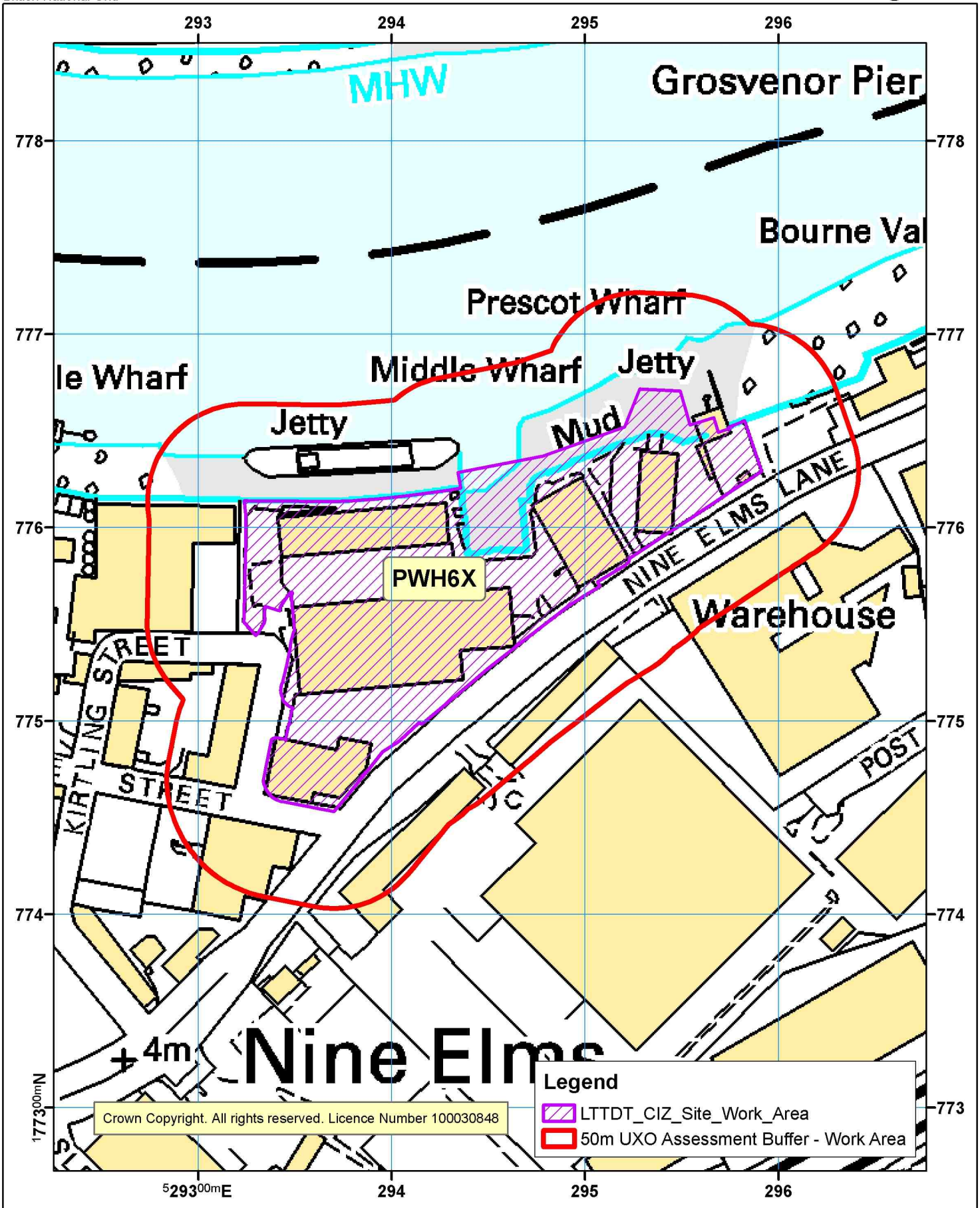
Figure One

Location of the Proposed Works

Thames Tideway Tunnel - Work Area PWH6X
Work Area Location

British National Grid

Figure 1



6 Alpha Associates Ltd.
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0203 371 3900

0 10 20 40 60 80 100 120 Meters

N

Project Number: P2278_R76

Drawn By: Gary Hubbard

Checked by: Lee Gooderham

Date: 4th January 2011

Figure Two

Current Aerial Photography

Thames Tideway Tunnel - Work Area PWH6X
Current Aerial Photograph

British National Grid

Figure 2

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Figure Three

WWII High Explosive Bomb Strikes

Thames Tideway Tunnel - Work Area PWH6X
Location of WWII High Explosive Bombs

British National Grid

Figure 3

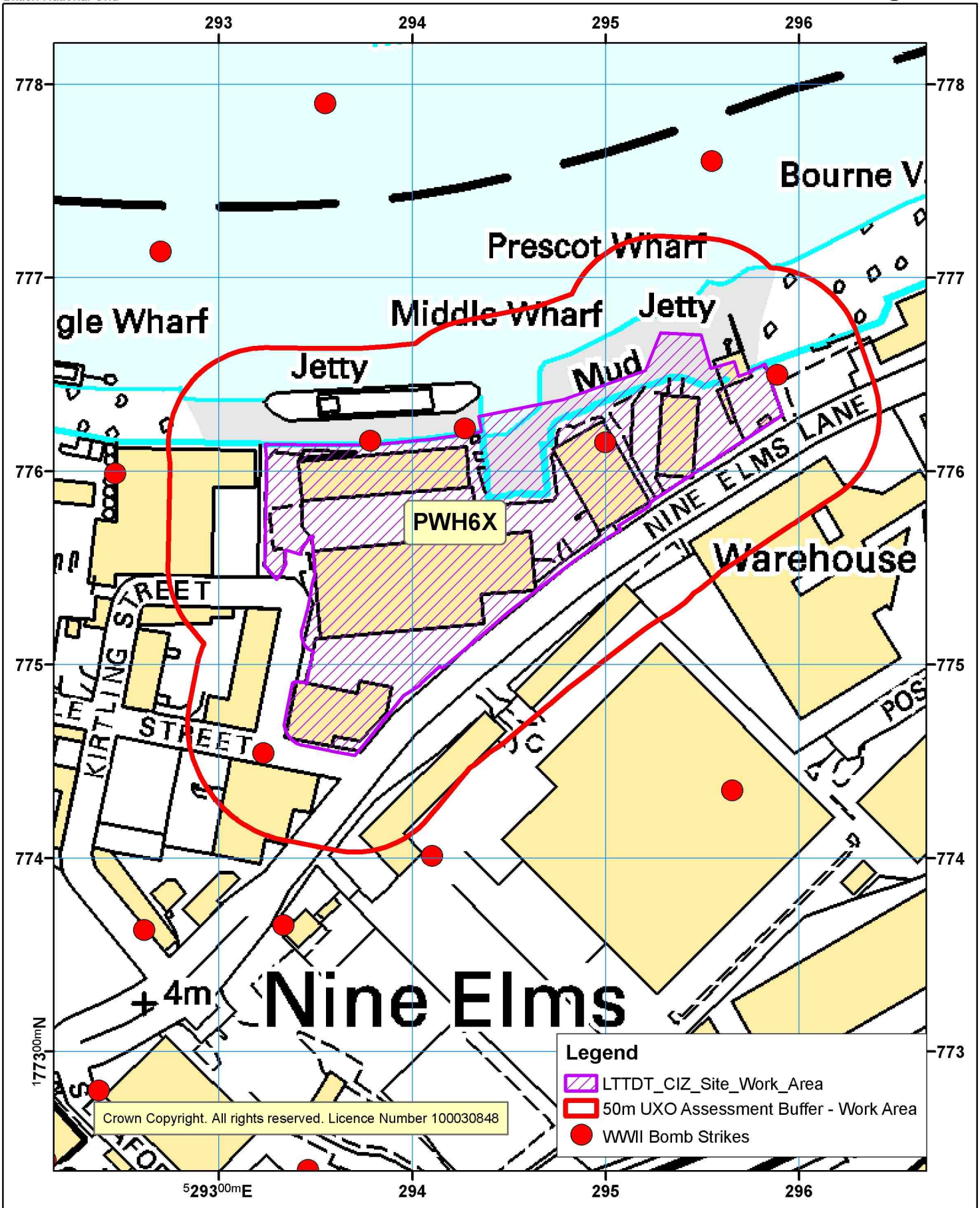

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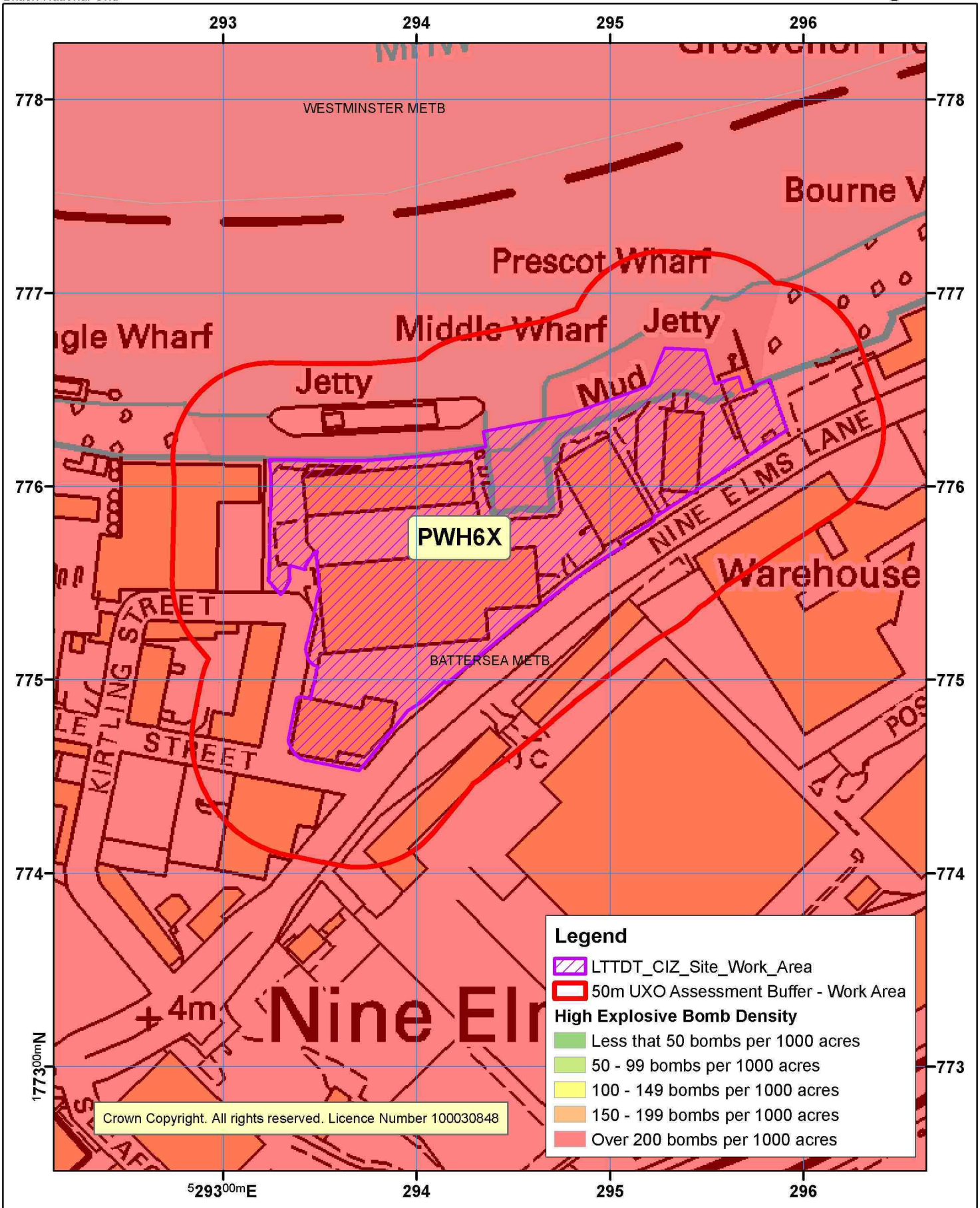
Figure Four

WWII High Explosive Bomb Density

Thames Tideway Tunnel - Work Area PWH6X
WWII High Explosive Bomb Density

British National Grid

Figure 4



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Checked by: Lee Gooderham

Date: 4th January 2011

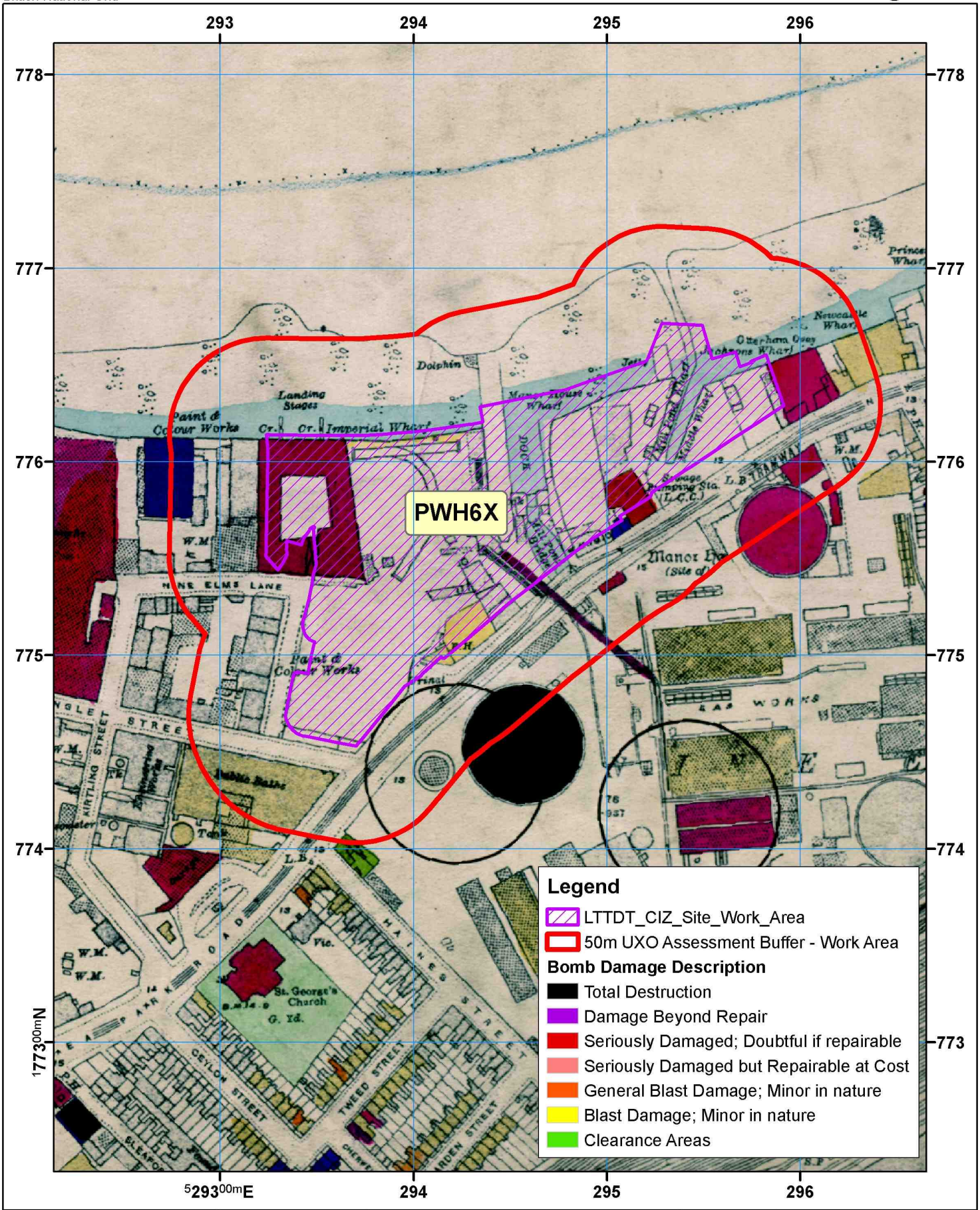
Figure Five

London County Council Bomb Damage Mapping

Thames Tideway Tunnel - Work Area PWH6X
London County Council Bomb Damage Mapping

British National Grid

Figure 5



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Project Number: P2278_R76

Drawn By: Gary Hubbard

Checked by: Lee Gooderham

Date: 4th January 2011

References

[1] British Geological Survey. *Geological Survey of Great Britain (England and Wales)*, sheet 270 (Solid and Drift Edition), South London, Scale 1:50,000 (1998).

[2] Department for the Environment, Food and Rural Affairs and The Environment Agency, *CLR8: Potential Contaminants for the assessment of land,* Environment Agency (2002).

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

[4] Defra/EA. *Soil Guideline values for industrial and light commercial land use* (2009).

[5] Land Quality Management/Chartered Institute of Environmental Health. *Generic Assessment Criteria for Human Health Risk Assessment*, 2nd Edition (2009).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.15**

Volume 15: Heathwall Pumping Station appendices

Appendix G: Noise and vibration

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 15 Appendices: Heathwall Pumping Station site assessment

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 residential receptors to Heathwall Pumping Station are the houseboats moored close to the site at Nine Elms Pier and the proposed residential dwellings in the Riverlight development. Residences at Elm Quay, River Lodge and Embassy Gardens are also located in relatively close proximity to the site. The Battersea Barge is a non-residential receptor located to the west of the site.

Survey methodology

G.1.3 The London Borough of Wandsworth 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 19-20th June, 2011 and additional data was collected 22nd June, 2011 and 28-29th June, 2011. The baseline surveys comprised short term attended measurements at two locations taken during the daytime, evening and night-time, as well as completing continuous unattended monitoring at two measurement locations over a four day period.

G.1.5 For the attended survey locations, measurements were undertaken during the interpeak periods of 10:00-12:00, 14:00-16:00, 20:00-22:00 and 00:00-04:00 on a typical weekday, and 14:00-18:00 and 00:00-04:00 on a typical weekend day so that the baseline data is representative of the quieter periods where any disturbance from construction would be most noticeable.

G.1.6 Continuous unattended noise monitoring was completed at two locations within the grounds of Heathwall Pumping Station. Data was collected over a four day period (19th through 22nd June) in accordance with the survey methodology agreed with the Borough.

G.1.7 Vol 15 Table G.1 describes the survey equipment that was used to collect the baseline data at the site.

Vol 15 Table G.1 Noise – survey equipment

Item	Type	Manufacturer	Serial Number(s)	Laboratory Calibration Date
Initial Baseline Survey: 19th - 20th June, 2011				
Hand-Held Analyzer(s)	2250	Brüel & Kjær	2435919 2611546 2626232	25/05/2011* 14/03/2011* 15/02/2010**
½ " Microphone(s)	4189	Brüel & Kjær	2643144 2670669 2621211	13/05/2011* 10/03/2011* 15/02/2011**
B&K Sound Calibrator(s)	4231	Brüel & Kjær	2445811	14/10/2010*
Additional baseline survey: 22nd June, 2011				
Hand-Held Analyzer(s)	2250	Brüel & Kjær	2506362 2626232	25/05/2011* 15/02/2010**
½ " Microphone(s)	4189	Brüel & Kjær	2670669 2621211	10/03/2011* 15/02/2010**
B&K Sound Calibrator(s)	4231	Brüel & Kjær	2619373 2619375	10/02/2011* 12/01/2011*
Additional baseline survey: 28th - 29th June, 2011				
Hand-Held Analyzer(s)	2250	Brüel & Kjær	2626231 2626233	20/01/2010** 15/02/2010**
½ " Microphone(s)	4189	Brüel & Kjær	2621208 2621212	19/01/2010** 15/02/2010**
B&K Sound Calibrator(s)	4231	Brüel & Kjær	2619372 2619374	13/01/2011* 21/02/2011*

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

G.1.8 Prior to and on completion of the survey, 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.1.9 For the attended measurements, the sound level meters were tripod-mounted with the microphone approximately 1.3m above ground level. A windshield was fitted over the microphone at all times during the survey period to minimise the effects of any wind induced noise.

G.1.10 For the unattended 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 to prevent birds from perching on the equipment.

G.1.11 The prevailing weather conditions observed during the baseline surveys are described in Vol 15 Table G.2.

G.1.12 Contemporary weather data recorded at Heathrow Airport (EGLL) has been summarised in Vol 15 Table G.3. This is deemed to be representative of the prevailing weather conditions for the continuous unattended monitoring kit.

Vol 15 Table G.2 Noise – weather conditions during baseline noise surveys

Wind speed (ms-1)	Wind direction	Temperature (°C)	Precipitation	Description
Initial baseline survey – 19th June, 2011 (daytime, 14:00-18:00)				
Maximum: 1.4-2.8 Average: 0.3-0.8	W; SW	18-21	No	Overcast and breezy
Additional baseline survey – 20th June, 2011 (night-time, 00:00 – 04:00)				
Maximum: 0.4-1.8 Average: 0-0.5	Variable	12-13	No	Dry, calm and cloudy
Additional baseline survey – 22nd June, 2011 (daytime, 10:00–12:00)				
Maximum: 0.8-4.8 Average: 0.4-1.6	SW, SSW	16-19	Yes, damp with light drizzle for second hour	Overcast and breezy
Additional baseline survey – 28th June, 2011 (evening, 20:00–22:00)				
Maximum: 1.7-4.5 Average: 0.3-1.6	NW; NNW	16-18	Yes, light drizzle for 10 mins in middle of survey period	Overcast and breezy
Additional baseline survey – 29th June, 2011, (night-time, 00:00 – 04:00)				
Maximum: 1.0-3.4 Average: 0.3-1.1	NW, WNW	14-17	No	Partly cloudy with occasional breeze

Vol 15 Table G.3 Noise – contemporary weather data for Heathrow Airport

Wind speed (ms^{-1})	Wind direction	Temperature (°C)	Precipitation?	Description
Sunday 19th June, 2011 (15:00 onwards) [a]				
2-7.9	Variable (Predominantly W, WSW and SW)	12-18	No	Overcast and breezy
Monday 20th June, 2011[b]				
1-5.7	Variable (Predominantly S and SSW)	10-21	Yes (Light rain between 5PM and 10PM)	Scattered cloud and dry for majority of day
Tuesday 21st June, 2011[c]				
3.6-9	Variable (Predominantly SW and WSW)	13-21	No	Scattered cloud, dry and breezy
Wednesday 22nd June, 2011(until 13:30) [d]				
2.6-7.2	Variable (Predominantly SW and SSW)	12-17	Yes (Light rain from 12.20PM onwards)	Cloudy and breezy. Dry for majority of day

a http://www.wunderground.com/history/airport/EGLL/2011/6/19/DailyHistory.html
b http://www.wunderground.com/history/airport/EGLL/2011/6/20/DailyHistory.html
c http://www.wunderground.com/history/airport/EGLL/2011/6/21/DailyHistory.html
d http://www.wunderground.com/history/airport/EGLL/2011/6/22/DailyHistory.html

Measurement locations

G.1.13 Vol 15 Table G.4 details the measurement locations which are also presented in Vol 15 Figure G.1 Noise – measurement locations (see separate volume of figures), and shown in Vol 15 Plate G.1 to Vol 15 Plate G.4.

Vol 15 Table G.4 Noise – measurement locations

Measurement location number	Description	Co-ordinates	
		X	Y
KST01	On public footpath adjacent to Nine Elms Lane, outside residential dwelling	529327	177365
HEA03	On public footpath adjacent to Grosvenor Road, opposite Pimlico Gardens	529660	177959
HEA01	Within Heathwall Pumping Station, west of main building	529514	177613

Measurement	Description	Co-ordinates	
HEA02	Within Heathwall Pumping Station, east of main building	529569	177623

Results

G.1.14 The range of values for each of the parameters collected during the baseline surveys are summarised in Vol 15 Table G.5 to Vol 15 Table G.5Table G.9.

Vol 15 Table G.5 Noise – sampled noise survey results - KST01

Location detail: KST01, on public footpath adjacent to Nine Elms Lane, in front of residential dwellings						
Measurement period	**Noise level (dB(A) free-field)**			**Averaged ambient noise level, dBLAeq,15min**		**dBLAeq,15min (rounded to nearest 5dB)**
	LAFmax	**LA90,15 min**	**LAeq,15 min**	**Free field**	**Façade**	**Façade**
Daytime (10.00-12.00, 14.00-16.00)	85	61	70-71	70	73*	75
Evening (20.00-22.00)	99	58	69-73	71	74*	75
Night (00.00-04.00)	90	49	64-67	66	69*	70
Weekend day (14.00-18.00)	98	59	69-72	71	74*	70
Weekend night (00.00-04.00)	88	48	62-67	65	68*	70

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

Vol 15 Table G.6 Noise – sampled noise survey results - HEA03

Location detail: HEA03, on public footpath adjacent to Grosvenor Road, opposite Pimlico Gardens						
Measurement period	**Noise level (dB(A) free-field)**			**Averaged ambient noise level, $dBL_{Aeq,15min}$**		**$dBL_{Aeq,15min}$ (rounded to nearest 5dB)**
	L_{AFmax}	**$L_{A90,15min}$**	**$L_{Aeq,15min}$**	**Free field**	**Façade**	**Façade**
Daytime (10.00-12.00, 14.00-16.00)	96	61	71-74	72	75*	75
Evening (20.00-22.00)	93	61	69-73	71	74*	75
Night (00.00-04.00)	87	49	65	65	68*	70
Weekend day (14.00-18.00)	87	60	67	67	70*	70
Weekend night (00.00-04.00)	86	48	63-65	64	67*	65

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

Vol 15 Table G.7 Noise – continuously logged noise survey results - HEA01

Location detail: HEA01, within the private grounds of Heathwall Pumping Station, west of main building							
Day	**Period**	**Period noise level (dB(A) free-field)**			**Period noise level (dB(A) façade)**		
		L_{AFmax}	**L_{A90}**	**L_{Aeq}**	**L_{AFmax}**	**L_{A90}**	**L_{Aeq}**
Weekday	07.00-08.00	91	57	65	94	60	68
	08.00-18.00	93	59	66	96	62	69
	18.00-19.00	91	56	65	94	59	68
	19.00-22.00	91	53	64	94	56	67
	22.00-07.00	95	47	61	98	50	64
Sunday	07.00-21.00*	87	53	63	90	56	66
	21.00-07.00	91	46	61	94	59	64

**The data presented in this row is deemed to be representative of the reference period. The continuous monitors only started collecting data from 4PM on the Sunday after the engineers had successfully installed it onsite.*

Vol 15 Table G.8 Noise – continuously logged noise survey results - HEA02

Location detail: HEA02, within the private grounds of Heathwall Pumping Station, east of main building							
Day	**Period**	**Period noise level (dB(A) free-field)**			**Period noise level (dB(A) façade)**		
		L_{AFmax}	**L_{A90}**	**L_{Aeq}**	**L_{AFmax}**	**L_{A90}**	**L_{Aeq}**
Weekday	07.00-08.00	86	57	64	89	60	67
	08.00-18.00	105	57	65	108	60	68
	18.00-19.00	82	57	64	85	60	67
	19.00-22.00	89	54	62	92	57	65
	22.00-07.00	95	46	60	98	49	63
Sunday	07.00-21.00*	88	53	62	91	56	65
	21.00-07.00	90	44	59	93	47	62

**The data presented in this row is deemed to be representative of the reference period. The continuous monitors only started collecting data from 4PM on the Sunday after the engineers had successfully installed it onsite.*

Vol 15 Table G.9 Noise – measurements near embankment (for river-based traffic assessment

Sensitive receptor locations	Measurement location	Measurement period	Noise level (dBLAeq, facade)
Nine Elms Pier (western embankment)	HEA01	Day/evening (07.00-23.00)	69
Elm Quay (eastern embankment)	HEA02	Day/evening (07.00-23.00)	68

Plates of noise measurement locations

G.1.15 The following plates (Vol 15 Plate G.1 to G.4) illustrate the noise measurement locations.

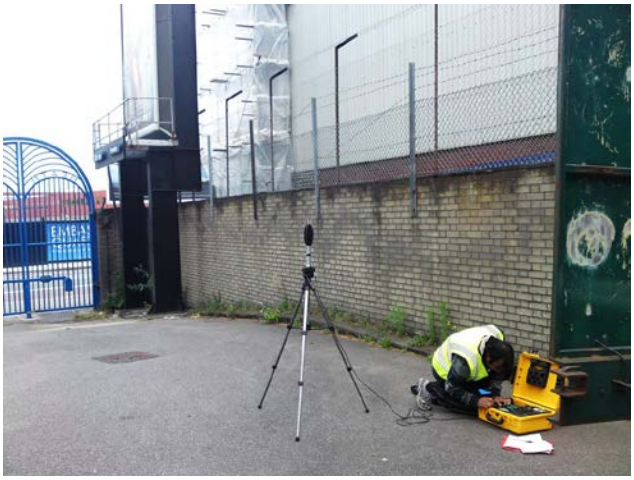
Vol 15 Plate G.1 Noise measurement location KST01

** Note: On public footpath alongside Nine Elms Lane, looking southwest*

Vol 15 Plate G.2 Noise measurement location HEA03

** Note: On public footpath along Grosvenor Road, looking northeast*

Vol 15 Plate G.3 Noise measurement location HEA01



** Note: Within Heathwall Pumping Station, looking south towards Nine Elms Lane*

Vol 15 Plate G.4 Noise measurement location HEA02

** Note: Within Heathwall Pumping Station, looking north towards River Thames*

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 15 Table G.10.

G.2.4 Time histories of the predicted daytime construction noise levels across the programme of construction works are shown in Vol 15 Plate G.5 to Vol 15 Plate G.9.

Vol 15 Table G.10 Noise – typical construction plant schedule

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
Hoarding General site equipment NOT applicable during this phase	Excavator digging post holes for hoarding	1	105	30	BS5228-1[i]: Table C.2, Item 2	Tracked excavator, 71 t
	Generator 35kVA	1	94	100	BS5228-1: Table C.4, Item 78	Diesel generator,
	Circular saw cutting timber	1	113	10	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	1	101	10	BS5228-1: Table C.4, Item 95	Handheld cordless nail gun, 15 to 50 mm nails
	Compressor 250cfm	1	93	30	BS5228-1: Table C.5, Item 5	Compressor for hand-held pneumatic breaker, 1 t
	Hand-held percussive breaker	1	111	30	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker,
	Waste collection via skip or tipper lorry	1	106	10	BS5228-1: Table C.8, Item 21	Skip wagon,
	Oxyaceteline cutting equipment	1	93	10	BS5228-1: Table C.3, Item 35	Hand-held gas cutter, 230 bar
Site set up and general	Oxyaceteline cutting equipment	1	93	10	BS5228-1: Table C.3, Item 35	Hand-held gas cutter, 230 bar

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
site	JCB with hydraulic breaker	1	116	25	BS5228-1: Table C.5, Item 1	Backhoe mounted 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 C.5, Item 5	Compressor for hand-held pneumatic breaker, 1 t
	Generator - 200 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,
	Telescopic Handler/FLT	1	99	30	BS5228-1: Table C.2, Item 35	Telescopic handler, 10 t
	Wheel wash	1	110	20	Measured	Jet wash,
	Hiab lorry/crane	1	105	5	BS5228-1: Table C.4, Item 53	Lorry with lifting boom, 6 t
	Water settling/treatment	1	104	100	Measured	Dirty water plant,
	Dewatering Pump	1	96	100	BS5228-1: Table C.4, Item 88	Water pump
	Well drilling Rig	1	107	50	Manufacturer	Bauer BBA well drilling rig,

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
Demolition General site equipment also applicable during this phase	Service Crane 25T mobile Crane	1	98	30	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	22T Excavator c/w hydraulic hammer	1	119	15	BS5228-1: Table D.2, Item 4	Tracked excavator fitted with breaker, 200 kg·m
	Site dumper	1	104	30	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	Pneumatic breaker	1	111	15	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
Cofferdam construction General site equipment also applicable during this phase note: piling and backfilling will be concurrent however the two operations will be	400 cfm compressor	2	93	100	BS5228-1: Table C.5, Item 5	Compressor for hand-held pneumatic breaker, 1 t
	150t crawler crane	1	103	60	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	Barges	1	101	5	Measured	Barge arriving and slurry loading,
	Generator	1	94	100	BS5228-1: Table C.4, Item 78	Diesel generator,
	Jack-up barge	1	100	10	Measured	Jack up barge,
	Oxyaceteline cutting equipment	1	93	10	BS5228-1: Table C.3, Item 35	Hand-held gas cutter, 230 bar

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
separated by some distance.	Silent piler	1	91	10	BS5228-1: Table C.3, Item 9	Piling, 10 t
	Vibratory piling rig	1	116	60	BS5228-1: Table C.3, Item 8	Vibratory piling rig, 52 t
	25t excavator	1	105	80	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t
	Plate compactors	2	108	10	BS5228-1: Table C.2, Item 41	Vibratory plate (petrol) ,
	Vibrating rollers	2	101	50	BS5228-1: Table C.2, Item 38	Roller, 18 t
Piling for culvert support	100t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	25 tonne mobile crane	1	98	50	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	Vibratory piling rig	1	116	80	BS5228-1: Table C.3, Item 8	Vibratory piling rig, 52 t
Shaft sinking by caisson or underpinning General site equipment also applicable during this	100t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	40t crawler crane	1	98	50	BS5228-1: Table C.3, Item 29	Tracked mobile crane, 55 t
	Waste collection via skip or tipper lorry	1	106	10	BS5228-1: Table C.8, Item 21	Skip wagon,
	Bentonite/grout mixing plant	1	96	50	Measured	Electronic bentonite

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
phase						pump,
	Ventilation fans	1	100	100	Measured	Ventilation fans,
	Long reach excavator	1	106	80	BS5228-1: Table C.7, Item 1	Long reach tracked excavator, 21 m arm / 39 t
	12t excavator with breaker	1	110	15	BS5228-1: Table D.8, Item 13a	Tracked excavator fitted with hydraulic rock breaker,
	25t excavator	1	105	30	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
Connection tunnel construction General site equipment also applicable during this phase	100t crawler crane	1	103	25	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
	Grout mixer including silos and feeders	1	108	100	BS5228-1: Table D.6, Item 13	Grout and mixer,
	Ventilation fans	1	100	100	Measured	Ventilation fans,
	Dumper	1	107	30	BS5228-1: Table C.2, Item 26	Wheeled loader,

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
	Mains substation	1	100	100	Measured	Diesel generator, 800kVA
	Waste collection via skip or tipper lorry	1	106	10	BS5228-1: Table C.8, Item 21	Skip wagon,
	Loading shovel	1	114	10	BS5228-1: Table C.9, Item 8	Wheeled loader, 50 t
Shaft and connection tunnel secondary lining General site equipment also applicable during this phase	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	99	20	BS5228-1: Table C.4, Item 19	Cement mixer truck (idling),
	Concrete pump	2	95	20	BS5228-1: Table C.4, Item 24	Concrete pump + cement mixer truck (discharging), 8 t / 350 bar
	Fixed and portable concrete vibrators	4	106	20	BS5228-1: Table C.4, Item 33	Poker vibrator,
Culvert and chamber works General site equipment also applicable	Service crane - 100T mobile crane	1	99	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,	Dumper, 7 t

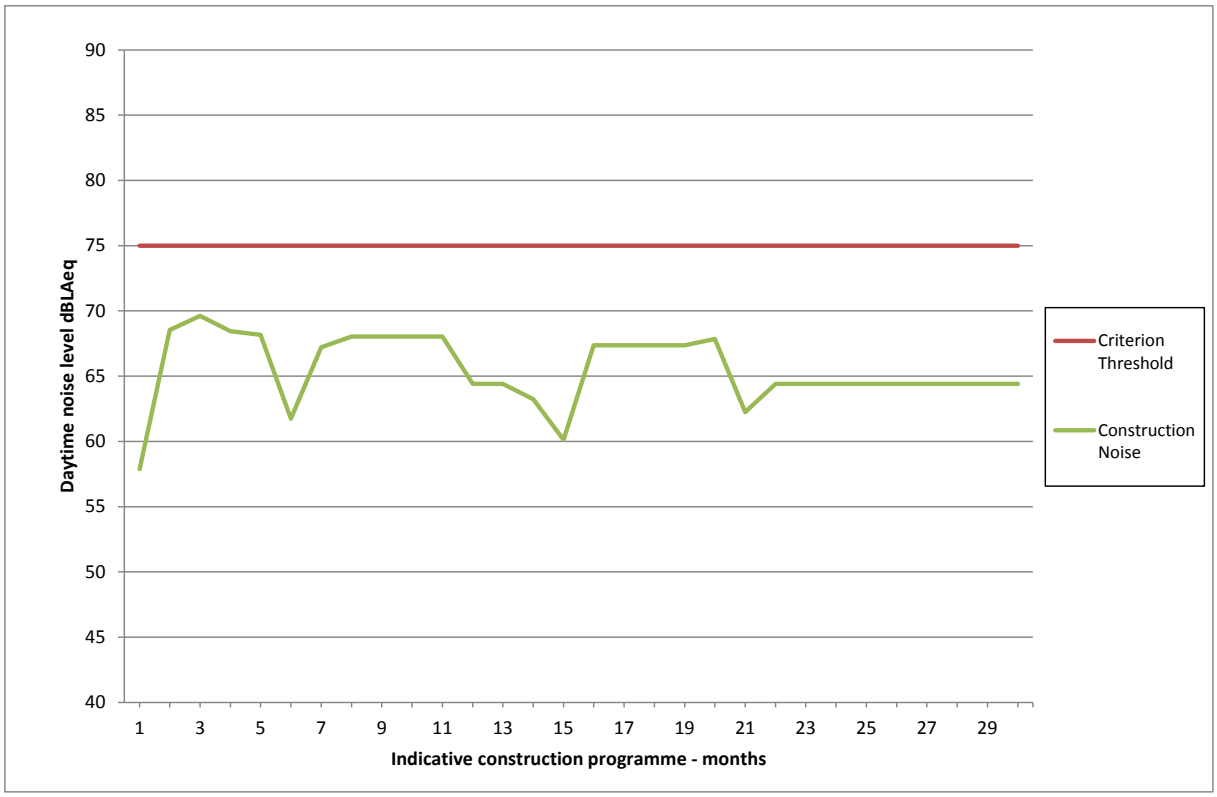
Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
during this phase					Item 3	
	Concrete deliveries (discharging)	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
	Concrete boom pump	1	108	20	BS5228-1: Table C.4, Item 29	Truck mounted concrete pump + boom arm, 26 t
	Fixed and portable concrete vibrators	4	106	20	BS5228-1: Table C.4, Item 33	Poker vibrator,
Landscaping General site equipment NOT applicable during this phase	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	102	10	BS5228-1: Table C.1, Item 8	Hydraulic breaker power pack, 63 kg/ 138 bar
	Hand-held percussive breaker	1	111	10	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker,
	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,	Roller, 18 t

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
					Item 38	

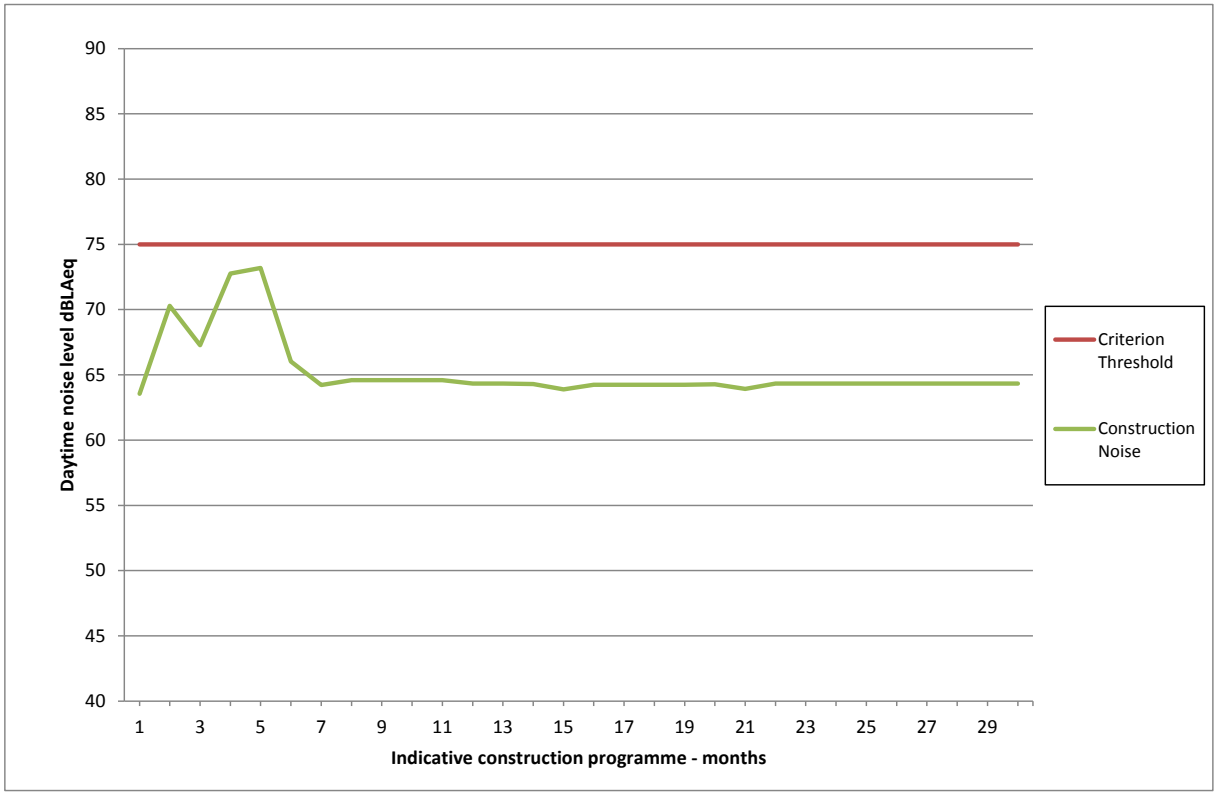
** Note: This schedule provides an illustration of typical plant that could be used in the construction of the Thames Tideway Tunnel at this site. The appointed Contractor must comply with section 6 of the CoCP but may vary the method and plant to be used. This schedule therefore represents the most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

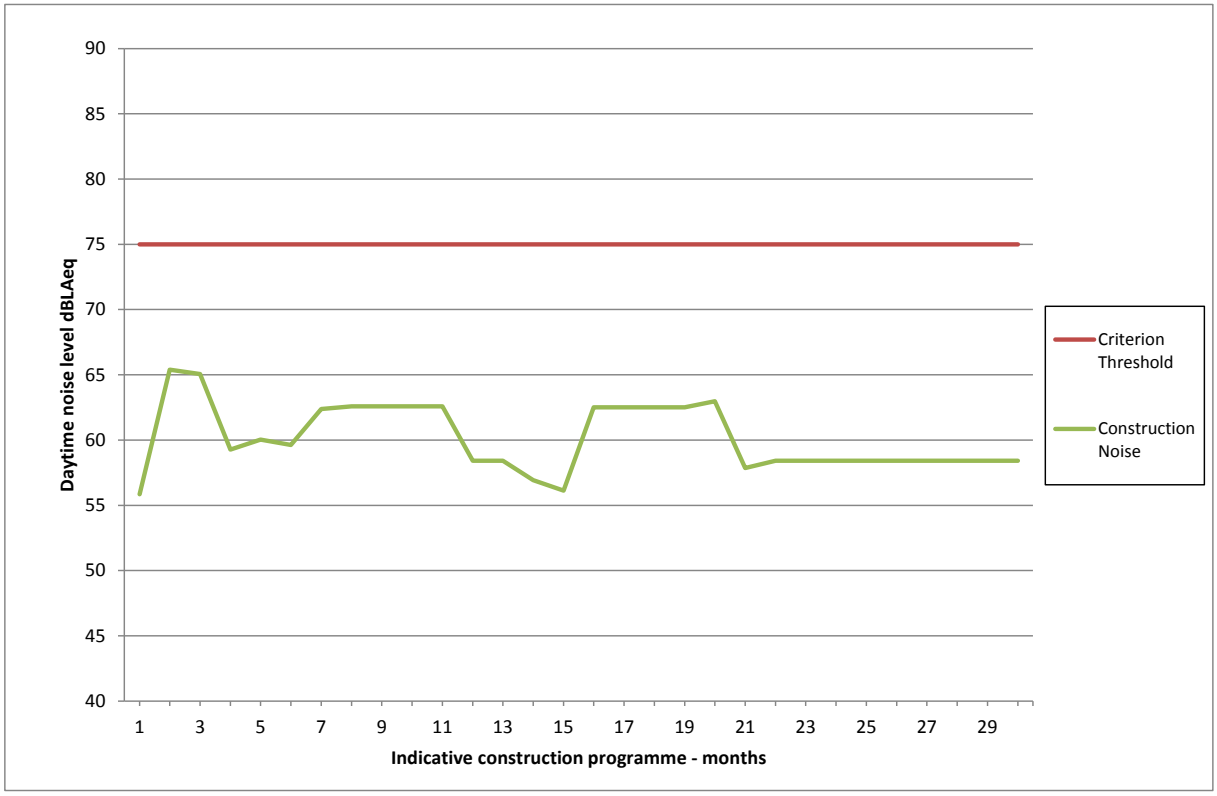
Vol 15 Plate G.5 Average monthly daytime noise level over duration of construction – Elm Quay (HE1)



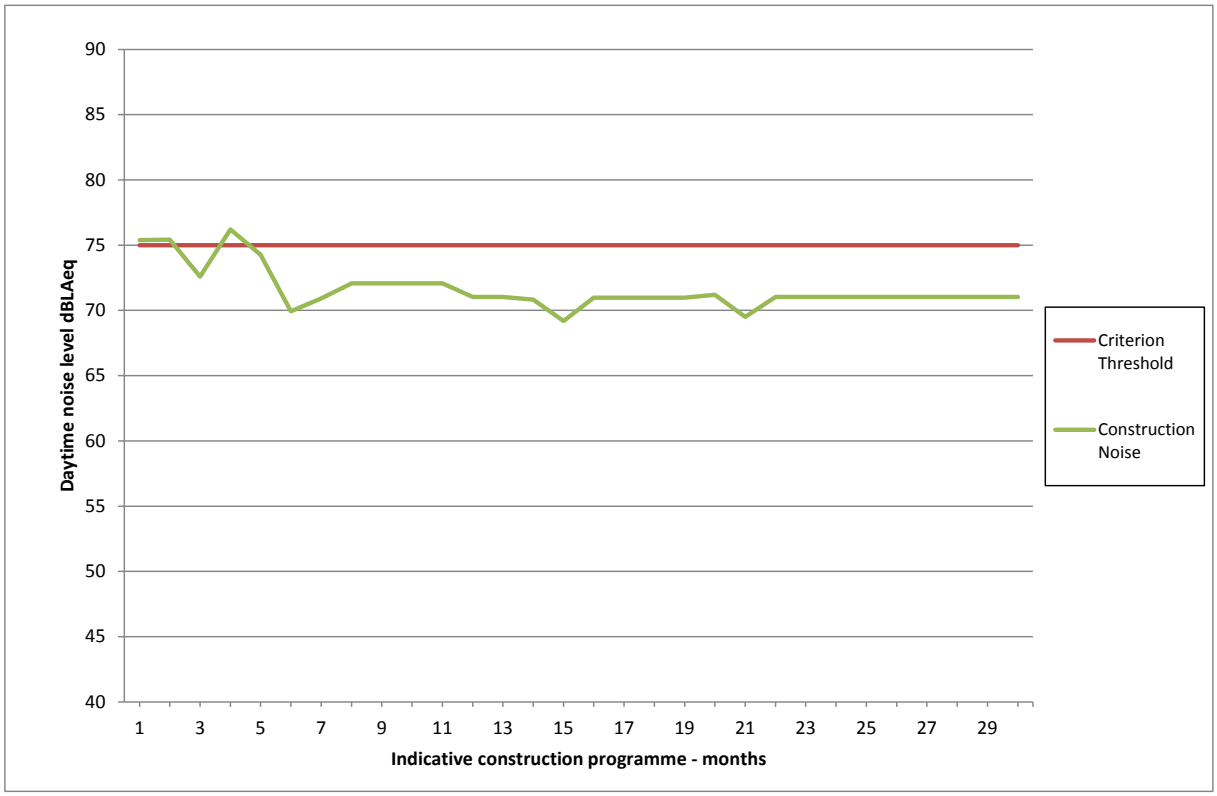
Vol 15 Plate G.6 Average monthly daytime noise level over duration of construction – Nine Elms Pier Houseboats (HE2)



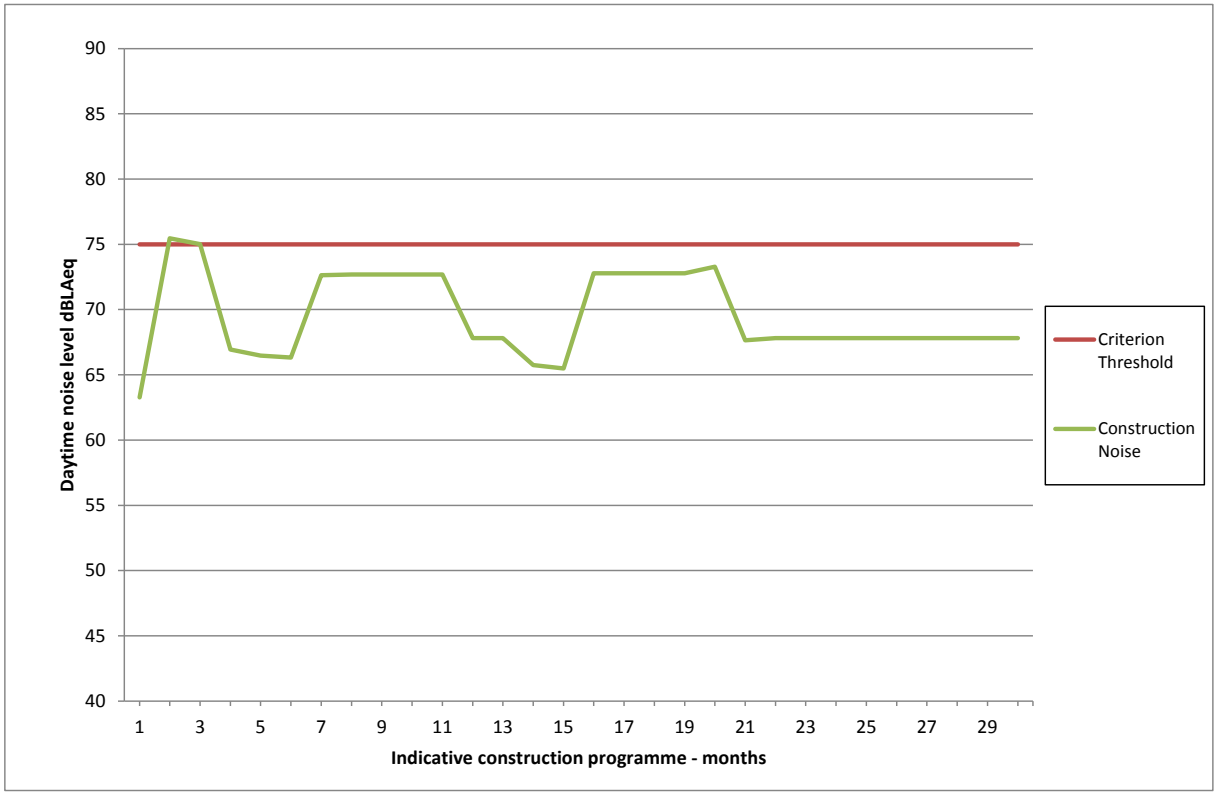
Vol 15 Plate G.7 Average monthly daytime noise level over duration of construction – River Lodge and Icon Apartments (HE3)



Vol 15 Plate G.8 Average monthly daytime noise level over duration of construction – Riverlight (HE4)



Vol 15 Plate G.9 Average monthly daytime noise level over duration of construction – Embassy Gardens (HE5)



References

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

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.15**

Volume 15: Heathwall Pumping Station 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

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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 both 'Output Area' (OA) and local authority level data from the Office of National Statistics (ONS). The data have been obtained from four sources: Census 2001[1] (the last census for which data are available[i]), Department of Communities and Local Government Deprivation Indices 2010[2], London Public Health Observatory 2012[3], and the Network of Public Health Observatories 2011[4] (see Volume 2 Methodology). Data is grouped according to those 'protected characteristics'[ii] or groups which are relevant for consideration in relation to this socio-economic impact assessment. This baseline community profile provides context for this socio-economic assessment.

H.1.2 On the basis of likely impacts on receptors identified in this socio-economic assessment, the community profile examines the 'immediate area' surrounding the construction site (ie, within an assessment area of 250m[iii]) the 'wider local area' (ie, within an assessment area of 1km[iv]) and the overall borough level (which in this case is the London Borough [LB] of Wandsworth).

H.1.3 The main protected characteristic group concentrated[v] within the immediate area surrounding the proposed construction site is persons aged over 65 years old.

H.1.4 The main protected characteristic groups concentrated within the wider local area surrounding the proposed construction site are:

a. persons aged under 16 years old

b. persons belonging to Black and Minority Ethnic (BME) groups.

Resident population

H.1.5 The resident population was approximately 775 people within 250m of the site and approximately 33,225 within 1km at the time of the last census.

Gender and age

H.1.6 Of the total population within 250m 51.5% of residents are female. Within 1km and at a borough wide level, females are also predominant (at 51.3% and 52.5% respectively).

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

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

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

[iv] The statistics presented for the study area within 1km of the site include both sides of the River Thames.

[v] In this instance 'concentrated' refers to the occurrence of a particular protected characteristic group, the proportion of which is much higher than borough wide proportions.

H.1.7 Vol 15 Table H.1 outlines age breakdown by assessment area, it illustrates that within 250m the proportion of under 16 year olds (6.2%) is considerably lower than within 1km (15.4%) and the LB of Wandsworth (16.3%), and much lower than across Greater London (20.2%).

H.1.8 Within 250m, the proportion of over 65 year olds (18.6%) is moderately higher than within 1km (12.6%), the LB of Wandsworth (10.4%) and Greater London (12.4%).

Vol 15 Table H.1 Socio-economics - age breakdown by assessment area

Age group (years)	Assessment area			
	Immediate area (250m) in %	Wider local area (1km) in %	Borough wide (LB of Wandsworth) in %	Greater London in %
Under 16	6.2	15.4	16.3	20.2
Over 65	18.6	12.6	10.4	12.4

Ethnicity

H.1.9 Vol 15 Table H.2 outlines ethnicity by assessment area, showing that within 250m of the site, White residents comprise over four fifths of the population (88.3%) with BME groups making up the remaining 11.7% residents. The proportion of White residents within 250m (88.3%) is somewhat higher than within 1km (74.7%), the LB of Wandsworth (78.0%) and Greater London level (71.2%).

H.1.10 Correspondingly, the proportion of BME residents within 250m (11.7%) is considerably lower than the proportion within 1km (25.4%) and Greater London (28.8%). In line with the overall low proportion of BME residents within 250m, Asian and Black residents account for 3.5% and 2.5% of the population respectively. This contrasts with an average of 12.1% and 10.9% for Greater London, figures which are four times as high.

Vol 15 Table H.2 Socio-economics - ethnicity by assessment area

Ethnicity	Assessment area			
	Immediate area (250m) in %	Wider local area (1km) in %	Borough wide (LB of Wandsworth) in %	Greater London in %
White	88.3	74.7	78.0	71.2
BME	11.7	25.3	22.1	28.8
Asian	3.5	4.7	7.0	12.1
Black	2.5	13.0	9.6	10.9
Other	3.2	3.7	2.1	2.7
Mixed	2.6	3.9	3.4	3.2

** Note: The figure for BME data presented in Vol 15 Table H.2 is the sum of data for Asian, Black, Other and Mixed ethnicities.*

Religion and belief

H.1.11 Within 250m and 1km of the site, and at a borough wide level, Christians are the predominant religious group at 65.2%, 64.1% and 61.8% respectively. Muslims are the second largest religious group accounting for 3.7% of residents within 250m and 6.9% within 1km. Within 250m, Jewish residents also account for 3.5% of the population. By contrast, within 1km the proportion of Jewish residents amounts to 0.8% the population, in line with the LB of Wandsworth proportion of 0.6%.

H.1.12 Within 250m and 1km, approximately 25% residents do not follow a religion, broadly in line with the Greater London average of 24.3%.

Health indicators

H.1.13 Vol 15 Table H.3 outlines health indicators by assessment area, noting that within 250m, the proportion of residents suffering from a long term or limiting illness (13.5%) is in line with the LB of Wandsworth (13.4%) but slightly lower than within 1km (15.9%) and Greater London (15.5%).

H.1.14 Within 250m the proportion of residents who claim disability living allowance (3.0%) is considerably lower than within 1km (5.4%), and somewhat lower than the borough wide level (3.9%). The rate also compares favourably with Greater London level (4.5%).

Vol 15 Table H.3 Socio-economics - health indicators by assessment area

Health indicator	Assessment area			
	Immediate area (250m) in %	Wider local area (1km) in %	Borough wide (LB of Wandsworth) in %	Greater London in %
Long term limiting illness	13.5	15.9	13.4	15.5
Disability living allowance	3.0	5.4	3.9	4.5

H.1.15 In the Middle Layer Super Output Area (MSOA)[vi] (Office of National Statistics, 2012)[5] within which the construction site falls levels of adult fall within the middle quintile relative to Greater London. Similarly, for child obesity, which is measured across the borough as a whole, the LB of Wandsworth also ranks within the middle quintile relative to Greater London.

H.1.16 Data available at a borough level only indicates that adults fall within the highest quintile (ie, the highest being the best) relative to the rest of London's boroughs for undertaking physical activity. Contrastingly,

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

children living with the LB of Wandsworth rank within the lowest quintile relative to other London boroughs in terms of undertaking physical activity.

H.1.17 For death rates by heart disease, the local MSOA falls within the middle quintile relative to the rest of Greater London. For death rates by cancer, circulatory disease and stroke are more prevalent, the local MSOA falls within the second highest quintile (ie, highest being the worst) and for death rates by respiratory disease, it falls within the highest quintile relative to Greater London.

H.1.18 For female life expectancy the local MSOA falls in the second lowest quintile (ie, the lowest being the worst) and for male life expectancy, it falls within the lowest quintile relative to Greater London. Average life expectancy for female residents is 83.2 to 84.9 years and for male residents is 74.6 to 80.3 years old.

Lifestyle and deprivation indicators

H.1.19 Vol 15 Table H.4 outlines lifestyle and income deprivation indicators by assessment area, showing that approximately half of all households within 250m of the site do not own a car (50.3%). The number of households without cars within 1km is higher still (59.0%). This compares with the lower rates of households without a car in the LB of Wandsworth and Greater London (40.7% and 37.5% respectively).

H.1.20 Income deprivation within 250m (19.7%) is moderately lower than within 1km (27.5%) and across Greater London (30.8%).

H.1.21 There is no overall deprivation recorded within 250m, but by contrast overall deprivation within 1km (21.3%) is only somewhat lower than the average across Greater London (24.5%).

Vol 15 Table H.4 Socio-economics - lifestyle and income deprivation levels by assessment area

Indicator	Assessment area			
	Immediate area (250m) in %	Wider local area (1km) in %	Borough wide (LB of Wandsworth) in %	Greater London in %
No car households	50.3	59.0	40.7	37.5
Income	19.7	27.5	15.4	30.8
Overall	0.0	21.3	10.1	24.5

H.2 Baseline economic profile

H.2.1 This section presents a profile of the economy local to the proposed construction site at Heathwall Pumping Station.

H.2.2 Data are presented for the geographical area within a radius or 'catchment' of approximately 250m from the boundary of the Limits of land to be acquired or used (LLAU) of the project site. Data are also provided at the overall borough level (which in this case is the London Borough [LB] of Wandsworth) and for Greater London.

H.2.3 Data are sourced from Experian's National Business Database (2012)[6] which draws primarily on regularly updated records from Companies House[vii].

Employment and businesses

H.2.4 Within approximately 250m of the site there are approximately 1,700 jobs.[viii] Vol 15 Table H.5[ix] illustrates the breakdown of employment by sector based on the UK Standard Industrial Classification (SIC) 2007[7]. It shows data for those sectors which account for more than 5% of total employment within 250m. It can be seen that:

a. Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles accounts for 33% of employment within 250m, more than double that within both the LB of Wandsworth (14%) and Greater London (16%).

b. Administrative and Support Service Activities account for 14% of employment within 250m, considerably more than within both the LB of Wandsworth and Greater London (both 8%).

c. Professional, Scientific and Technical Activities account for 9% to 11% of employment across all three geographical levels.

d. Transportation and Storage accounts for 9% of employment within 250m, three times more than within the LB of Wandsworth (3%) and more than double that within Greater London (4%).

e. Information and Communication accounts for 5% to 7% of employment across all three geographical levels.

[vii] 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.

[viii] 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.

[ix] Data in tables rounded to nearest whole percentage and do not always sum due to rounding.

Vol 15 Table H.5 Socio-economics - employment by top five sectors (2012)

	Assessment area		
Sector (Standard Industrial Code 2007)	**Immediate area (250m)**	**Borough wide (LB of Wandsworth)**	**Greater London**
Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles	33%	14%	16%
Administrative and Support Service Activities	14%	8%	8%
Professional, Scientific and Technical Activities	11%	9%	11%
Transportation and Storage	9%	3%	4%
Information and Communication	7%	5%	7%
Other (including unclassified)	27%	61%	55%

H.2.5 Within approximately 250m of the site there are approximately 140 businesses (defined here as business locations[x]). The split of businesses by sector within 250m generally reflects the breakdown of employment by sector as set out in Vol 15 Table H.5, with a relatively high number of businesses engaged in Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles (16%), Professional, Scientific and Technical Activities (15%), Administrative and Support Service Activities (13%) and Information and Communication (9%). However, Transportation and Storage accounts for 3% of businesses, while generating 9% of employment.

H.2.6 Vol 15 Table H.6 illustrates the size of businesses in terms of the number of employees at each business location / unit. At all geographical levels the, businesses within the smallest size band (one to nine employees) account for the greatest proportion. However there are a greater proportion of larger businesses within approximately 250m of the site than within the wider geographical areas. Within 250m, 28% of businesses employ more than ten employees, which is almost three times that within both the LB of Wandsworth (10%) and Greater London as a whole (12%).

H.2.7 For the sectors accounting for the greatest proportion of jobs and businesses within approximately 250m the size banding profile of businesses varies somewhat. Around 82% of Professional, Scientific and Technical Activities have one to nine employees while 70% of Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles businesses are of this size, compared to an average across all sectors of 73%. Within the Administrative and Support Service Activities sector the proportion of businesses with one to nine employees is lower at 63%, with 21% of

[x] 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.

businesses in this sector employing ten to 24 staff and 11% employing between 50 and 99 employees.

Vol 15 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)	73%	16%	6%	5%	0%	1%
Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles	70%	17%	4%	4%	0%	0%
Professional, Scientific and Technical Activities	82%	9%	5%	5%	0%	0%
Administrative and Support Service Activities	63%	21%	5%	11%	0%	0%
Borough wide (LB of Wandsworth)	90%	7%	2%	1%	0%	0%
Greater London	88%	8%	2%	1%	1%	0%

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[1] ONS. Neighbourhood Statistics (2001). Available at: http://neighbourhood.statistics.gov.uk/dissemination/

[2] Department for Communities and Local Government. Index of Multiple Deprivation 2010 (2010). Available at: http://www.communities.gov.uk/communities/research/indicesdeprivation/deprivation10/

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[6] Experian. *National Business Database* (Database of employment and enterprise statistics). Accessed: September 2012.

[7] Office of National Statistics. *UK Standard Industrial Classification of Economic Activities 2007 (SIC 2007)*, 2009. Available at: http://www.ons.gov.uk/ons/guide-method/classifications/current-standard-classifications/index.html. Accessed 5/9/12.

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.15**

Volume 15: Heathwall Pumping Station appendices

Appendix I: Townscape and visual

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

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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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: **6.2.15**

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Appendix J: Transport

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Appendix J: Transport

J.1 Introduction

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Appendix K: Water resources - groundwater

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Appendix K: Water resources – groundwater

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Appendix K: Water resources – groundwater

K.1 Geology

K.1.1 A summary of the anticipated geological succession at the Heathwall Pumping Station is shown in the Vol 15 Table K.1.

Vol 15 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
			Harwich
	Palaeocene	Lambeth	Upper Shelly Beds
			Upper Mottled Beds
			Laminated Beds
			Lower Shelly Beds
			*Mid-Lambeth Hiatus**
			Lower Mottled Beds
			Upnor

** Not a Formation but an important depositional feature*

K.1.2 The superficial and solid geology in the vicinity of the site, as published by the British Geological Survey (BGS, 2009)[1], is shown in Vol 15 Figure 13.4.1 and Vol 15 Figure 13.4.2 respectively (see separate volume of figures).

K.1.3 The ground investigation undertaken for the Thames Tideway 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 the geological layers have been based on ground investigation boreholes located on site: these are boreholes PR1085 and SR1086. Additional ground investigation boreholes, namely PR1081 and SR1083 and overwater boreholes SA2063 and SA2064 have been used to gauge the lateral continuity of strata across the general area. The locations of boreholes around the site are shown in Vol 15 Figure 13.4.1 (see separate volume of figures). The depths and thicknesses of geological layers encountered are summarised in Vol 15 Table K.2.

Vol 15 Table K.2 Groundwater – anticipated ground conditions

Formation	Top elevation* (mATD)**	Depth below ground level (m)	Thickness (m)
Made Ground	104.40	0.00	4.90
Alluvium/ River Terrace Deposits	99.10	4.90	5.60
London Clay Formation	93.9	10.50	28.70
Harwich Formation	65.20	39.20	0.70
Lambeth Group			
USB	64.50	39.90	1.60
UMB	62.90	41.50	3.40
LtB	58.50	44.90	2.40
LSB	56.10	47.30	0.10
LMB	56.00	47.40	6.00
UPN (Gv)	50.00	53.40	1.20
UPN	45.80	54.60	1.10

** Based on an assumed ground level of 104.40mATD*
*** mATD = metres above tunnel datum. A commonly used term for sub-surface construction projects, which defines height above a datum set at -100mAOD (above Ordnance Datum)*
USB–Upper Shelly Beds; UMB–Upper Mottled Beds; LtB–Laminated Beds; LSB-Lower Shelly Beds; LMB-Lower Mottled Beds; UPN (Gv)-Upnor Formation (Gravel); UPN-Upnor Formation

K.1.4 The combined sewer overflow (CSO) shaft at the Heathwall Pumping Station would extend down to approximately 58.23mATD and would pass through the Made Ground, Alluvium, River Terrace Deposits, London Clay Formation, Harwich Formation and into the Laminated Beds of the Lambeth Group. The base slab would extend to approximately 55.23mATD and be founded within the Lower Mottled Beds of the Lambeth Group.

K.1.5 As assumed for the purpose of this assessment the intermediate foreshore shaft approximately 14.9m would extend down to 89.4mATD into the London Clay Formation and the connection tunnel approximately 22.72m would extend down to 82.6mATD into the London Clay Formation.

K.1.6 The Made Ground, comprising of sandy, slightly gravely clay with brick and occasional clinker, is expected to be 4.9m thick at the Heathwall Pumping Station site.

K.1.7 The Alluvium is comprised of silty clay and clayey silt, with occasional scatted pebbles and granules

K.1.8 The River Terrace Deposits are formed of extensive alluvial sand and gravel deposits laid down in river terraces a braided river system of

approximately 5km width, in river terraces since the Anglian glaciation. The River Terrace Deposits, in combination with the Alluvium, are expected to be 5.6m thick at the Heathwall Pumping Station site.

K.1.9 The London Clay is described by the BGS as "fine, sandy, silty clay/silty clay, glauconitic at base" (BGS, 2012)[2] and is comprised of stiff to very stiff clay at the Heathwall Pumping Station site. The London Clay is divided into sub-units referred from oldest to youngest as A to E, with some of these sub-units dividing further, for example A2, A3i-iii, B in decreasing age order. The London Clay Formation is expected to be 28.7m thick at the Heathwall Pumping Station site.

K.1.10 The Harwich Formation is expected to be 0.7m thick at the Heathwall Pumping Station site and comprises of fine-grained glauconitic sand and rounded black flinty pebble beds, commonly deposited in a series of superimposed channels.

K.1.11 The Upper Shelly Beds (USB) of the Lambeth Group comprises grey, shelly clays with scattered glauconite grains and are expected to be 1.6m thick at the Heathwall Pumping Station site. .

K.1.12 The Upper Mottled Beds (UMB) of the Lambeth Group comprises silty clay and clay, generally un-bedded, fissured and blocky, with up to 50% silt and sand and are expected to be 3.4m thick at the Heathwall Pumping Station site.

K.1.13 The Laminated Beds (LtB) of the Lambeth Group comprises thinly interbedded fine to medium grained sand, silt and clay with shells, with sand lenses found locally and are expected to be 2.4m thick at the Heathwall Pumping Station site.

K.1.14 The Lower Shelly Beds (LSB) of the Lambeth Group comprises dark grey to black clay with abundant shells and are expected to be 0.1m thick at the Heathwall Pumping Station site.

K.1.15 The Lower Mottled Beds (LMB) of the Lambeth Group comprises silty clay and clay, generally un-bedded, fissured and blocky, with up to 50% silt and sand and are expected to be 6m thick at the Heathwall Pumping Station site.

K.1.16 The Upnor Formation (UPN) is a variably bioturbated fine- to medium-grained sand with glauconite, rounded flint pebbles and minor clay, with distinctive pebble beds base and top (UPN (Gv)). The Upnor Formation is expected to be 2.3m thick at the Heathwall Pumping Station site.

K.2 Hydrogeology

K.2.1 A summary of the anticipated hydrogeological conditions at the Heathwall Pumping Station site is shown in Vol 15 Table K.3.

Vol 15 Table K.3 Groundwater – anticipated hydrogeological units

Group	Formation	Hydrogeology
Superficial	(Made ground)	Confining layer

Group	Formation	Hydrogeology
deposits	Alluvium	
	River Terrace Deposits	Upper aquifer
Thames	London Clay	Aquiclude*
	Harwich	Aquitard** / aquifer
Lambeth	Upper Shelly Beds Upper Mottled Beds Laminated Beds Lower Shelly Beds -----Mid Lambeth Hiatus---- Lower Mottled Beds	Aquitards/ aquifers
	Upnor	Lower Aquifer

** Aquiclude - a hydrogeological unit which, although porous and capable of storing water, does not transmit it at rates sufficient to furnish an appreciable supply for a well or spring (USGS, 1989)[3].*

*** Aquitard - a poorly-permeable geological formation that does not yield water freely, but may still transmit significant quantities of water to or from adjacent aquifers (EA, 2012)[4].*

K.2.2 The Made Ground and Alluvium, overlying the River Terrace Deposits or upper aquifer, are likely to act as a confining layer above the upper aquifer in the vicinity of ground investigation borehole PR1085 and SR1086, where clay and silty clay was recorded.

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" (EA, 2012).

K.2.4 The lower aquifer comprises the Upnor and the Thanet Sand formations (both classified as secondary aquifers by the EA), and the Chalk (classified as a principal aquifer by the EA). A principal aquifer is described by the EA as "layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer" (EA, 2012).

K.2.5 The main CSO shaft would pass through the upper aquifer and then the London Clay Formation. This 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 flows. 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 laminea/lenses at this horizon, may

act as horizontal conduits for migration of groundwater from a nearby source.

K.2.6 The main CSO shaft would then pass through the Harwich Formation, which may form a minor aquifer unit where it is isolated from the lower aquifer by the Lambeth Group. There may be limited connection via erosive features to the lower aquifer.

K.2.7 The main CSO shaft would also pass through the Lambeth Group, in which several confined groundwater layers are anticipated to be encountered. Groundwater inflows are expected during excavation within the Upper Shelly Beds (USB) with potentially small inflows and more significantly at sub-artesian pressures within the Laminated Beds (formerly part of the Woolwich Formation).

K.2.8 The main CSO shaft would not extend down into the lower aquifer; however the separation distance between the base slab and the top of the Upnor Formation (top of the lower aquifer) would be around 5.23m.

K.3 Groundwater level monitoring

K.3.1 Groundwater level monitoring was undertaken at a number of ground investigation boreholes across the assessment area with a few exceptions. In addition, the EA has a regional network of monitoring boreholes, mainly within the lower aquifer, across London which records are available dating back over 50 years.

K.3.2 Information on groundwater levels for this assessment was collected from one ground investigation borehole located at 160m from the Heathwall Pumping Station site (SA1084). This borehole has a response zone[i] and monitors groundwater levels in the River Terrace Deposits. The response zone depth, the monitored strata and the frequency of monitoring are detailed in Vol 15 Table K.4. The manual dip and logger data collected from this monitoring borehole is shown in Vol 15 Table K.5.

Vol 15 Table K.4 Groundwater – monitoring borehole

Borehole	Response zone depths mATD	Strata	Monitoring
SA1084	99.5 – 96.71	River Terrace Deposits	Fortnightly dips

Vol 15 Table K.5 Groundwater – summary level data

Borehole	Period of record	Maximum month year		Minimum month year		Average over the period of record	
		mbgl	mATD	mbgl	mATD	mbgl	mATD
SA1084	28/05/2009 –	4.46 (Oct.	100.55 (Oct.	4.81 (July 2009)	100.20 (July	4.66	100.35

[i] Response zone - the section of a borehole that is open to the host strata (EA, 2006)

Borehole	Period of record	Maximum month year		Minimum month year		Average over the period of record	
	13/07/2011	2010)	2010)		2009)		

K.3.3 The recorded water levels in the River Terrace Deposits at SA1084 range from 100.2mATD to 100.55mATD. These water levels consistently remain above the top of the formation at 98.4mATD, indicating that this formation is fully saturated and is confined by the overlying Made Ground and Alluvium.

K.3.4 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.3.5 As there is only one monitoring borehole within the River Terrace Deposits, it is not possible to accurately determine the direction of groundwater flow in these deposits. However it is likely that given the close proximity of the site to the River Thames, that the direction of groundwater movement would be to the northwest 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)[5] does not identify a condition status for the upper aquifer.

K.4.2 The status of the lower aquifer is not relevant to this assessment as the construction would not reach to this depth at the Heathwall Pumping Station site.

K.4.3 No dewatering of the upper aquifer is anticipated at the Heathwall Pumping Station site. However, vacuum ejector wells would be drilled into the Lambeth Group around the outside of the jacking collar of the shaft and pumped to lower the water pressure in the Lambeth Group. Pumps would be placed in the wells and groundwater would be extracted at a rate of less than 200m^3/d and discharged directly to the River Thames on site, following any necessary treatment and subject to EA approval. This volume of dewatering is within the most restrictive abstraction licensing limit set by the EA of 0.2Ml/d (200m^3/d) for Central and South London (EA, 2006). Therefore a detailed local assessment is unlikely to be required by the EA.

Licensed abstractions

K.4.4 The EA licenses abstraction from groundwater within London for all sources in excess of 20m^3/d. Groundwater abstractions within 1km of the site have been identified.

K.4.5 The nearest licensed groundwater abstraction from the River Terrace Deposits or upper aquifer is licence number 28/39/39/0225, held by the Royal Horticultural Society for agricultural purposes and is located

approximately 1.1km to the northwest of the Heathwall Pumping Station site.

K.4.6 There are several licensed groundwater abstractions from the Chalk located at 20m to 0.7km to the east, west, north and northeast of the Heathwall Pumping Station site. The licensed abstractions from the lower aquifer (Chalk) would be unaffected due to construction taking place entirely within the upper aquifer, the London Clay Formation and the Lambeth Group.

K.4.7 The details of the licensed abstraction within the River Terrace Deposits are summarised in Vol 15 Table K.6.

Vol 15 Table K.6 Groundwater - licensed abstractions

Licence number	Licence holder	Purpose	Aquifer
28/39/39/0225	Royal Horticultural Society	Agriculture	River Terrace Deposits

K.4.8 There are no known unlicensed groundwater abstractions within 1km of the Heathwall Pumping Station site.

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 The Heathwall Pumping Station site is located within the modelled SPZ 1 (50 day time of travel to the source) for the Thames Water Utilities source located approximately 0.3km away to the southwest (see Vol 15 Figure 13.4.2 in separate volume of figures).

K.5.3 There is a second modelled SPZ 1 at 100m to the north-northeast of the Kirtling Street site, which is designated for the Mantilla Limited source, which is located at <1km to the north. These sources are from the lower aquifer (Chalk) and would be unaffected due to construction taking place entirely within the upper aquifer, the London Clay Formation and the Lambeth Group.

K.5.4 As part of this assessment, a capture zone[ii] (Hiscock, 2005)[6] was estimated the licensed groundwater abstraction from the River Terrace Deposits or upper aquifer 28/39/39/0225, using licence information and appropriate aquifer properties. The boundaries of this capture zone would be approximately 1km from the Heathwall Pumping Station site.

[ii] Capture zone - a zone of contribution around a well that encompasses all areas or features that supply groundwater to the well.

K.6 Environmental designations

K.6.1 There are no environmental designations relevant to groundwater such as SSSI, SAC and SNCIs within 1km of the Heathwall Pumping Station site.

K.7 Groundwater quality and land quality assessment

K.7.1 Historical land use mapping at the Heathwall Pumping Station, reviewed as part of the land quality assessment, identified the presence of works at c1875, a pumping station and tank onsite at c1961-1984) (Vol 15 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 15 Table K.7 has been sourced from the ground investigation and monitoring works undertaken as part of the Thames Tideway Tunnel project and includes data from monitoring boreholes located off site and up to 970m away (PR1085, SR1086, SA1084, SA1082, PR1081, SR1083 and PR1088) (for locations see Vol 15 Figure 13.4.1 in separate volume of figures) and within the River Terrace Deposits and Chalk. Any exceedances of the UK drinking water standards (The Water Supply Regulations, 2000)[7] or relevant Environmental Quality Standards - EQS (River Basin Districts Typology…, 2010))[8] are shaded in blue in this table.

K.7.3 The data shows exceedances of the relevant standards within the River Terrace Deposits at PR1085 (located at 41m from the site) with respect to ammonia, chloride, heavy metals, PAHs and turbidity, at SA1084 (located at 157m from the site) with respect to arsenic and at PR1088 (located at 965m from the site) with respect to ammonia, chloride, cypermethrin, sodium and turbidity. The data also shows exceedances within the Chalk at PR1081 (located at 151m from the site) with respect to heavy metals and sulphate and at SR1083 (located at 180m from the site) with respect to polycyclic aromatic hydrocarbons (PAHs). PAHs may be formed during a range of human activities, including incomplete combustion of carbon-based fuels and other industrial processes (EA, 2010)[9]. In addition, PAHs are considered to be Priority Hazardous Substances under the Water Framework Directive (Commission of the European Communities, 2009)[10].

K.7.4 The EA monitors groundwater quality at number of points across London. The nearest EA monitoring is at Dolphin Square at approximately 0.6km to the northeast of the Heathwall Pumping Station site, on the other side of the River Thames. The data here shows exceedances of the UK drinking water standard within the Chalk with respect to ammonia, pesticides, herbicides, heavy metals, sulphate, potassium, PAH's and benzene.

K.7.5 The land quality data from the ground investigation boreholes used in the groundwater quality assessment show no exceedances of the human health screening values (EA, 2009)[11] (soil guideline values designed to be protective of human health) within the River Terrace Deposits but exceedances with respect to heavy metals and hydrocarbons in the

overlying Made Ground and Alluvium. Further detail is provided in the land quality assessment (see Vol 15 Appendix F).

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Vol 15 Table K.7 Groundwater – groundwater quality results

Source of data*				SI	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT
Name				PR1085	PR1085	PR1085	PR1085	PR1085	SA1082	SA1084	SR1083	SR1072A	SA1074A	PR1074	PR1088	PR1088	PR1088	PR1088	PR1088	PR1088
Hydrogeological unit**				ALV	ALV	ALV	ALV	ALV	CK	RTD	SCK	TSF	RTD	TSF	RTD	RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria			41m	41m	41m	41m	41m	108m	157m	180m	864m	930m	930m	965m	965m	965m	965m	965m	965m
Chemical	Value	Units	Source	2009	14/11/211	13/1/2012	20/4/2012	31/5/2012	2009	2009	2009	2009	2009	2009	22/8/2011	2/11/2011	9/1/2012	23/3/2012	2/5/2012	14/8/2012
1,1 - Dichloroethane	10	ug/l	WFD 2010	-	-	-	-	-	-	<1.2	-	-	-	-	-	-	-	-	-	-
1,1 - Dichloroethene	30	ug/l	WHO 2004	-	-	-	-	-	-	<1.2	-	-	-	-	-	-	-	-	-	-
1,1 - Dichloropropene	-	ug/l	None	-	-	-	-	-	-	<1.3	-	-	-	-	-	-	-	-	-	-
1,1,1 - Trichloroethane	100	ug/l	SW Regs 98	-	<0.08	<0.08	-	< 0.08	-	<1.3	-	-	-	-	<0.08	<0.08	<0.08	-	< 0.08	<0.08
1,1,1,2 - Tetrachloroethane	-	ug/l	None	-	-	-	-	-	-	<1.3	-	-	-	-	-	-	-	-	-	-
1,1,2 - Trichloroethane	400	ug/l	SW Regs 98	-	<0.2	<0.2	-	< 0.2	-	<2.2	-	-	-	-	<0.2	<0.2	<0.2	-	< 0.2	<0.2
1,1,2,2 - Tetrachloroethane {Acetosan}{Bonaform}{Cas Rn 79-34-5}	-	ug/l	None	-	-	-	-	-	-	<5.2	-	-	-	-	-	-	-	-	-	-
1,2 - Dibromo - 3 - Chloropropane	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<9.8	-	-	-	-	-	-	-	-	-	-
1,2 - Dibromoethane	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<2.3	-	-	-	-	-	-	-	-	-	-
1,2 - Dichlorobenzene	1000	ug/l	WHO 2004	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
1,2 - Dichloroethane {Ethylene Dichloride}	3	ug/l	WS Regs 20	-	<0.12	<0.12	-	< 0.12	-	<3.3	-	-	-	-	<0.12	<0.12	<0.12	-	< 0.12	<0.12
1,2 - Dichloroethene (Trans)	30	ug/l	WHO 2004	-	-	-	-	-	-	<1.9	-	-	-	-	-	-	-	-	-	-
1,2 - Dichloropropane	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<3	-	-	-	-	-	-	-	-	-	-
1,2,3 - Trichlorobenzene	-	ug/l	None	-	-	-	-	-	-	<3.1	-	-	-	-	-	-	-	-	-	-
1,2,3 - Trichloropropane	-	ug/l	None	-	-	-	-	-	-	<7.8	-	-	-	-	-	-	-	-	-	-
1,2,4 - Trichlorobenzene	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
1,2,4 - Trimethylbenzene	-	ug/l	None	-	-	-	-	-	<1.7	-	<1.7	-	-	-	-	-	-	-	-	-
1,3 - Dichlorobenzene	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
1,3 - Dichloropropane	-	ug/l	None	-	-	-	-	-	-	<2.2	-	-	-	-	-	-	-	-	-	-
1,3 - Dichlorobenzene	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
1,3 - Dichloropropane	-	ug/l	None	-	-	-	-	-	-	<2.2	-	-	-	-	-	-	-	-	-	-
1,3 - Dichloropropene (Trans)	-	ug/l	None	-	-	-	-	-	-	<3.5	-	-	-	-	-	-	-	-	-	-
1,3,5 - Trichlorobenzene	-	ug/l	None	-	-	-	-	-	-	<10	-	-	-	-	-	-	-	-	-	-
1,3,5 - Trimethylbenzene	-	ug/l	None	-	-	-	-	-	<1.8	<1	<1.8	-	-	-	-	-	-	-	-	-
2 - Chloronaphthalene	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
2 - Chlorophenol	50	ug/l	WFD 2010	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
2 - Chlorotoluene	-	ug/l	None	-	-	-	-	-	-	<1.9	-	-	-	-	-	-	-	-	-	-
2 - Methylnaphthalene	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
2 - Methylphenol {O-Cresol}	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
2 - Nitroaniline	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
2 - Nitrophenol	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
2,2 - Dichloropropane	-	ug/l	None	-	-	-	-	-	-	<3.8	-	-	-	-	-	-	-	-	-	-
2,3 - Dimethylphenol {2,3-Xylenol}	-	ug/l	None	-	-	-	<0.0500	-	-	-	-	-	-	-	-	-	-	<0.0500	-	-
2,3,5,6 - Tetrachloroaminobenzene {2,...Aniline}	-	ug/l	None	-	-	-	0.00170	-	-	-	-	-	-	-	-	-	-	<0.00500	-	-
2,4 - Dichlorophenol	20	ug/l	WFD 2010	<0.4	-	-	-	-	-	<1	-	<0.1	<0.4	<0.1	-	-	-	-	-	-
2,4 - Dimethylphenol {2,4-Xylenol}	-	ug/l	None	<0.4	-	-	-	-	-	<1	-	<0.1	<0.4	<0.1	-	-	-	-	-	-
2,4 - Dinitrotoluene	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
2,4,5 - Trichlorophenol	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
2,4,6 - Trichlorophenol	-	ug/l	None	<0.4	-	-	-	-	-	<1	-	<0.1	<0.4	<0.1	-	-	-	-	-	-
2,6 - Dichlorophenol	-	ug/l	None	<0.4	-	-	-	-	-	-	-	<0.1	<0.4	<0.1	-	-	-	-	-	-
2,6 - Dimethylphenol {2,6 Xylenol}	-	ug/l	None	-	-	-	<0.0500	-	-	-	-	-	-	-	-	-	-	<0.0500	-	-
2,6 - Dinitrotoluene	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
3 - Nitroaniline	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
3,4 - Dimethylphenol {3,4 Xylenol}	-	ug/l	None	-	-	-	<0.0500	-	-	-	-	-	-	-	-	-	-	<0.0500	-	-
4 - Bromophenylphenyl ether	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
4 - Chloro - 3- Methylphenol {P-Chloro-M-Cresol}	40	ug/l	WFD 2010	<0.4	-	-	-	-	-	<1	-	<0.1	<0.4	<0.1	-	-	-	-	-	-

Source of data*				SI	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT
Name				PR1085	PR1085	PR1085	PR1085	PR1085	SA1082	SA1084	SR1083	SR1072A	SA1074A	PR1074	PR1088	PR1088	PR1088	PR1088	PR1088	PR1088
Hydrogeological unit**				ALV	ALV	ALV	ALV	ALV	CK	RTD	SCK	TSF	RTD	TSF	RTD	RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria			41m	41m	41m	41m	41m	108m	157m	180m	864m	930m	930m	965m	965m	965m	965m	965m	965m
Chemical	Value	Units	Source	2009	14/11/211	13/1/2012	20/4/2012	31/5/2012	2009	2009	2009	2009	2009	2009	22/8/2011	2/11/2011	9/1/2012	23/3/2012	2/5/2012	14/8/2012
4 - Chloroaniline	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
4 - Chlorophenyl phenyl ether	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
4 - Chlorotoluene	-	ug/l	None	-	-	-	-	-	<1.9	-	<1.9	-	-	-	-	-	-	-	-	-
4 - Isopropyltoluene	-	ug/l	None	-	-	-	-	-	-	<2.6	-	-	-	-	-	-	-	-	-	-
4 - Nitroaniline	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
4 - Nitrophenol	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
4-Methylphenol {para-Cresol}	-	ug/l	None	-	-	-	<0.0500	-	-	<1	-	-	-	-	-	-	-	<0.0500	-	-
Acenaphthene	-	ug/l	None	<0.01	-	-	-	-	<0.015	<0.015	1.55	<0.01	<0.01	<0.01	-	-	-	-	-	-
Acenaphthylene	-	ug/l	None	<0.01	-	-	-	-	<0.011	<0.011	0.331	<0.01	<0.01	<0.01	-	-	-	-	-	-
Acenapthene	-	ug/l	None	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	-
Acenapthylene	-	ug/l	None	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	-
Aliphatics >C10-C12	-	ug/l	None	<1	-	-	-	-	<10	<10	<10	<1	1	<1	-	-	-	-	-	-
Aliphatics >C12-C16 (Aqueous)	-	ug/l	None	<1	-	-	-	-	<10	<10	1030	3	4	3	-	-	-	-	-	-
Aliphatics >C16-C21 (Aqueous)	-	ug/l	None	2	-	-	-	-	<10	<10	1480	5	8	6	-	-	-	-	-	-
Aliphatics >C21-C35 (Aqueous)	-	ug/l	None	4	-	-	-	-	<10	<10	585	7	8	7	-	-	-	-	-	-
Aliphatics >C6-C8	-	ug/l	None	<0.1	-	-	-	-	<10	<10	<10	<0.1	38	<0.1	-	-	-	-	-	-
Aliphatics >C8-C10	-	ug/l	None	<0.1	-	-	-	-	<10	<10	<10	<0.1	<0.1	<0.1	-	-	-	-	-	-
Aliphatics C5-C6	-	ug/l	None	<0.1	-	-	-	-	<10	<10	<10	<0.1	<0.1	<0.1	-	-	-	-	-	-
Alkalinity (Carbonate)	-	mg/l as CaCO3	None	-	<4	-	-	-	-	-	-	-	-	-	-	<4	-	-	-	-
Alkalinity Ph 4.5 - As CaCO3	-	mg/l as CaCO3	None	420	510	422	-	392	-	-	-	220	290	230	340	307	294	-	287	-
Aluminium Dissolved	200	ug/l as Al	DWS 2010	-	-	-	0.35	-	-	-	-	-	-	-	-	-	-	0.076	-	-
Aluminium Total	200	ug/l as Al	DWS 2010	-	240	0.06	-	0.31	-	-	-	-	-	-	37	62	0.034	-	0.013	0.057
Ammonia - As N	0.39	mg/l as N	WS Regs 20	-	20.1	13	-	9.89	-	-	-	-	-	-	2.7	3.4	3.8	-	2.72	2.84
Ammoniacal nitrogen	-	mg/l	None	9.4	-	-	-	-	0.948	3.25	<0.2	1.2	0.07	0.28	-	-	-	-	-	-
Anthracene	0.1	ug/l	SW WFD	<0.01	-	-	<0.01	-	<0.015	<0.015	1.28	<0.01	<0.01	<0.01	-	-	-	<0.01	-	-
Antimony Total	5	ug/l	DWS 2010	-	-	-	1.9	-	-	-	-	-	-	-	-	-	-	0.3	-	-
Aromatics >C7-C8	50	ug/l	WFD 2010	<0.1	-	-	-	-	<10	<10	<10	<0.1	<0.1	<0.1	-	-	-	-	-	-
Aromatics >EC10-EC12	-	ug/l	None	2	-	-	-	-	<10	<10	<10	3	7	4	-	-	-	-	-	-
Aromatics >EC12-EC16 (Aqueous)	-	ug/l	None	3	-	-	-	-	<10	<10	852	4	7	6	-	-	-	-	-	-
Aromatics >EC16-EC21 (Aqueous)	-	ug/l	None	3	-	-	-	-	<10	<10	854	6	12	8	-	-	-	-	-	-
Aromatics >EC21-EC35 (Aqueous)	-	ug/l	None	13	-	-	-	-	<10	<10	575	14	20	17	-	-	-	-	-	-
Aromatics >EC8-EC10	-	ug/l	None	<0.1	-	-	-	-	<10	<10	<10	<0.1	<0.1	<0.1	-	-	-	-	-	-
Aromatics C6-C7	1	ug/l	DWS 2010	<0.1	-	-	-	-	<10	<10	<10	<0.1	<0.1	<0.1	-	-	-	-	-	-
Arsenic Total	10	ug/l as As	DWS 2010	<1	2	3.2	-	2.3	<0.75	10.5	3	<1	<1	<1	4.1	4.8	4.1	-	3.2	3.9
Atrazine { }	0.1	ug/l	DWS 2010	-	<0.08000	<0.08000	-	<0.00800	-	-	-	-	-	-	<0.00300	<0.00300	<0.04000	-	<0.00800	<0.00800
Azobenzene	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Barium Dissolved	100	ug/l as Ba	SW Regs 96	-	-	-	37	-	-	-	-	-	-	-	-	-	-	120	-	-
Barium Total	100	ug/l as Ba	SW Regs 96	-	-	-	37	-	-	-	-	-	-	-	-	-	-	130	-	-
Bentazone	0.1	ug/l	DWS 2010	-	<0.00800	<0.00800	-	<0.00800	-	-	-	-	-	-	<0.00800	<0.00800	<0.00800	-	<0.00800	<0.00800
Benz[a]-Anthracene	-	ug/l	None	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	-
Benzene	1	ug/l	DWS 2010	<1	0.13	0.1	<0.07	< 0.07	<10	<1.3	<10	<1	<1	<1	<0.07	<0.07	<0.07	<0.07	< 0.07	<0.07
Benzene (Ethylbenzene)	20	ug/l	FW List II	-	-	-	<0.06	-	-	-	-	-	-	-	-	-	-	0.1	-	-
Benzo (a) anthracene	-	ug/l	None	<0.01	-	-	-	-	<0.009	<0.009	0.0576	<0.01	<0.01	<0.01	-	-	-	-	-	-

Source of data*				SI	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT
Name				PR1085	PR1085	PR1085	PR1085	PR1085	SA1082	SA1084	SR1083	SR1072A	SA1074A	PR1074	PR1088	PR1088	PR1088	PR1088	PR1088	PR1088
Hydrogeological unit**				ALV	ALV	ALV	ALV	ALV	CK	RTD	SCK	TSF	RTD	TSF	RTD	RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria			41m	41m	41m	41m	41m	108m	157m	180m	864m	930m	930m	965m	965m	965m	965m	965m	965m
Chemical	Value	Units	Source	2009	14/11/211	13/1/2012	20/4/2012	31/5/2012	2009	2009	2009	2009	2009	2009	22/8/2011	2/11/2011	9/1/2012	23/3/2012	2/5/2012	14/8/2012
Benzo[a]Pyrene	0.01	ug/l	DWS 2010	<0.01	0.01230	<0.00500	<0.01	<0.00500	<0.009	<0.009	0.0242	<0.01	<0.01	<0.01	<0.00500	<0.00500	<0.00500	<0.01	<0.00500	<0.00500
Benzo[b]Fluoranthene	0.03	ug/l	WFD D 10	<0.01	-	-	<0.01	-	<0.023	<0.023	0.0414	<0.01	<0.01	<0.01	-	-	-	<0.01	-	-
Benzo[g,h,i]Perylene	0.002	ug/l	WFD D 10	<0.01	-	-	<0.01	-	<0.016	<0.016	<0.016	<0.01	<0.01	<0.01	-	-	-	<0.01	-	-
Benzo[k]Fluoranthene	0.03	ug/l	WFD D 10	<0.01	-	-	<0.01	-	<0.027	<0.027	<0.027	<0.01	<0.01	<0.01	-	-	-	<0.01	-	-
Bifenthrin	-	ug/l	None	-	-	-	0.00910	-	-	-	-	-	-	-	-	-	-	0.01400	-	-
Bis (2 - chloroethoxy) methane	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Bis (2 - chloroethyl) ether	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl) phthalate	1.3	ug/l	WFD 2010	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-
Boron Dissolved	1000	ug/l as B	DWS 2010	-	-	-	74	-	-	-	-	-	-	-	-	-	-	190	-	-
Boron Total	1000	ug/l as B	DWS 2010	350	160	120	-	0.12	-	-	-	410	390	430	210	200	180	-	0.2	0.21
Bromate	10	ug/l as BrO3	DWS 2010	-	<0.5	<0.5	-	< 5.0	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	< 5.0	<0.5
Bromobenzene	-	ug/l	None	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-
Bromochloromethane	-	ug/l	None	-	-	-	-	-	-	<1.9	-	-	-	-	-	-	-	-	-	-
Bromodichloromethane	100	ug/l	WS Regs 20	-	-	-	-	-	-	<0.9	-	-	-	-	-	-	-	-	-	-
Bromoform	100	ug/l	WS Regs 20	-	-	-	-	-	-	<3	-	-	-	-	-	-	-	-	-	-
Bromomethane	-	ug/l	None	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-
Butyl benzyl phthalate	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Cadmium Total	5	ug/l as Cd	DWS 2010	<2	3	<1.5	<1.5	< 1.5	<0.22	<0.22	<0.22	<2	<2	<2	<1.5	<1.5	<1.5	<1.5	< 1.5	<1.5
Calcium Total	250	mg/l as Ca	DWS 2010	-	190	140	-	140	-	-	-	-	-	-	150	160	210	-	220	-
Carbazole	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Carbendazim / Benomyl	0.1	ug/l	FW List II	-	-	-	-	<0.00500	-	-	-	-	-	-	0.01000	0.01000	0.01100	-	0.00800	<0.00500
Carbetamide	-	ug/l	None	-	-	-	-	<0.01000	-	-	-	-	-	-	<0.00600	0.00800	0.00800	-	<0.01000	<0.01000
Carbon Dioxide	-	ug/l	None	-	-	-	97600	-	-	-	-	-	-	-	-	-	-	55000	-	-
Carbon disulphide	-	ug/l	None	-	-	-	-	-	-	<1.3	-	-	-	-	-	-	-	-	-	-
Carbon Organic Dissolved	-	mg/l as C	None	-	-	-	4.6	-	-	-	-	-	-	-	-	-	-	2.5	-	-
Carbon tetrachloride	3	ug/l	DWS 2010	-	<0.07	<0.07	-	< 0.070	-	<1.4	-	-	-	-	<0.07	<0.07	<0.07	-	< 0.070	<0.070
Chlorfenvinphos	0.1	ug/l	DWS 2010	-	<0.00900	<0.00900	-	<0.00900	-	-	-	-	-	-	<0.00900	<0.00900	<0.00900	-	<0.00900	<0.00900
Chloride	250	mg/l as Cl	DWS 2010	210	259	192	-	173	-	-	-	110	66	92	291	389	515	-	621	-
Chlorobenzene	-	ug/l	None	-	-	-	-	-	-	<3.5	-	-	-	-	-	-	-	-	-	-
Chloroethane	-	ug/l	None	-	-	-	-	-	-	<2.5	-	-	-	-	-	-	-	-	-	-
Chloroform	100	ug/l	WS Regs 20	-	<0.6	<0.6	-	< 0.600	-	<1.8	-	-	-	-	<0.6	<0.6	<0.6	-	< 0.600	<0.600
Chloromethane	-	ug/l	None	-	-	-	-	-	-	<1.7	-	-	-	-	-	-	-	-	-	-
Chlortoluron	2	ug/l	FW List II	-	<0.05000	<0.05000	-	<0.01000	-	-	-	-	-	-	0.00600	0.00600	0.00600	-	<0.01000	<0.01000
Chromium Dissolved	50	ug/l as Cr	DWS 2010	-	-	-	10	-	-	-	-	-	-	-	-	-	-	16	-	17
Chromium Total	50	ug/l as Cr	DWS 2010	<5	15	14	-	19	1.16	2.3	2.39	<5	<5	<5	15	16	16	-	15	-
Chrysene	-	ug/l	None	<0.01	-	-	<0.01	-	<0.013	<0.013	0.0804	<0.01	<0.01	<0.01	-	-	-	<0.01	-	-
cis-1,3 - Dichloropropene	-	ug/l	None	-	-	-	-	-	-	<1.9	-	-	-	-	-	-	-	-	-	-
cis-1-2-Dichloroethene	-	ug/l	None	-	-	-	-	-	-	<2.3	-	-	-	-	-	-	-	-	-	-
Clopyralid	-	ug/l	None	-	<0.01900	<0.01900	-	<0.01900	-	-	-	-	-	-	<0.01900	<0.01900	<0.01900	-	<0.01900	<0.01900
Conductivity @ 20°C	2500	uS/cm	WS Regs 20	1440	-	-	-	-	997	-	-	1190	1230	932	-	-	-	-	-	-
Copper Total	2000	ug/l as Cu	DWS 2010	<2	<5.5	<5.5	-	7	1.86	3.36	8.13	<2	<2	<2	<5.5	<5.5	<5.5	-	< 5.5	<5.5
Coumaphos	0.1	ug/l	DWS 2010	-	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	<0.00500	-	-
Cresols	-	ug/l	None	<0.4	-	-	-	-	-	-	-	<0.1	<0.4	<0.1	-	-	-	-	-	-

Source of data*				SI	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT
Name				PR1085	PR1085	PR1085	PR1085	PR1085	SA1082	SA1084	SR1083	SR1072A	SA1074A	PR1074	PR1088	PR1088	PR1088	PR1088	PR1088	PR1088
Hydrogeological unit**				ALV	ALV	ALV	ALV	ALV	CK	RTD	SCK	TSF	RTD	TSF	RTD	RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria			41m	41m	41m	41m	41m	108m	157m	180m	864m	930m	930m	965m	965m	965m	965m	965m	965m
Chemical	Value	Units	Source	2009	14/11/211	13/1/2012	20/4/2012	31/5/2012	2009	2009	2009	2009	2009	2009	22/8/2011	2/11/2011	9/1/2012	23/3/2012	2/5/2012	14/8/2012
Cyanazine	0.1	ug/l	DWS 2010	-	<0.12000	<0.06000	-	<0.00800	-	-	-	-	-	-	<0.00700	<0.00700	<0.00700	-	<0.00800	<0.00800
Cyanide (Free)	50	ug/l as CN	DWS 2010	<20	-	-	-	-	-	-	-	<20	<20	<20	-	-	-	-	-	-
Cyanide (Total)	50	ug/l as CN	DWS 2010	<40	-	-	-	-	-	-	-	<40	<40	<40	-	-	-	-	-	-
Cypermethrin	0.0001	ug/l	WFD 2010	-	<0.1	<0.1	-	< 0.100	-	-	-	-	-	-	0.19	<0.1	<0.1	-	< 0.100	<0.100
Cypermethrin ID	-	Code	None	-	-	-	12	-	-	-	-	-	-	-	-	-	-	21	-	-
Dalapon	-	ug/l	None	-	<0.05000	<0.05000	-	<0.05000	-	-	-	-	-	-	<0.05000	<0.05000	<0.05000	-	<0.05000	-
Di - n - octyl phthalate	-	ug/l	None	-	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-
Diazinon	0.1	ug/l	DWS 2010	-	<0.00900	<0.00900	-	<0.00900	-	-	-	-	-	-	<0.00900	<0.00900	<0.00900	-	<0.00900	<0.00900
Dibenz-[A,H]-Anthracene	-	ug/l	None	<0.01	-	-	<0.01	-	<0.016	<0.016	<0.016	<0.01	<0.01	<0.01	-	-	-	<0.01	-	-
Dibenzofuran	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Dibromochloromethane	100	ug/l	WS Regs 20	-	-	-	-	-	-	<1.7	-	-	-	-	-	-	-	-	-	-
Dibromoethane	-	ug/l	None	-	-	-	-	-	-	<2.7	-	-	-	-	-	-	-	-	-	-
Dichlorodifluoromethane	-	ug/l	None	-	-	-	-	-	-	<1.3	-	-	-	-	-	-	-	-	-	-
Dichloromethane	20	ug/l	WFD 2010	-	<3	<3	-	< 3.0	-	<3.7	-	-	-	-	<3	<3	<3	-	< 3.0	<3.0
Dichlorprop	0.1	ug/l	DWS 2010	-	<0.01100	<0.01100	-	<0.01100	-	-	-	-	-	-	<0.01100	<0.01100	<0.01100	-	<0.01100	<0.01100
Diethyl phthalate	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Dimethyl phthalate	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Diuron	0.1	ug/l	DWS 2010	-	<0.05000	<0.05000	-	<0.01000	-	-	-	-	-	-	0.04300	0.03300	<0.10000	-	0.04100	0.04700
Enterococci (Species)	-	Nr/100ml	None	-	-	-	>100	-	-	-	-	-	-	-	-	-	-	0	-	-
Escherichia coli (Confirmed)	0	Nr/100ml	WS Regs 20	-	-	-	4	-	-	-	-	-	-	-	-	-	-	0	-	-
Ethofumesate	-	ug/l	None	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	-
Ethylbenzene	-	ug/l	None	<1	-	-	-	-	<10	<10	<10	<1	<1	<1	-	-	-	-	-	-
Fenuron	-	ug/l	None	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	<0.01	-	-
Fluoranthene	0.2	ug/l	EEC MAC	<0.01	-	-	<0.01	-	<0.014	<0.014	0.313	<0.01	<0.01	<0.01	-	-	-	<0.01	-	-
Fluorene	-	ug/l	None	<0.01	-	-	<0.01	-	<0.014	<0.014	4.74	<0.01	<0.01	<0.01	-	-	-	<0.01	-	-
Fluoride	1.5	mg/l as F	DWS 2010	-	0.06	0.07	-	0.326	-	-	-	-	-	-	0.4	0.36	0.25	-	0.33	0.488
Glyphosate	-	ug/l	None	-	<0.01400	<0.01400	-	<0.01400	-	-	-	-	-	-	<0.01400	<0.01400	<0.01400	-	<0.01400	<0.01400
GRO C4-C12	-	ug/l	None	-	-	-	-	-	<10	<10	<10	-	-	-	-	-	-	-	-	-
Hardness Total - As CaCO3	-	mg/l as CaCO3	None	-	-	-	170	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachloro 1,3 Butadiene	0.1	ug/l	WFD 2010	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene	0.01	ug/l	WFD 2010	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Hexachlorocyclopentadiene	-	ug/l	None	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-
Hexachloroethane	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Indeno-[1,2,3-Cd]-Pyrene	0.002	ug/l	WFD D 10	<0.01	-	-	<0.01	-	<0.014	<0.014	<0.014	<0.01	<0.01	<0.01	-	-	-	<0.01	-	-
Iodide Ion	-	ug/l as I	None	-	-	-	59	-	-	-	-	-	-	-	-	-	-	41	-	-
Irgarol 1051	-	ug/l	None	-	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	<0.00500	-	-
Iron Dissolved	200	ug/l as Fe	DWS 2010	-	-	-	5.3	-	-	-	-	-	-	-	-	-	-	5.6	-	-
Iron Total	200	ug/l as Fe	DWS 2010	-	-	-	5.4	-	-	-	-	-	-	-	-	-	-	5.6	-	-
Isophorone	-	ug/l	None	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-
Isopropylbenzene (Cumene)	-	ug/l	None	-	-	-	-	-	-	<1.4	-	-	-	-	-	-	-	-	-	-
Isoproturon (Diip1,3Dithiolan-2-Ylidenemalonate)	0.1	ug/l	DWS 2010	-	<0.05000	<0.05000	-	<0.00800	-	-	-	-	-	-	0.00800	0.00600	<0.05000	-	<0.00800	<0.00800
Lambda Cyhalothrin	-	ug/l	None	-	-	-	<5.00	-	-	-	-	-	-	-	-	-	-	<5.00	-	-

Source of data*				SI	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT
Name				PR1085	PR1085	PR1085	PR1085	PR1085	SA1082	SA1084	SR1083	SR1072A	SA1074A	PR1074	PR1088	PR1088	PR1088	PR1088	PR1088	PR1088
Hydrogeological unit**				ALV	ALV	ALV	ALV	ALV	CK	RTD	SCK	TSF	RTD	TSF	RTD	RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria			41m	41m	41m	41m	41m	108m	157m	180m	864m	930m	930m	965m	965m	965m	965m	965m	965m
Chemical	Value	Units	Source	2009	14/11/211	13/1/2012	20/4/2012	31/5/2012	2009	2009	2009	2009	2009	2009	22/8/2011	2/11/2011	9/1/2012	23/3/2012	2/5/2012	14/8/2012
Lead Total	10	ug/l	WS Regs 20	<4	11	<5	-	23	0.666	0.559	1.28	<4	<4	<4	<5	<5	<5	-	< 5	5
Lithium Dissolved	-	ug/l as Li	None	-	-	-	<0.0006	-	-	-	-	-	-	-	-	-	-	<0.0006	-	-
Lithium Total	-	ug/l as Li	None	-	-	-	<0.0006	-	-	-	-	-	-	-	-	-	-	<0.0006	-	-
Magnesium Dissolved	50	mg/l as Mg	EEC MAC	-	-	-	3.7	-	-	-	-	-	-	-	-	-	-	33	-	-
Magnesium Total	50	mg/l as Mg	EEC MAC	13	13	9.2	-	10	-	-	-	54	13	26	23	26	34	-	36	-
Manganese Dissolved	50	ug/l as Mn	DWS 2010	-	-	-	0.31	-	-	-	-	-	-	-	-	-	-	0.28	-	-
Manganese Total	50	ug/l as Mn	DWS 2010	-	-	-	0.31	-	-	-	-	-	-	-	-	-	-	0.29	-	-
MCPA {2-methyl-4-chlorophenoxyacetic acid }	0.1	ug/l	DWS 2010	-	<0.00900	<0.00900	-	<0.00900	-	-	-	-	-	-	<0.00900	<0.00900	<0.00900	-	<0.00900	<0.00900
Mecoprop { }	0.1	ug/l	DWS 2010	-	<0.01000	<0.01000	-	<0.01000	-	-	-	-	-	-	<0.01000	<0.01000	<0.01000	-	<0.01000	<0.01000
Mercury Total	1	ug/l Hg	WS Regs 20	<0.05	0.003	<0.002	-	0.005	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.002	0.006	<0.002	-	< 0.002	0.002
Metazachlor	-	ug/l	None	-	<0	<0	-	< 0	-	-	-	-	-	-	<0	<0	<0	-	< 0	<0.00800
Methane	-	ug/l	None	-	-	-	<10.0	-	-	-	-	-	-	-	-	-	-	42	-	-
Molybdenum Total	0	ug/l	GW Regs 98	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	<5	-	-
MTBE {Methyl Tert-Butyl Ether}	-	ug/l	None	<1	-	-	-	-	<10	<1.6	<10	<1	<1	<1	-	-	-	-	-	-
Multi Residual Scan	-	ug/l	None	-	-	-	-	<0.10000	-	-	-	-	-	-	-	-	-	-	<0.10000	-
n - Butylbenzene	-	ug/l	None	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-
Naphthalene	1.2	ug/l	WFD D 10	<0.01	-	-	0.29	-	<0.1	<0.1	0.794	<0.01	<0.01	<0.01	-	-	-	0.12	-	-
Nickel Total	20	ug/l as Ni	DWS 2010	<10	11	4	-	6	3.61	4.93	6.04	<10	<10	13	<4	<4	<4	-	5	<4
Nitrate - N	11.3	mg/l as N	WS Regs 20	<0.1	<0.043	<0.043	-	< 0.068	0.0678	<0.0677	2.96	<0.1	27	<0.1	<0.043	<0.043	<0.043	-	< 0.068	<0.068
Nitrobenzene	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Nitrogen Total Oxidised	11.3	mg/l as N	WS Regs 20	-	-	-	<0.081	-	-	-	-	-	-	-	-	-	-	0.519	-	-
N-nitrosodi-n-propylamine	-	ug/l	None	-	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Orthophosphate	-	mg/l as P	None	-	-	-	<0.18	-	-	-	-	-	-	-	-	-	-	0.25	-	-
Oxamyl	-	ug/l	None	-	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	<0.00500	-	-
o-Xylene	-	ug/l	None	-	-	-	-	-	<10	<1.7	<10	-	-	-	-	-	-	-	-	-
PAH 16 Total	0.1	ug/l	DWS 2010	-	-	-	-	-	<0.1	<0.1	12.8	-	-	-	-	-	-	-	-	-
PAHs Total	0.1	ug/l	DWS 2010	-	-	-	0.29	-	-	-	-	-	-	-	-	-	-	0.12	-	-
PCB Congener 028	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.015	-	-	-	-	-	-	-	-	-	-
PCB Congener 052	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.015	-	-	-	-	-	-	-	-	-	-
PCB Congener 101	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.015	-	-	-	-	-	-	-	-	-	-
PCB Congener 118	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.015	-	-	-	-	-	-	-	-	-	-
PCB Congener 138	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.015	-	-	-	-	-	-	-	-	-	-
PCB Congener 153	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.015	-	-	-	-	-	-	-	-	-	-
PCB Congener 180	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.015	-	-	-	-	-	-	-	-	-	-
PCB Total of 7 Congener (Aqueous)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.015	-	-	-	-	-	-	-	-	-	-
Pentachlorophenol	9	ug/l	WHO 2004	-	-	-	-	-	-	<3	-	-	-	-	-	-	-	-	-	-
Permethrin (Cis + Trans)	0.01	ug/l	WFD D 10	-	<0.01000	<0.10000	-	-	-	-	-	-	-	-	-	<0.10000	<0.10000	-	-	<0.10000
pH	10	pH units	DWS 2010	7.5	-	-	-	-	8.15	8	7.69	7.9	7.1	7.3	-	-	-	-	-	-
Phenanthrene	-	ug/l	None	0.02	-	-	<0.01	-	<0.022	<0.022	2.87	0.02	0.01	<0.01	-	-	-	<0.01	-	-
Phenol	0.5	ug/l	EEC MAC	<0.4	-	-	-	-	<2.0	<2.0	<2.0	<0.1	<0.4	<0.1	-	-	-	-	-	-
Phenol (Pentachlorophenol (PCP))	-	ug/l	None	-	<0.00900	<0.00900	-	<0.00900	-	-	-	-	-	-	<0.00900	<0.00900	<0.00900	-	<0.00900	-
Phenols Total For SWAD (7 Compounds)	-	ug/l	None	-	<800.0	459.0	-	<2,500.0	-	-	-	-	-	-	<8.0	<8.0	24.0	-	<8.0	<8.0

Source of data*				SI	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT
Name				PR1085	PR1085	PR1085	PR1085	PR1085	SA1082	SA1084	SR1083	SR1072A	SA1074A	PR1074	PR1088	PR1088	PR1088	PR1088	PR1088	PR1088
Hydrogeological unit**				ALV	ALV	ALV	ALV	ALV	CK	RTD	SCK	TSF	RTD	TSF	RTD	RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria			41m	41m	41m	41m	41m	108m	157m	180m	864m	930m	930m	965m	965m	965m	965m	965m	965m
Chemical	Value	Units	Source	2009	14/11/211	13/1/2012	20/4/2012	31/5/2012	2009	2009	2009	2009	2009	2009	22/8/2011	2/11/2011	9/1/2012	23/3/2012	2/5/2012	14/8/2012
Polynuclear Aromatic Hydrocarbons (Total)	0.1	ug/l	DWS 2010	<0.2	-	-	-	-	-	-	-	<0.2	<0.2	<0.2	-	-	-	-	-	-
Potassium Dissolved	-	mg/l as K	None	-	-	-	6.4	-	-	-	-	-	-	-	-	-	-	20	-	-
Potassium Total	-	mg/l as K	None	-	14	11	-	13	-	-	-	-	-	-	15	17	20	-	22	-
Preparation (Purge And Trap)	-	Text	None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Prepared
Propazine	0.1	ug/l	DWS 2010	-	<0.08000	<0.04000	-	<0.00500	-	-	-	-	-	-	<0.00400	<0.00400	-	-	<0.00500	<0.00500
Propetamphos	0.1	ug/l	DWS 2010	-	<0.00500	<0.00500	-	<0.00500	-	-	-	-	-	-	<0.00500	<0.00500	<0.00500	-	<0.00500	<0.00500
Propylbenzene	-	ug/l	None	-	-	-	-	-	-	<2.6	-	-	-	-	-	-	-	-	-	-
Pyrene	-	ug/l	None	0.02	-	-	<0.01	-	<0.015	<0.015	0.682	0.03	<0.01	<0.01	-	-	-	<0.01	-	-
SECB	-	ug/l	None	-	-	-	-	-	-	<1.7	-	-	-	-	-	-	-	-	-	-
Selenium	10	ug/l as Se	DWS 2010	<3	-	-	<0.4	-	1.3	2.69	<1	<3	<3	<3	-	-	-	<0.4	-	-
Silicate Reactive Dissolved - As SiO2	-	mg/l	None	-	-	-	18	-	-	-	-	-	-	-	-	-	-	18	-	-
Simazine	0.1	ug/l	DWS 2010	-	<0.08000	<0.08000	-	<0.00400	-	-	-	-	-	-	<0.00900	<0.00900	<0.04000	-	<0.00400	<0.00400
Sisumxylene	-	ug/l	None	-	-	-	-	-	<10	<10	<10	-	-	-	-	-	-	-	-	-
Sodium Total	200	mg/l as Na	DWS 2010	120	140	100	-	100	-	-	-	190	43	73	180	180	230	-	250	-
Strontium Dissolved	-	ug/l as Sr	None	-	-	-	0.28	-	-	-	-	-	-	-	-	-	-	0.76	-	-
Strontium Total	-	ug/l as Sr	None	-	-	-	0.29	-	-	-	-	-	-	-	-	-	-	0.8	-	-
Styrene	-	ug/l	None	-	-	-	-	-	-	<1.2	-	-	-	-	-	-	-	-	-	-
Sulphate	250	mg/l as SO4	DWS 2010	11	<1.7	8.37	-	48.2	183	146	94.2	290	160	170	180	173	161	-	175	-
Sulphide	-	ug/l	None	<10	-	-	<29.0	-	-	-	-	<10	<10	<10	-	-	-	<29.0	-	-
Sum of BTEX	-	ug/l	None	-	-	-	-	-	<10	<10	<10	-	-	-	-	-	-	-	-	-
Terbutryn	0.1	ug/l	DWS 2010	-	<0.08000	<0.04000	-	<0.00500	-	-	-	-	-	-	<0.00300	<0.00300	<0.00300	-	<0.00500	0.00700
tert - Butylbenzene	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-
Tetrachloroethene (Per/Tetrachloroethylene)	10	ug/l	DWS 2010	-	-	-	-	-	-	<1.5	-	-	-	-	-	-	-	-	-	-
Tetrachloroethylene	-	ug/l	None	-	<0.09	<0.09	-	< 0.09	-	-	-	-	-	-	<0.09	<0.09	<0.09	-	< 0.09	<0.09
Tetrachlorothioanisole	-	ug/l	None	-	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	<0.00500	-	-
Tin Total	0	ug/l as Sn	GW Regs 98	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	<5	-	-
Titanium	0	ug/l as Ti	GW Regs 98	-	-	-	0.032	-	-	-	-	-	-	-	-	-	-	0.078	-	-
Toluene (Methylbenzene)	50	ug/l	WFD 2010	<1	-	-	<0.55	-	<10	<1.4	<10	<1	<1	<1	-	-	-	<0.55	-	-
Total Aliphatic TPH	-	ug/l	None	<10	-	-	-	-	-	-	-	15	59	16	-	-	-	-	-	-
Total Aliphatics & Aromatics >C12-C44 (Aqueous)	-	ug/l	None	-	-	-	-	-	<10	<10	5380	-	-	-	-	-	-	-	-	-
Total Aliphatics >C12-C35 (Aqueous)	-	ug/l	None	-	-	-	-	-	<10	<10	3100	-	-	-	-	-	-	-	-	-
Total Aliphatics C5-C12	-	ug/l	None	-	-	-	-	-	<10	<10	<10	-	-	-	-	-	-	-	-	-
Total Aromatic TPH	-	ug/l	None	22	-	-	-	-	-	-	-	28	47	35	-	-	-	-	-	-
Total Aromatics >EC12-EC35 (Aqueous)	-	ug/l	None	-	-	-	-	-	<10	<10	2280	-	-	-	-	-	-	-	-	-
Total Aromatics C6-C12	1	ug/l	DWS 2010	-	-	-	-	-	<10	<10	<10	-	-	-	-	-	-	-	-	-
Total Chemical Oxygen Demand	-	mg/l	None	80	-	-	-	-	-	-	-	<10	<10	26	-	-	-	-	-	-
Total Monohydric Phenols (W)	-	ug/l	None	-	-	-	-	-	<15.0	<15.0	<15.0	-	-	-	-	-	-	-	-	-
Trichloroethene (Trichloroethylene)	10	ug/l	DWS 2010	-	<0.07	<0.07	-	< 0.07	-	<2.5	-	-	-	-	<0.07	<0.07	<0.07	-	< 0.07	<0.07
Trichlorofluoromethane	-	ug/l	None	-	-	-	-	-	-	<1.3	-	-	-	-	-	-	-	-	-	-
Trietazine	-	ug/l	None	-	<0.04000	<0.02000	-	<0.00800	-	-	-	-	-	-	<0.00600	<0.00600	<0.00600	-	<0.00800	<0.00800
Trifluralin	0.1	ug/l	DWS 2010	-	<0.01000	<0.01000	-	<0.01000	-	-	-	-	-	-	<0.01000	<0.01000	<0.01000	-	<0.01000	-
Turbidity	1	FTU	WS Regs 20	-	238	121	-	49.9	-	-	-	-	-	-	45	51.1	54.1	-	49.9	-

Source of data*				SI	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT
Name				PR1085	PR1085	PR1085	PR1085	PR1085	SA1082	SA1084	SR1083	SR1072A	SA1074A	PR1074	PR1088	PR1088	PR1088	PR1088	PR1088	PR1088
Hydrogeological unit**				ALV	ALV	ALV	ALV	ALV	CK	RTD	SCK	TSF	RTD	TSF	RTD	RTD	RTD	RTD	RTD	RTD
Distance from site	EQS Criteria			41m	41m	41m	41m	41m	108m	157m	180m	864m	930m	930m	965m	965m	965m	965m	965m	965m
Chemical	Value	Units	Source	2009	14/11/211	13/1/2012	20/4/2012	31/5/2012	2009	2009	2009	2009	2009	2009	22/8/2011	2/11/2011	9/1/2012	23/3/2012	2/5/2012	14/8/2012
Uranium	0	ug/l as U	GW Regs 98	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	<0.1	-	-
Vinyl Chloride	0.5	ug/l	DWS 2010	-	-	-	-	-	-	<1.2	-	-	-	-	-	-	-	-	-	-
Xylene (Meta & Para){1,3+1,4-Dimethylbenzene}	30	ug/l	WFD 2010	<1	<0.09	<0.09	<0.180	-	<10	<10	<10	<1	<1	<1	<0.09	0.13	<0.09	<0.180	< 0.09	<0.09
Xylene (ortho)	30	ug/l	SW Regs 98	-	-	-	<0.09	-	-	-	-	-	-	-	-	-	-	<0.09	-	-
Zinc Total	50	ug/l as Zn	DWS 2010	4	<5	<5	-	10	<5	<5	19.5	6	2	18	<5	8	<5	-	36	13

Notes:

xx	GAC1 exceedance
' - '	Not tested
' < '	Less than MDL

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

*** Hydrogeological unit: SCK – Seaford Chalk, CK – Chalk, TSF – Thanet Sands, RTD – River Terrace Deposits*

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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) (EA, 2009)[12] shows no groundwater body designation for either the upper or lower aquifers within the area in which the Heathwall Pumping Station site is located; therefore no baseline assessment of quantitative or chemical status is available.

K.8.3 The baseline assessment for groundwater status classification for the nearby Greenwich Chalk and Tertiaries (consisting of the Lambeth Group, Thanet Sands, Blackheath Formation and Chalk Formation) shows poor quantitative status and poor quality status for 2009. The predicted quantitative and chemical quality was poor for 2015 due to treatment or improvement being disproportionately expensive or technically infeasible.

K.8.4 The baseline assessment for groundwater status classification for the nearby Lower Thames Gravels is good quantitative status and poor quality status for 2009. The predicted chemical quality was poor for 2015 due to treatment or improvement being disproportionately expensive or technically infeasible.

K.8.5 Only eight out of forty-six groundwater bodies within the Thames River basin district are at good status overall; this is not expected to change by 2015 (EA, 2009)[12].

K.8.6 The Thames Tideway Tunnel project would prevent deterioration of the current and predicted status and would adhere to the key actions identified in the RBMP to achieve good status by 2021 or 2027, as follows (EA, 2009)[12]:

- The control of pollution to groundwater that may arise from any development which takes place on land.
- Prevent input of nitrates to groundwater body.
- Prevent inputs to and mitigate potential mobilisation of copper, other metals and hazardous substances in groundwater.
- 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.
- Prevent direct discharges of pollutants to groundwater.

K.9 Data sources

K.9.1 A list of data used for the Heathwall Pumping Station assessment is given in Vol 15 Table K.8.

Vol 15 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)
LBs*	Unlicensed groundwater abstraction boreholes and their details	June 2009	Contacted 14 London Boroughs along tunnel alignment
EA	Designated source protection zones (SPZ)	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 Tideway 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 Tideway Tunnel project	Groundwater monitoring strategy	Draft strategy Feb 2012	
Thames Tideway	Land quality data	February 2011	

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

** LBs – London Boroughs, **Source protection zones (SPZ)*

References

[1] British Geological Survey. *British geology onshore digital maps 1:50 000 scale*. Received from Thames Tunnel (February 2009).

[2] British Geological Survey. *The BGS Lexicon of Named Rock Units*. Available at: http://www.bgs.ac.uk/Lexicon/. Accessed May 2012.

[3] 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).

[4] Environment Agency. *Environment Agency Website*. Available at: http://www.environment-agency.gov.uk/homeandleisure/117020.aspx. Accessed April 2012.

[5] 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.

[6] Hiscock, K. *Hydrogeology, Principles and Practice*. Blackwell Publishing (2005).

[7] The Water Supply (Water Quality) Regulations (2000). Available at: http://www.legislation.gov.uk/uksi/2000/3184/contents/made.

[8] *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/.

[9] Environment Agency. REACH Annex XVII Restrictions Polycyclic-aromatic Hydrocarbons (PAHs) Guidance Note Part 1 (October 2010). Available at: http://www.environment-agency.gov.uk/static/documents/Business/Part_1_PAH_Guidance_Note.pdf

[10] Commission of the European Communities. *Directive of the European Parliament and of the Council on environmental quality standards in the field of water policy and amending Directive 2000/60/EC* (2009). Available at: http://ec.europa.eu/environment/water/water-dangersub/pdf/com_2006_397_en.pdf?lang=_e.

[11] Environment Agency. *Soil Guideline Value Reports* (2009). Available at: http://www.environment-agency.gov.uk/research/planning/64015.aspx.

[12] 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.

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.15**

Volume 15: Heathwall Pumping Station appendices

Appendix L: Water resources - surface water

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

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Appendix L: Water resources – surface water

L.1 Introduction

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

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Appendix M: Water resources - flood risk

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Appendix M: Water resources – flood risk

M.1 Policy considerations

M.1.1 The relevant planning document that would be used to assess the proposals is the National Policy Statement (NPS) for Waste Water (Defra, 2012)[1] which was published in February 2012.

M.1.2 The Waste Water NPS considers the Thames Tideway Tunnel project as 'nationally significant waste water infrastructure.'

M.1.3 General policy documents (eg, NPS) have been reviewed within Volume 2 Environmental assessment methodology. A summary of local and regional policy relevant to flood risk at Heathwall Pumping Station is provided below.

Local policy

Strategic Flood Risk Assessment

M.1.4 The Heathwall Pumping Station site lies within the London Borough (LB) of Wandsworth. LB of Wandsworth produced a Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA) (Scott Wilson Ltd, 2009)[2]. These outline the main flood sources to the borough and present the outcomes of the hydraulic modelling completed as part of the Level 2 study to investigate the residual risk of breaches in the Thames Tideway Defences (Thames Barrier and Tidal flood defence walls) at a number of locations along the River Thames.

M.1.5 The SFRAs confirm that the Thames Tidal Defence network reduces the annual probability of flooding from the Thames to less than 0.1%. The risk of flooding is therefore a residual risk associated with a breach in the defences.

M.1.6 The SFRAs advocate the use of flood resilience and resistant measures. These should be adopted during the construction and operation phases of the project.

M.1.7 According to the SFRAs:

a. The site overlies London Clay.

b. The site is within the Wandsworth Tidal Flood Warning Area, the River Wandle from Colliers Wood to Wandsworth Fluvial Flood Warning Area and the Environment Agency (EA) Flood Zone 3

c. The site is situated within an area identified as having increased risk of surface water ponding based on topography, geology and historic flooding records

d. In terms of emergency planning during the construction phase, rest and reception centres have been identified as as Leisure Centres, Churches, Schools and Community Centres.

M.1.8 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.1.9 The Council, in partnership with the Greater London Authority (GLA), Thames Water and the EA has produced a Surface Water Management Plan (SWMP) (GLA, 2011)[3] as part of the Drain London project. The SWMP sets out the preferred surface water management strategy for the borough.

M.1.10 According to the SWMP:

a. The site does not lie within a Critical Drainage Area (CDA)[i].

b. The site does not lie along an identified flow path for the 1% AEP + 30% climate change rainfall event.

c. There are no recorded sewer flood incidents in the vicinity to the site.

Regional policy

Thames Estuary 2100

M.1.11 The site lies within the Wandsworth to Deptford Policy Unit which has been assigned flood risk management policy 'P5' within the Thames Estuary 2100 (TE2100) Plan (EA, 2012)[4], meaning that further action will be taken to reduce flood risk beyond that required to mitigate the impact of climate change.

M.1.12 The TE2100 Plan identifies the local sources of flood risk at this location including:

a. tidal flooding from the River Thames

b. fluvial flooding from the River Wandle

c. heavy rainfall and urban drainage sources

d. a risk of groundwater flooding from superficial strata which is possibly connected to high water levels in the River Thames.

M.1.13 Flood Mitigation from these sources include:

e. the Thames Barrier and secondary tidal defences along the Thames frontage (both making up the Thames Tidal Defences) and the lower reach of the River Wandle

f. combined sewer overflows (CSOs) for mitigation of urban drainage

g. flood forecasting and warning.

[i] Area susceptible to surface water flooding.

M.1.14 The TE2100 Plan seeks to promote, where possible, defence improvements that ensure views are maintained and impacts to river access/views are minimised. Where defence raising in the future to manage the consequences of climate change is not possible, secondary defences and floodplain management should be introduced. There is also a vision to increase flood risk awareness within the area.

M.1.15 There is an acknowledgement that tidal defences on the River Wandle will require raising for estuary wide options.

London Regional Flood Risk Appraisal

M.1.16 For the reach between Hammersmith Bridge and the Thames Barrier (City Reach the London Regional Flood Risk Appraisal (RFRA) (GLA, 2009)[5] encourages small scale set back of development from the river walls where possible. The aim of this is to enable modification, raising and maintenance in a sustainable, environmentally acceptable and cost effective way. Development should be designed in such a way as to take opportunities to reduce flood risk and include resilience.

M.1.17 There is particular concern surrounding confluences of tributaries into the River Thames and the interactions between tidal and fluvial flows in the future due to climate change. This should be taken into consideration during the re-development process.

M.1.18 The RFRA indicates that SuDS should be included within developments to reduce surface water discharge.

References

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

[2] Scott Wilson Ltd . *London Boroughs of Wandsworth, Merton, Sutton and Croydon Level 1 Final Report. Scott Wilson Ltd (Dec 2008). London Boroughs of Wandsworth, Merton, Sutton and Croydon Level 2 Final Report.* (April 2009).

[3] Greater London Authority. *London Borough of Wandsworth Surface Water Management Plan* (August 2011).

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

[5] Greater London Authority. *London Regional Flood Risk Appraisal.* (October 2009).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

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Volume 15: Heathwall Pumping Station appendices

Appendix N: Development schedule

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Appendix N: Development schedule

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Appendix N: Development schedule

N.1 Summary

N.1.1 The assessments undertaken for this site take account of other relevant development projects within the vicinity of the site which are under construction, permitted but not yet implemented or submitted but not yet determined. In order to identify the relevant developments for consideration, the Planning Inspectorate, local planning authorities and the Greater London Authority have been consulted on the methodology (see Volume 2) and asked to assist in identifying and verifying the development projects included in the assessment. A schedule is provided in Vol 15 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.

N.1.2 Appendix N.2 presents specific information regarding the Northern Line Extension and assumptions made for the Thames Tideway Tunnel environmental impact assessment.

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Vol 15 Table N.1 Development schedule for Heathwall Pumping Station

Category types:

a. Under construction

b. Permitted but not yet implemented

c. Submitted but not yet determined

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions		Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2017 (Site Year 1 of construction and peak construction traffic year)	2023 (Year 1 of operation)		
Riverlight (Tideway Industrial Estate)	Adjacent	2011/3748	St James Group Limited	Redevelopment of the site to provide a residential-led mixed-use development of six buildings between twelve and twenty storeys (plus two basement levels) comprising 806 residential units, including affordable housing, flexible commercial uses at ground and first floor levels including retail, financial and professional services, restaurant/café and bar uses, healthcare facilities, a crèche and gallery space (A1/A2/A3/A4 and D1 uses), together with ancillary uses including a concierge/ management suite, a business suite and leisure facilities, and associated car and bicycle parking and landscaping including provision of a riverside walk.	A	90% complete & operational Assume that Blocks B, C, D, E and F are complete and occupied. Assume that Block A is under construction.	100% complete & operational	Email from developer St James Ltd (31/01/12) Phasing is proposed east to west – source: discussions with developer. *application supersedes previous 2010/3739	**2017:** Base case = Blocks B, C, D, E & F Cumulative = Block A **2023:** Base case = all blocks No cumulative
Embassy Gardens, Land to the south of Nine Elms Lane comprising DHL Depot and 1-12 Ponton Road and 51 Nine Elms Lane	15m south (at closest part of dev)	2011/1815		An outline planning application for demolition of all existing buildings and construction of a mixed use redevelopment comprising 9 building plots with buildings to a maximum height of 23 storeys (approximately 80m AOD) and a maximum overall floorspace of 263,030sq.m. GEA (including 18,571 sq m basement) including: 163,605 sq.m. and 192,825 sq.m. of residential use (equating to between 1626 and 1982 residential units, including affordable housing, and 6050sq.m. of serviced apartments); up to 7,834sq.m. of retail, financial and professional services, café/restaurant, bar and takeaway uses (A1 to A5); up to 1,886sq.m. GEA of car showroom (Sui Generis); between 21,329sq.m. and 49,159sq.m. of office floorspace (B1); up to 10,400sq.m. of hotel use (C1); 750sq.m. of community uses (D1); 1130sq.m. of assembly and leisure uses (D2).	B	Buildings A9, A10 & A11 complete & operational. Buildings A01, A02, A03, A04, A05 & A07 under construction.	100% complete & operational	Environmental Statement (Chapter 6 Development Programme and Construction page 2-3). Phasing information taken from application drawings (Phasing Diagrams)	**2017:** Base case = Buildings A09, A10 & A11 Cumulative = Buildings A01, A02, A03, A04, A05 & A07 **2023:** Base case = all buildings No cumulative

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions		Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2017 (Site Year 1 of construction and peak construction traffic year)	2023 (Year 1 of operation)		
Nine Elms Parkside	45m south (at closest part of dev)	2011/2462	Royal Mail Estates Ltd	An outline planning application for demolition of all existing buildings and construction of a mixed use redevelopment comprising 7 building plots with buildings to a maximum height of 23 storeys (approximately 76m AOD) and a maximum overall floorspace of 222,120sq.m.	B	Plots C & D under construction	Plots A, B, C & D complete & operational. Plots, E, F & G under construction.	Environmental Statement (Chapter 6 Demolition and Construction page 6-1). 2014 start on site assumption.	**2017:** No base case Cumulative = Plots C & D **2023:** Base case = Plots A, B, C & D Cumulative = Plots E, F & G
US Embassy - Land on south side of Nine Elms Lane incorporating Ponton Road	130m southeast	2009/1506 & (2009/1507) realignment of Pontoon Road Several non material amendment application and amendments to conditions	US Department of State	**2009/1506** Redevelopment of an area of 2.15 hectares to provide a new United States Embassy, to a maximum possible height of 97m, associated buildings, and new access road from Nine Elms Lane. **2012/2759 (reserved matters)** Details of external appearance of the building, including facing materials, layout of the building, scale of the building and landscaping of the site (condition 3), site levels (condition 4), a scheme to implement mitigation measures within the flood risk assessment (condition 8), a surface water drainage scheme (condition 9), an inclusive access strategy (condition 13), establishment of a Design Review Panel (condition 18), detailed energy strategy (condition 19), details of docking station for cycle hire scheme (condition 20) of outline planning permission ref 2009/1506 dated 12/10/2010 for the redevelopment of an area of 2.15ha to provide a new United States Embassy, associated buildings and access from Nine Elms Lane. Public Art Strategy and details of Design Review Panel pursuant to Clause 2 and Clause 5 of the S106 agreement dated 12/10/2010 relating to planning permission 2009/1506. Details of visitor cycle parking pursuant to condition 9 of planning permission ref 2009/1507 dated 12/10/2010 for formation of new junctions and new road to replace Pontoon Road.	B	100% complete & operational	100% complete & operational	Environmental Statement (Chapter 6 Development Programme and Construction page 1)	Base case (all years)

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions		Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2017 (Site Year 1 of construction and peak construction traffic year)	2023 (Year 1 of operation)		
New Covent Garden Market	Approx 340m south	2011/4664	Covent Garden Market Authority	Demolition of existing wholesale fruit, vegetable and flower market and ancillary building and structures, and residential building on Nine Elms Lane. Construction of a mixed-use redevelopment comprising a new fruit and vegetable and flower market and ancillary uses, residential flats, hotel, flexible retail uses including retail, financial and professional services, café/restaurant, bar uses and hot food takeaway, offices, non-residential institutions and assembly and leisure uses. Provision of car, cycle and motorcycle parking and servicing and new vehicle access. An energy centre. Provision of open space including part of the Linear Park. Total floor area 426,874sq.m.	B	Buildings B1, B2, B3, B4, B5 & B6 under construction.	Buildings B1, B2, B3, B4, B5, B6 & Site Entrance are complete & operational. Buildings T1, T2 & T3 are under construction	Development Specification (Table 8), November 2011.	**2017:** No base case Cumulative = Buildings B1, B2, B3, B4, B5 & B6 **2023:** Base case = Buildings B1, B2, B3, B4, B5, B6 & Site Entance Cumulative = Buildings T1, T2 & T3
Battersea Power Station	Approx 360m west	2009/3575 Applications 2009/3576, 2009/3577 and 2009/3578 also accompany the Battersea Power Station application.	REO (Power Station) Ltd	Restoration, extension, alterations and conversion of the Power Station building to provide retail, residential flats, business, cultural, hotel and conference facilities, event space and incidental accommodation; the demolition of other buildings and development of the land surrounding the Power Station and adjacent/ nearby sites to provide retail, restaurants bars and cafes, offices, hotel, residential, community and cultural space, assembly and leisure space, student housing, serviced apartments, an energy centre and basement plant; parking for cars, coaches, motorcycles and bicycles; new access and internal road system and servicing; 'off-site' highway works; works to the jetty to facilitate river transport and fuel delivery, including alterations to the river wall; provision of open space and landscaping works.	B	Phase 1 (RS-1) and Phase 2 (PS) are complete and operational. Phase 3 (RS-4 & O-1) is under construction.	Phase 1 (RS-1), Phase 2 (PS), Phase 3 (RS-4 & O-1), Phase 4 (RS-5), part of Phase 5 (RS-2) and Phase 6 (RS-2) are complete and operational. Part of Phase 5 (RS-6) and Phase 7 (RS-WF) are under construction.	Environmental Statement (Chapter 5 Site preparation and construction page 5-2) and Design & Access Statement. Decision notice requires development to be implemented within five years of the date of decision notice (23 August 2011) Assumptions regarding % complete in each assessment year are based on professional judgement using phasing information obtained from Design & Access Statement.	**2017:** Base case = Phases 1 & 2 Cumulative = Phase 3 **2023:** Base case = Phases 1, 2, 3, 4, part of 5 (RS-2) & 6 Cumulative = Part of Phase 5 (RS-6) & 7
10 Pascal Street	Approx 410m southeast	11/03931/FUL	Banham Security	Demolition of existing building and redevelopment of the site involving the erection of a part 13, part 6 and part 3 storey building to provide 3,964 sq m office space (Use Class B1) at ground, first and second floor levels and 63 residential units (Use Class C3) on the	C	100% complete & operational	100% complete & operational	No construction programme information available in application documentation. Given the size of the development it is assumed that it will be complete by Site Year 1 of construction.	Base case (all years)

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions		Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2017 (Site Year 1 of construction and peak construction traffic year)	2023 (Year 1 of operation)		
				upper floors together with a basement level to provide 31 car parking spaces, 5 motor bike spaces and 68 cycle spaces.					
Nine Elms Sainsbury's, Wandsworth Road	Approx 420m southeast	11/02326/OUT	Sainsbury's Supermarkets Ltd	A part detailed and part outline planning application comprising: Full detailed planning permission for the demolition of the existing retail store and petrol station to allow for the erection of a replacement retail store (7,432msq net trading floorspace (13,059msq gross internal floor area), childrens tutoring facility (298msq), lobby/circulation space (1,707msq), energy centre (779msq), flexible retail, community floorspace (787msq), business, office floorspace (1,860msq) and 671 residential units with ancillary gymnasium (369msq) arranged in seven blocks including towers of 19, 28 and 37 storeys. Also proposed are 363 retail and 148 residential parking spaces, 882 cycle spaces together with associated open space, childrens play space, landscaping and public realm improvements along Wandsworth Road and a new route from Wandsworth Road to New Covent Garden. Outline planning permission (with appearance, landscaping and access to be Reserved Matters) for 105msq of flexible A1, A2, A3, A4, D1 floorspace and 66 dwellings within 2 blocks. In addition outline planning permission is also sought for a further 1736msq of flexible floorspace for use in association with either the proposed Nine Elms Northern Line station or A1, A2, A3, A4, D1 use. This application is accompanied by an Environmental Statement	B	100% complete & operational	100% complete & operational	Information provided by LB Lambeth - if approved in 2012 the development is expected to take 2-3 years to construct. Would therefore be complete and operational by Site Year 1 of construction.	Base case (all years)
Market Towers	Approx 500m east	2012/0380	Kish Six Limited	Demolition of existing buildings and structures. Erection of two new buildings of 58 storeys (up to 200m above ground) and 43 storeys (up to 161m above ground) high to include the following uses with floorspace of up to: 77,548 sq.m. of residential floorspace	B	100% complete & operational	100% complete & operational	ES NTS. Section 6.	Base case (all years)

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions		Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2017 (Site Year 1 of construction and peak construction traffic year)	2023 (Year 1 of operation)		
				(up to 491 units); 721 sq.m. of retail uses (classes A1-A4); 10,986 sq.m. of office space (class B1); 11,617 sq.m. hotel (class C1) together with a high level viewing space; provision of private and public open spaces; vehicular access and reconfigured vehicular access routes; provision of cycle, motorcycle and car parking, servicing and energy centre within two level basement; landscaping; excavation works; and other associated works. An Environmental Statement has been submitted with the planning application under the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 2011					
St Georges Wharf (Vauxhall Tower)	Approx 550m northeast	03/01501/FUL	St George South London Limited	Revised proposal for redevelopment of part of St George Wharf site to provide 200 residential units in a 50-storey tower.	A	100% complete & operational	100% complete & operational	Information provided by LB Lambeth – advised of expected completion date of 2014	Base case (all years)
Vauxhall Square Cap Gemini Site (plot bounded by Parry Street, Bondway, Miles Street and Wandsworth Road)	Approx 560m east	11/04428/FUL	Vauxhall Cross Ltd	Demolition of existing buildings (except for the listed buildings on site) to provide a mixed use scheme comprising eight blocks ranging between 6, 9, 11, 16, 21, 26, 48 and 50 storeys, which include 604 dwellings 14,722sqm GIA of new office floor space (B1), 3047sqm GIA of A1-A5 retail, 438 bedroom hotel (C1), 40 bedroom replacement homeless hostel (sui generis), 416 student rooms (C2), new multi-screen cinema (D2), 1167sqm GIA Gym (D2), associated basement car parking and servicing; new public square and children's play area and associated public realm improvements.	C	Under construction	100% complete & operational	Information provided by LB Lambeth. If approved, lease on site does not run out until 2014, so works expected to start 2014/2015 and take up to five years.	**2017**: Cumulative **2023:** Base case

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions		Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2017 (Site Year 1 of construction and peak construction traffic year)	2023 (Year 1 of operation)		
Vauxhall Sky Gardens, 143-161 Wandsworth Road	Approx 570m east	09/04322/FUL	Frasers Property Developments Ltd	Redevelopment of the site involving the demolition of existing buildings and the erection of a part one storey, part eight storey and part 36 storey plus basement building to provide a mixed use development comprising ground floor commercial units (flexible use class A1, A2, A3 and D1) of 257 square metres, 4722 square metres of office floorspace (use class B1), 239 residential units, 3220 square metres of amenity space and landscaped amenity areas, 23 car parking spaces, 278 cycle parking spaces, refuse storage, public realm improvements at street level and the formation of new vehicular access from Wyvil Road.	B	100% complete & operational	100% complete & operational	Assumptions made on basis that ES (2009) assumes 2011 opening year (ie, two year construction period). As application was granted permission in Sept 2010 it is a reasonable assumption that it will be complete by Site Year 1 of construction.	Base case (all years)
Island Site Vauxhall Gyratory	Approx 690m east	10/02060/FUL	Kylun Ltd	Erection of two towers, Tower A rising to 42 storeys (approx 140m) and Tower B rising to 32 storeys (approx 115m), plus 4 basement levels below ground; to provide a mixed use development comprising 291 residential units (made up of 225 market units, 42 socially rented, 42 intermediate, which makes 23% of the units affordable, 663sqm of floorspace for food and drink commercial uses 2162sqm of floorspace for employment commercial uses), a 179 room hotel and 1371sqm of floorspace for community facilities/assembly and leisure (consisting of a dentist surgery, a soft play facility and a digital cinema/performance space – use classes D1 and D2); together with 30 car parking spaces, 10 motorbike parking spaces, 490 cycle parking spaces, refuse storage facilities, the provision of a public space/landscaping at street level, the formation of a new vehicular access from Parry Street and a new vehicle egress to Bondway, and other works incidental to the redevelopment of the site.	C	Under construction	100% complete & operational	Appeal in progress Works are expected to start in 2014 and take 2-3 years.	**2017:** Cumulative **2023:** Base case

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions		Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2017 (Site Year 1 of construction and peak construction traffic year)	2023 (Year 1 of operation)		
Riverwalk House, Millbank	Approx 720m northeast	11/09680/FUL	Derwent Valley Central Limited (parent company Derwent London plc)	Demolition of the existing building and erection of two buildings of 17 and 7 storeys linked by a central podium for use as 121 residential units (Class C3); dual/alternative use of part of the ground floor as a cafe/restaurant/gallery (Class A1/A3/D1); three levels of basement including car parking and plant area; replacement stair linking the river walk with Vauxhall Bridge and other associated works to the river walk and adjacent public landscape; works of hard and soft landscaping and other works incidental to the application.	B	100% complete & operational	100% complete & operational	Professional judgement – no phasing information available in application documentation	Base case (all years)
30-60 South Lambeth Road	Approx 780m east	11/04181/FUL	GMD Developments Limited	Redevelopment of the existing site to provide a 32 storey mixed-use building comprising new leisure uses (swimming pool & gymnasium) and 572 units for student residential accommodation. Provision of refuse and cycle storage, disabled parking and associated landscaping.	C	Under construction	100% complete & operational	Professional judgement – no phasing information available in application documentation	**2017:** Cumulative **2023:** Base case
1-9 Bondway and 4-6 South Lambeth Place	Approx 820m east	10/03151/FUL	Salmon Harvester Properties Ltd	Redevelopment of the site involving the demolition of the existing buildings and the erection of a 6 storey building (plus lower ground floor level) to provide a hotel comprising of 148 bedrooms (Use Class C1) with ancillary bar/restaurant facilities along with commercial floorspace at ground floor level in either Use Classes A1 (retail), A2 (financial and professional services), A3 (restaurants and cafes), A4 (drinking establishments) and formation of roof level plant.	A	100% complete & operational	100% complete & operational	Professional judgement – no phasing information available in application documentation	Base case (all years)
Marco Polo House, 346 Queenstown Road	Approx 830m southwest	2011/2089	Anastasia Ltd	Demolition of existing building. Erection of two new buildings of up to 17 storeys and 15 storeys high to provide 456 residential units and 1,257 sq.m. of commercial floor area comprising of office (B1 & A2), retail (A1) and cafe/restaurant (A3) uses, together with new pedestrian link and vehicular access, basement car and cycle parking, landscaping, excavation works and servicing.	B	Phase 1a complete & operational Phases 1b & 2 under construction	100% complete & operational (all phases)	Environmental Statement Part 1 (June 2011). Chapter 5 contains a phasing plan and information.	**2017:** Base case = Phase 1a Cumulative = Phases 1b & 2 **2023:** Base case = whole development No cumulative

Development within 1km (IPC or Mayoral referral unless otherwise noted)	Dist from site (closest point)	Development description			Category type (based on 'current' status)	Year specific assumptions		Source of assumption information / Notes	Base case or cumulative dev?
		Appl. No.	Developer	Description		2017 (Site Year 1 of construction and peak construction traffic year)	2023 (Year 1 of operation)		
Northern Line Extension	Approx 565m southwest(Battersea Power Station) Approx 420m southeast (Nine Elms Station)	N/A	TfL	Extension of the Northern Line (Charing Cross Branch) from Kennington to Battersea, with the creation of two new stations: one at Nine Elms near Wandsworth Road and the other at Battersea Power Station. To include the construction of three permanent shafts at Cottingham Road (intervention shaft), Kennington Green (ventilation shaft) and Kennington Park (ventilation shaft). In addition two temporary shafts would be built at Radcot Street and Harmsworth Street near to Kennington Station.	Not submitted	Under construction	100% complete & operational	Information provided by TfL in August 2012. In the absence of publically available information, see Assumptions note used by EIA team at the end of the Development Schedule.	**2017:** Cumulative **2023:** Base case

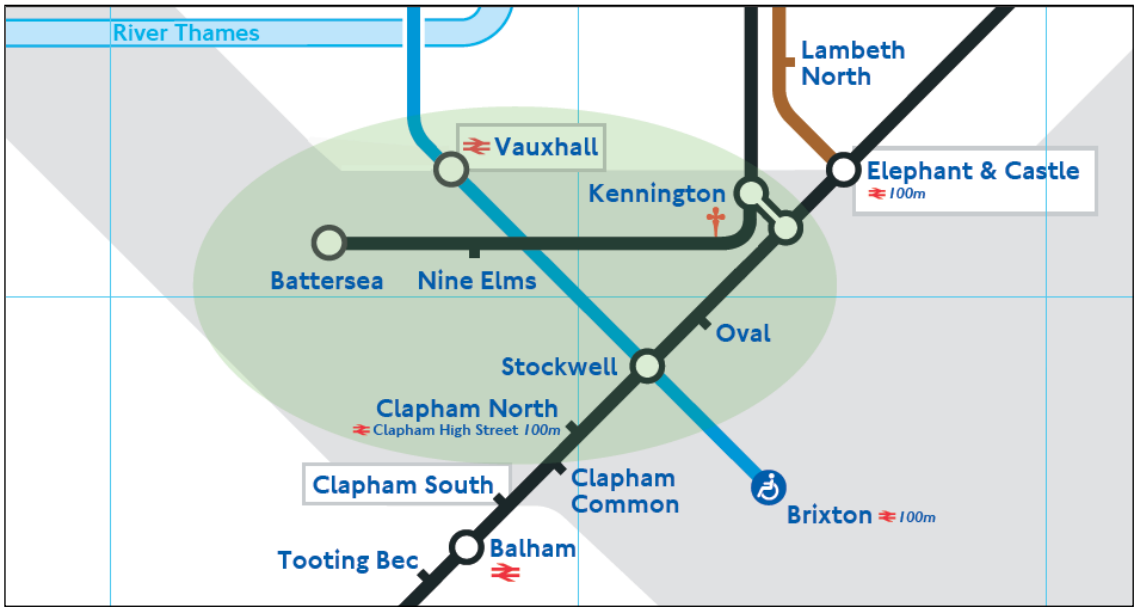
Note: phasing and site layout information has been sourced from local authority planning portals unless otherwise indicated.

N.2 Northern Line Extension – assumptions for Thames Tideway Tunnel EIA

N.2.1 This note has been produced to inform Thames Tideway Tunnel EIA specialists of the proposed Northern Line Extension (NLE) development, to be considered in the topic base case and cumulative effect assessments as appropriate.

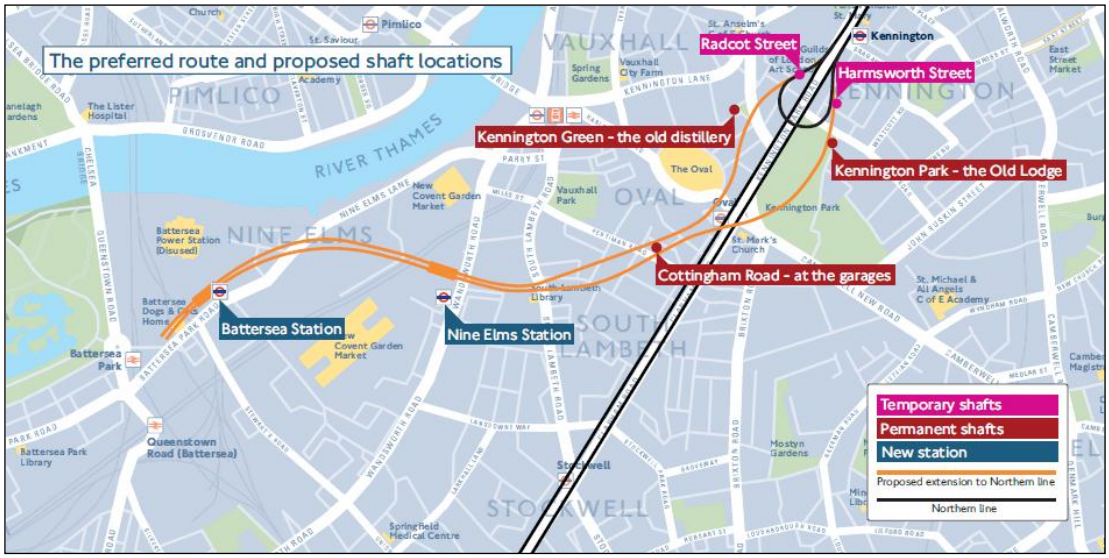
N.2.2 The NLE would extend the Northern Line from Kennington (Charing Cross branch) to Battersea, as shown in Vol 15 Plate N.1 below.

Vol 15 Plate N.1 Tube map showing proposed Northern Line extension



N.2.3 The NLE would include the creation of two new stations: one at Nine Elms near to Wandsworth Road, and the other at Battersea Power Station, as well as the construction of three permanent shafts at Cottingham Road/Claylands Road (intervention shaft), Kennington Green (ventilation shaft) and Kennington Park (ventilation shaft). In addition two temporary shafts would be built at Radcot Street and Harmsworth Street near to Kennington station. The preferred route and proposed shaft locations are shown in Figure 1.2 below.

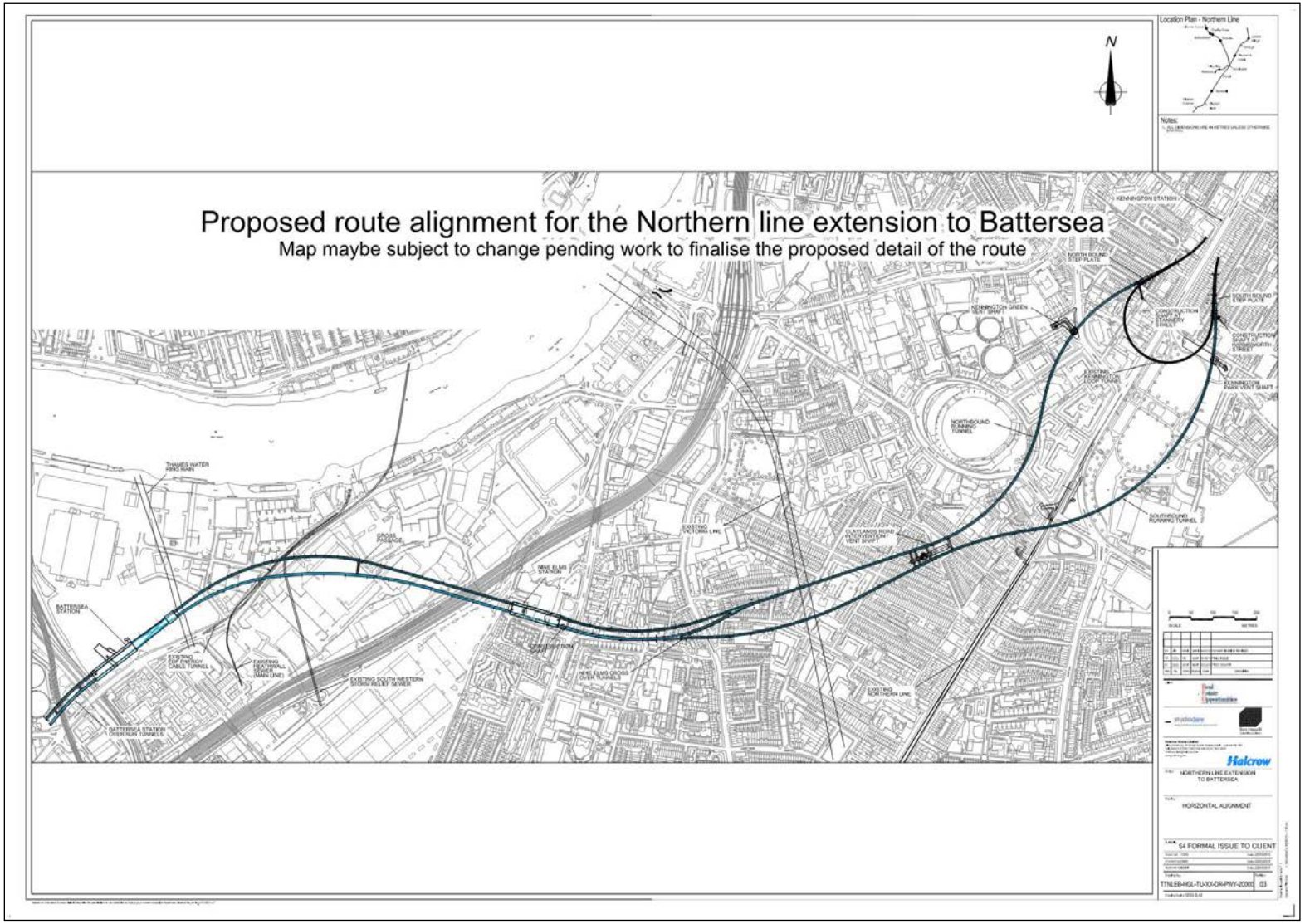
Vol 15 Plate N.2 Preferred route and proposed shaft locations of the Northern Line extension



N.2.4 The NLE would pass through the London Borough (LB) of Wandsworth, LB of Lambeth, and has a temporary shaft within LB of Southwark. It is also close to the City of Westminster, although it is separated by the River Thames.

N.2.5 A detailed proposed route alignment map can be seen in Vol 15 Plate N.3 below.

Vol 15 Plate N.3 Proposed route alignment



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N.2.6 A number of phasing scenarios are currently being considered by the NLE project as there are a number of uncertainties, including the development programme for the redevelopment of Battersea Power Station. However, the most likely scenario is that the NLE project would begin construction in late 2015/early 2016 and last about four years becoming operational in 2019. This is therefore assumed for the purposes of the Thames Tideway Tunnel EIA.

N.2.7 The current assumption for the NLE project (and therefore used for the Thames Tideway Tunnel EIA) is that inbound materials such as tunnel linings, would be brought in by road while excavated material would be removed by river.

N.2.8 To facilitate this, the project would use the Battersea Power Station jetty, which is anticipated to involve moving the existing cranes and installing a conveyor. It is estimated that 100m^3 (average) to 2000m^3 (maximum) of material would be transported in a 25 hour period (ie, over two tides).

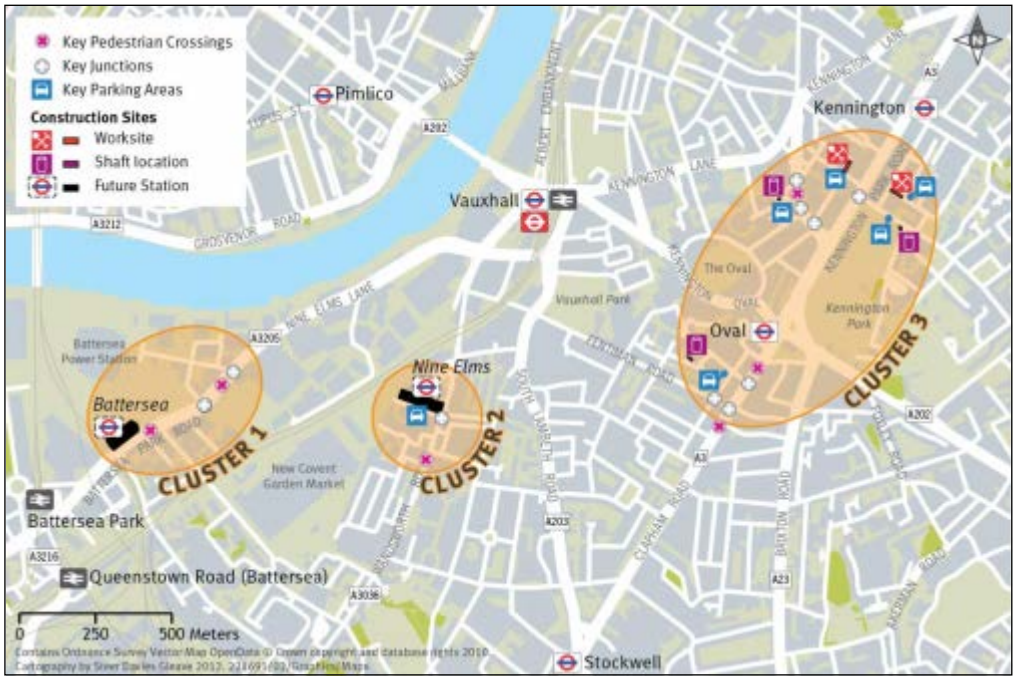
N.2.9 It is however noted that this remains subject to discussions with the Port of London Authority. Additionally, investigations are ongoing as to whether there can be greater use of rail and/or river, as well as the feasibility of on-site manufacturing.

N.2.10 TfL has produced a report outlining the proposed approach to transport and parking impact assessments, in which they break down the NLE construction sites into clusters as follows:

a. Cluster 1 – Battersea Park Road/Nine Elms Lane
    i Battersea Power Station
b. Cluster 2 – Wandsworth Road
    i Nine Elms Station (including Banham site)
c. Cluster 3 – Kennington Park Road
    i Claylands Road (Garages) intervention shaft
    ii Kennington Park (Old Lodge) ventilation shaft
    iii Kennington Green (Distillery) ventilation shaft
    iv Northern site (Radcot Street) temporary grouting shaft
    v Southern site (Harmsworth Street) temporary grouting shaft.

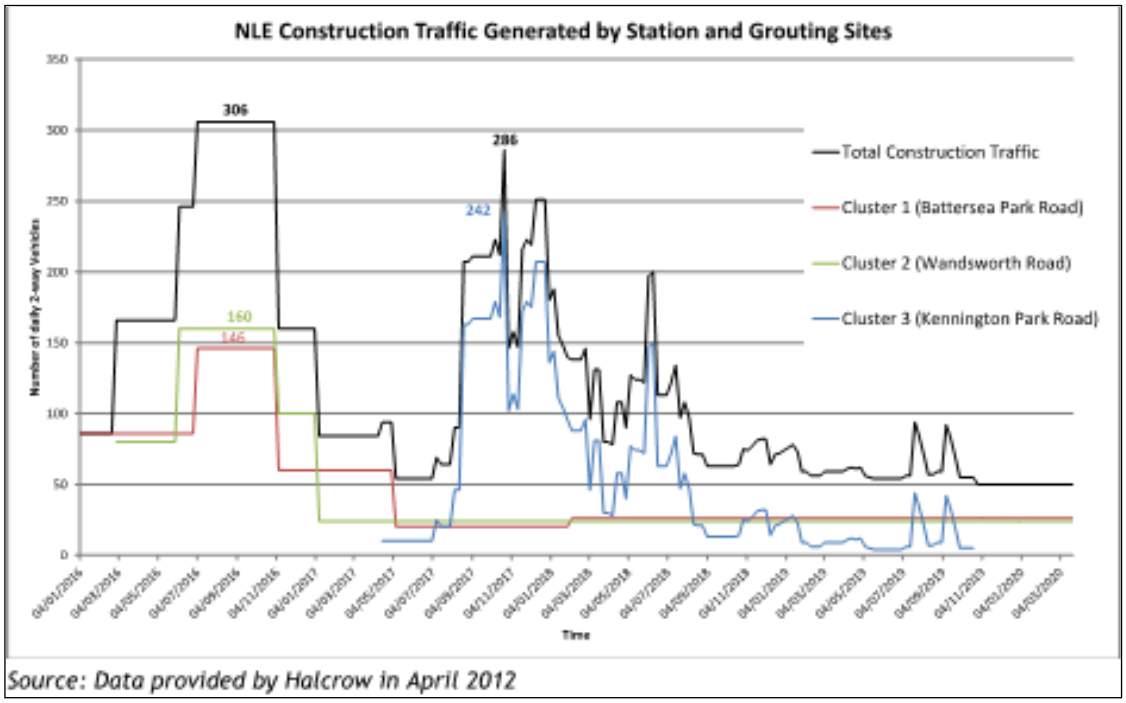
N.2.11 The aforementioned clusters are shown on Vol 15 Plate N.4 below:

Vol 15 Plate N.4 Northern Line Extension construction site clusters



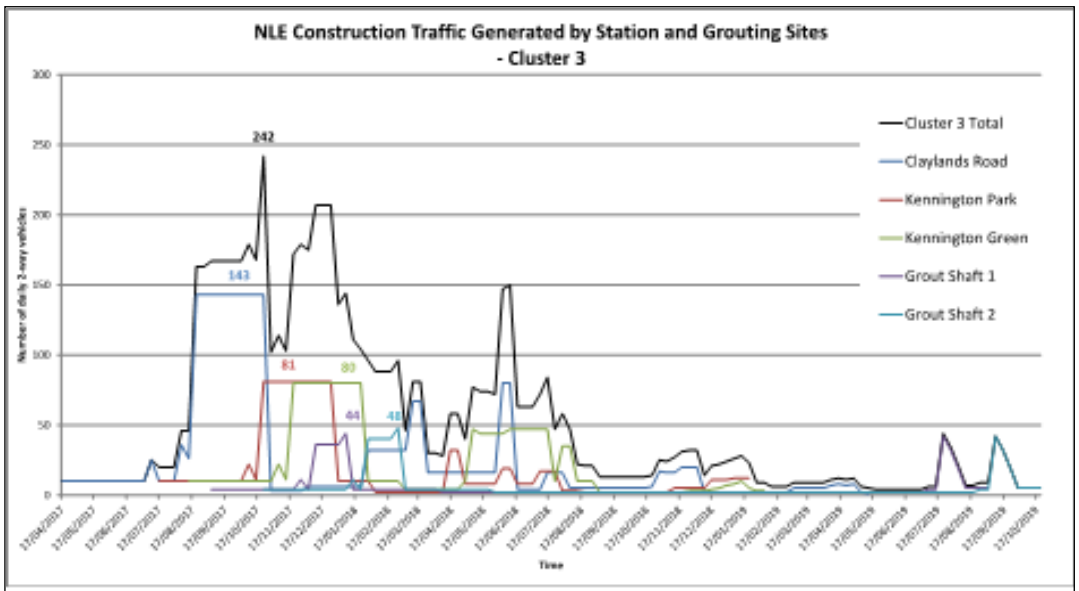
N.2.12 Daily two-way construction traffic, which includes all traffic going in and out of the construction sites in each cluster are shown in Vol 15 Plate N.5 below.

Vol 15 Plate N.5 Daily two-way construction traffic by all clusters



N.2.13 As cluster 3 includes five separate construction sites, Vol 15 Plate N.6 illustrates the traffic generated by each of these sites, both separately and in total.

Vol 15 Plate N.6 Daily two-way construction traffic in cluster 3



Source: Data provided by Halcrow in April 2012

N.2.14 It has been assumed in the above assessment that construction work would commence on 4 January 2016.

N.2.15 Peak construction activity in term of traffic generation is expected to occur between July and November 2016, with a total of 306 two-way vehicles generated every day.

N.2.16 A secondary peak of construction is expected to take place in November 2017, with a total of 242 two-way daily vehicles.

N.2.17 Of the total outgoing and incoming traffic from/to the construction sites, 30% would have an origin/destination in north London and 70% in south London.

N.2.18 All construction traffic would head to/from the M25 via the most easily accessible arterial routes located within the vicinity of each construction site.

N.2.19 During the construction period it is assumed that construction activity would take place for ten hours during the day, with construction traffic spread out equally across the day.

N.2.20 The main site at Battersea Power Station would not require any diversions, road closures, or parking suspensions; however Kirtling Street would be subject to a high number of vehicle movements.

N.2.21 Road closures/diversions would be required on two small residential streets in the vicinity of Kennington station in order to accommodate the temporary grouting shafts. Buses would be rerouted, and one bus lane may need to be removed in the vicinity of Kennington Green. A small but significant number of parking spaces would need to be suspended,

although this will be concentrated around the Kennington Road sites as well as by the proposed Nine Elms station on Wandsworth Road.

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