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

Creating a cleaner, healthier River Thames

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.22**

Volume 22: Earl Pumping Station appendices

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

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Thames Tideway Tunnel

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Thames Tideway Tunnel

Environmental Statement

List of contents

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Thames Tideway Tunnel

Environmental Statement

Volume 22 Earl Pumping Station site assessment

List of contents

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.22**

Volume 22: Earl Pumping Station appendices

Appendix A: Introduction

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 22 Earl Pumping Station appendices

Appendix A: Introduction

List of contents

Page number

This page is intentionally blank

Appendix A: Introduction

A.1 Summary

A.1.1 This document presents the appendices that accompany the *Environmental Statement* Volume 22 Earl 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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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.22**

Volume 22: Earl Pumping Station appendices

Appendix B: Air quality and odour

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

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 22 Earl Pumping Station appendices:

Appendix B: Air quality and odour

List of contents

Page number

List of plates

Page number

List of tables

Page number

This page is intentionally blank

Appendix B: Air quality and odour

B.1 Model verification

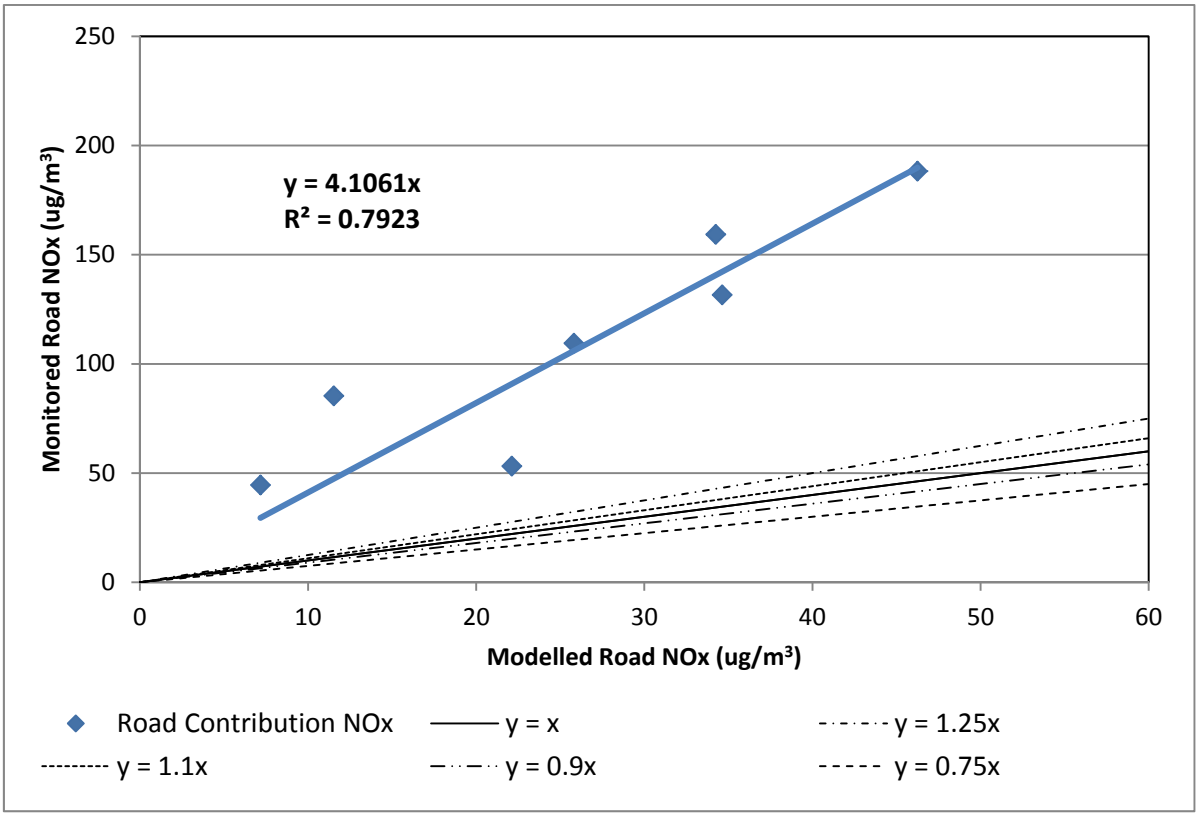
B.1.1 Modelled NO_2 concentrations have been plotted against monitored concentrations at seven diffusion tube sites (EPSM1 – EPSM7) as shown in Vol 22 Figure 4.4.1 (see separate volume of figures).

B.1.2 This showed that the modelled results underestimated NO_2 concentrations by between 19% and 41%. 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.

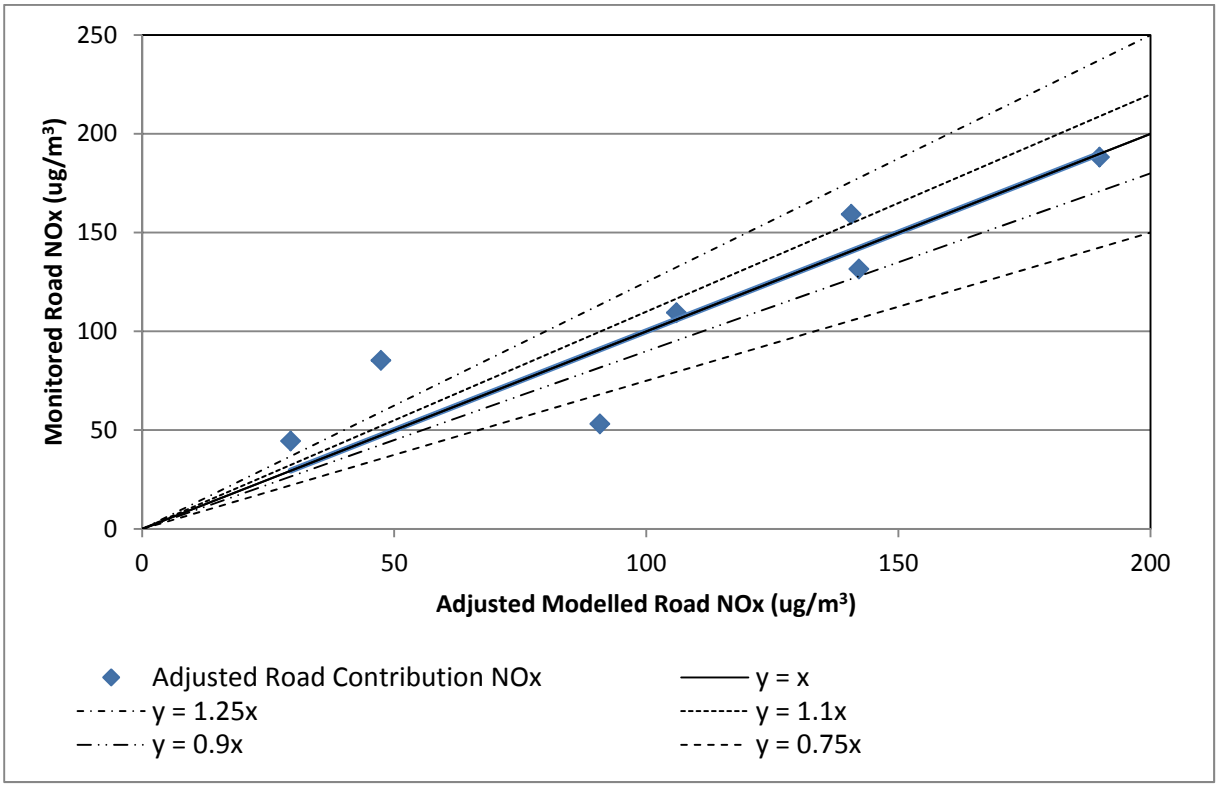
B.1.3 To derive the adjustment factor, modelled road NO_X concentrations were plotted against calculated monitored road NO_X concentrations (see Vol 22 Plate B.1 below). An adjustment factor of 4.11 was calculated for adjusting modelled roadside NO_X concentrations, in accordance with LAQM.TG(09)[1] and subsequently applied. This factor was also applied to the PM_{10} results as no local PM_{10} monitoring data were available for an area where traffic data were also available.

B.1.4 Applying the NO_X adjustment factor and then calculating NO_2 concentrations, as shown in Vol 22 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 22 Plate B.3, indicated that five of the seven modelled concentrations were within 10% of the measured value and that all were within 25% of the modelled value.

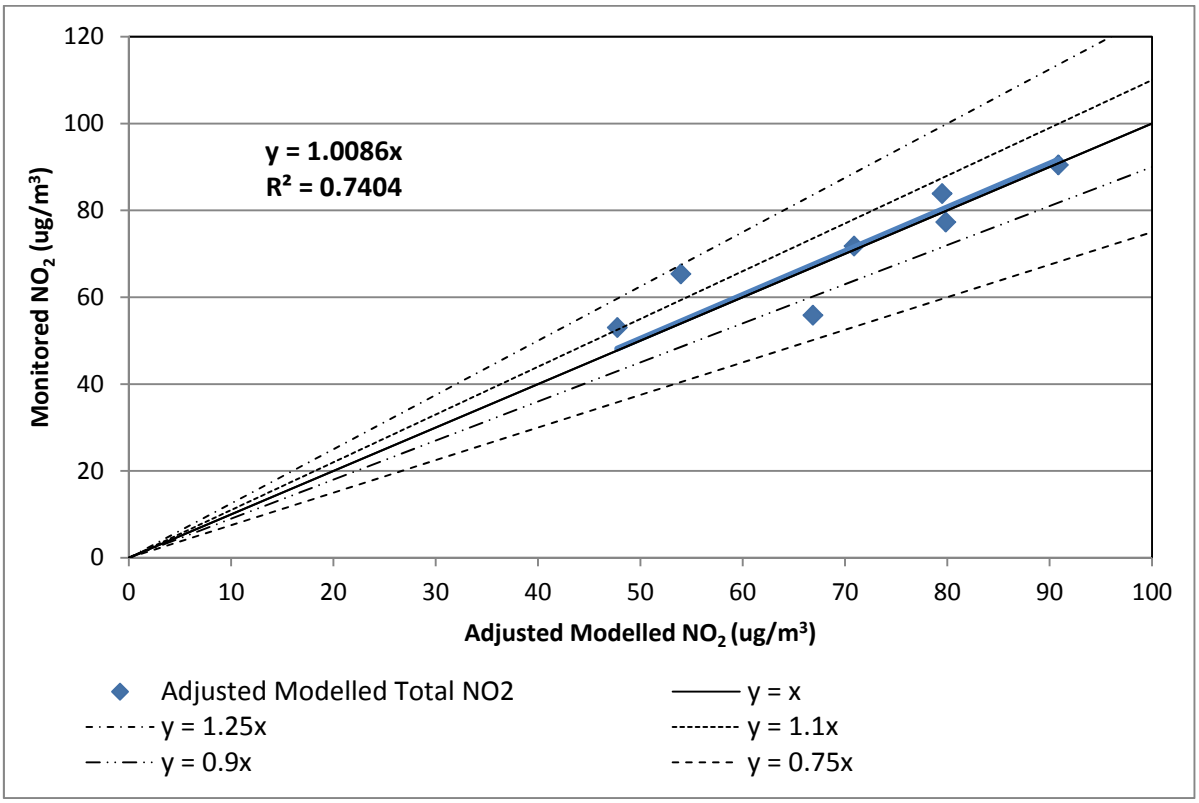
Vol 22 Plate B.1 Air quality - monitored road NO_X vs. modelled road NO_X



Vol 22 Plate B.2 Air quality – monitored road NO_X vs. adjusted modelled road NO_X



Vol 22 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 Earl Pumping Station site are shown in Vol 22 Table B.1.

Vol 22 Table B.1 Air quality - traffic data model inputs

Source	Road link	2010 baseline AADT*	Baseline % HGV >3.5t	Speed limit (mph)	Model input speed (mph)	Growth factor % (2009 - 2018)	Peak 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*** 'direct'	Lower Road north of Hawkstone Road	26976	10.6%	30	25.9	2.9%	27750	27784	10.7%	2959
TfL Model	Hawkstone Road	5739	2.9%	30	7.5	2.9%	5904	5904	2.9%	170
ATC*** 'Indirect'	Lower Road north of Redriff Road	23176	8.1%	30	25.9	2.9%	23841	23881	8.1%	1943
TfL Model	Rotherhithe Old Road	22699	8.2%	30	17.8	2.9%	23350	23380	8.3%	1946
ATC*** 'Indirect'	Lower Road south of Redriff Road	26648	5.8%	30	25.9	2.9%	27413	27455	5.9%	1613
TfL Model	Rotherhithe New Road west	24147	7.0%	30	21.9	2.9%	24839	24841	7.0%	1736

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)
	of Bush Road									
TfL Model	Rotherhithe New Road east of Bush Road	6441	7.7%	30	8.7	2.9%	6626	6653	8.0%	530
TfL Model	Plough Way	4496	8.4%	30	17.5	2.9%	4624	4658	9.0%	420
ATC*** 'Indirect'	Lower Road south of Plough Way	19124	5.2%	30	26.3	2.9%	19672	19715	5.3%	1038
Speed Limit	Yeoman Street	1198	11.4%	20	20.0	2.9%	1232	1266	13.8%	174
TfL Model	Bestwood Street / Bush Road	24674	6.3%	30	20.7	2.9%	25382	25409	6.4%	1619
ATC*** 'direct'	Evelyn Street	28640	10.3%	30	26.3	2.9%	29461	29524	10.5%	3094

** AADT – annual average daily traffic; ** CTC – classified traffic count; *** ATC – automatic traffic count.*

B.3 Construction plant emission factors

B.3.1 For the purpose of the assessment, the following listed equipment in Vol 22 Table B.2 has been modelled for the peak construction year at the Earl Pumping Station site.

Vol 22 Table B.2 Air quality - construction plant assessment model inputs

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time	Power (kW)	NO_X emission rate ($g/s/m^2$)	PM_{10} emission rate ($g/s/m^2$)
Site set up and general site	Ground level behind hoarding	Compressor 250cfm*	1	50	104	5.6×10^{-7}	3.5×10^{-8}
	Ground level behind hoarding	Generator - 200kVA	1	100	160	1.7×10^{-6}	1.1×10^{-7}
	Ground level behind hoarding	JCB with hydraulic breaker	1	50	67	3.6×10^{-7}	2.3×10^{-8}
	Ground level behind hoarding	Cutting equipment (diamond saw)	2	10	2.3	1.3×10^{-8}	2.7×10^{-8}
	Ground level behind hoarding	Telescopic handler / FLT**	1	30	60	1.9×10^{-7}	1.2×10^{-8}
	Ground level behind hoarding	Hiab*** lorry/crane	1	5	56	3.0×10^{-8}	1.9×10^{-9}
	Ground level behind hoarding	Well drilling rig	1	50	403	2.2×10^{-6}	1.4×10^{-7}
Demolition	Ground level behind hoarding	Service crane 25t mobile crane	1	30	275	8.9×10^{-7}	5.5×10^{-8}
	Ground level behind hoarding	22t excavator with hydraulic hammer	1	30	122	3.9×10^{-7}	2.5×10^{-8}

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time	Power (kW)	NO_X emission rate ($g/s/m^2$)	PM_{10} emission rate ($g/s/m^2$)
	Ground level behind hoarding	Site dumper	1	30	81	2.6×10^{-7}	1.6×10^{-8}
	Ground level behind hoarding	Concrete crusher	1	80	172	1.5×10^{-6}	9.3×10^{-8}
	Ground level behind hoarding	Vibrating rollers	2	50	145	1.6×10^{-6}	9.8×10^{-8}
Diaphragm wall construction	Ground level behind hoarding	Diaphragm wall rig (grab)	1	20	250	5.4×10^{-7}	3.4×10^{-8}
	Ground level behind hoarding	Diaphragm wall rig (hydrofraise)	1	80	250	2.2×10^{-6}	1.3×10^{-7}
	Ground level behind hoarding	Concrete deliveries (discharging)	1	20	223	4.8×10^{-7}	3.0×10^{-8}
	Ground level behind hoarding	Concrete pump	1	20	223	4.8×10^{-7}	3.0×10^{-8}
	Ground level behind hoarding	Compressor 400cfm*	1	50	104	5.6×10^{-7}	3.5×10^{-8}
	Ground level behind hoarding	Dumper	1	50	81	4.4×10^{-7}	2.7×10^{-8}
	Ground level behind hoarding	100t crawler crane	2	50	240	2.6×10^{-6}	1.6×10^{-7}
Shaft excavation	Ground level behind hoarding	Long reach excavator	1	80	178	7.1×10^{-7}	4.4×10^{-8}
	Within excavation	20t excavator with breaker	1	50	73	1.3×10^{-6}	8.1×10^{-8}

Construction activity	Typical location	Typical plant	Unit No(s)	% on-time	Power (kW)	NO_X emission rate ($g/s/m^2$)	PM_{10} emission rate ($g/s/m^2$)
	Ground level behind hoarding	25t excavator	1	80	125	5.6×10^{-7}	3.5×10^{-8}
	Ground level behind hoarding	Dumper	1	50	81	1.7×10^{-6}	1.1×10^{-7}
	Ground level behind hoarding	40t crawler crane	1	50	132	3.6×10^{-7}	2.3×10^{-8}
	Ground level behind hoarding	100t crawler crane	1	50	240	1.3×10^{-8}	2.7×10^{-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. cfm - cubic feet per minute. ** FLT – fork lift truck machine. ***Hiab – loader crane.*

B.4 Naphthalene emission rates

B.4.1 The naphthalene emission rates used in the modelling for odour and air quality at the Earl Pumping Station site are shown in Vol 22 Table B.3 and Vol 22 Table B.4 respectively.

Vol 22 Table B.3 Air quality and odour – naphthalene emission rates for odour modelling

Construction activity	Period	Emission rate (g/s)
Diaphragm wall (47 days)	Weekday overnights (17:00 to 08:00)	0.0058
	Weekends	0.0015
	Working day (08:00 to 17:00)	0.199
Shaft (52 days)	Weekday overnights (17:00 to 08:00)	0.0509
	Weekends	0.0127
	Working day (08:00 to 17:00)	1.38

Vol 22 Table B.4 Air quality and odour – naphthalene emission rates for air quality modelling

Construction activity	Period	Emission rate (g/s)
Diaphragm wall (47 days)	Mean	0.032
Shaft (52 days)	Mean	0.0216

References

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

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.22**

Volume 22: Earl Pumping Station appendices

Appendix C: Ecology - aquatic

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Thames Tideway Tunnel

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Thames Tideway Tunnel

Environmental Statement

Volume 22 Earl Pumping Station appendices

Appendix C: Ecology - aquatic

List of contents

Page number

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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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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.22**

Volume 22: Earl Pumping Station appendices

Appendix D: Ecology - terrestrial

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 22 Earl Pumping Station appendices

Appendix D: Ecology – terrestrial

List of contents

Page number

List of tables

Page number

This page is intentionally blank

Appendix D: Ecology – terrestrial

D.1 Notable species survey report

Introduction

D.1.1 Surveys for invasive plants were undertaken at Earl Pumping Station as suitable potential habitat for invasive plants was recorded on site during the Phase 1 Habitat Survey conducted on 24 November 2010 and shown in Vol 22 Figure 6.4.2(see separate volume of figures).

D.1.2 The purpose of the survey is to determine the presence / likely absence of invasive plants at and around the site.

D.1.3 The survey area is described as identified in para D.1.6. The results from the surveys are then presented (paras D.1.7 to D.1.9). The final section provides an interpretation of the results (para D.1.11). Figures referred to in this report are contained within Vol 22 Earl Pumping Station Figures.

D.1.4 Information on legislation, policy and methodology can be found in Volume 2 of the *Environmental Statement*. Information on site context can be found in Section 3 of this site assessment volume (Vol 22).

Survey area

Invasive plants

D.1.5 Invasive plants that are listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) occur in a wide range of habitats, although they are more often associated with watercourses or wet areas, or within areas of disturbed ground, where material contaminated with seeds and rhizomes (sections of root that can re-grow), may have been imported into the area.

D.1.6 The invasive plants survey area, as shown on Vol 22 Figure 6.4.3 (see separate volume of figures), comprises the proposed development site, and an area within 10m of the proposed development site boundary. The 10m zone beyond the site boundary was surveyed to record any invasive plants present adjacent to the site that could potentially spread onto the site, or that could have roots that extend into the site below ground (e.g. Japanese knotweed).

Results

D.1.7 In this section, the results of the desk study and invasive plant surveys are presented. The results are then interpreted in paragraphs D.1.7 to D.1.9.

Desk study

D.1.8 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 22 Table D.1.

Vol 22 Table D.1 Terrestrial ecology - species found within 500m of the site between 2001 - 2011

Common name	Species name (Latin)	Record count
Mammals		
Vespertilionidae	*Vespertilionidae*	1
Birds		
Common redpoll	*Carduelis flammea*	1
Common tern	*Sterna hirundo*	2
Greater scaup	*Aythya marila*	2
Greylag goose	*Anser anser*	1
House sparrow	*Passer domesticus*	5
Amphibians		
Common frog	*Rana temporaria*	2
Smooth newt	*Lissotriton vulgaris*	1
Invertebrates		
Latticed heath	*Chiasmia clathrata*	1

Invasive plants

D.1.9 The invasive plant survey was undertaken on 14 December 2011. One species of invasive plant, (Japanese knotweed *(Fallopia japonica))* was recorded.

D.1.10 Japanese knotweed was recorded at two locations within the site. These are shown on Vol 22 Figure 6.4.3 (see separate volume of figures), with a corresponding description given in Vol 22 Table D.2. One stand, which appears to have been treated, is located in centre of the proposed development site (the area of the site currently occupied by London Catering Services). The second stand is located in the south east of the proposed development site. Here there are dead stems of Japanese knotweed along the boundary walls and also along the boundary with the adjacent pavement.

Vol 22 Table D.2 Terrestrial ecology - invasive plant species

Common and scientific name	Location/description	NGR:	Stand dize
Japanese knotweed *(Fallopia japonica)*	One stand south of the centre of the proposed development site	TQ 36163 78763	1m x 1m
Japanese knotweed (*Fallopia japonica*)	One stand in the south east of the proposed development site	TQ 36178 78769	3m x 3m

Interpretation

Invasive Plants

D.1.11 The invasive plant species Japanese knotweed was recorded on site in two locations within the survey area. This species is listed on Schedule 9 of the Wildlife and Countryside Act 1981, which makes it illegal to cause these plants to spread or grow in the wild. Where works are to be undertaken within 10m of this species, control measures would be required to prevent its spread.

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.22**

Volume 22: Earl Pumping Station appendices

Appendix E: Historic environment

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

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Thames Tideway Tunnel

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This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 22 Earl Pumping Station appendices

Appendix E: Historic environment

List of contents

Page number

List of plates

Page number

List of tables

Page number

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 22 Table E.1 below, with their location shown on the historic environment features map (Vol 22 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 22 Table E.1 Historic environment – gazetteer of known heritage assets within the site and assessment area

HEA Ref no.	Description	Site code/ HER ref/ List Entry Number
1	Earl Pumping Station The Thames Water Earl Pumping Station is a T-shaped, single-storey 1940s municipal structure formed of red brick with Art Deco motifs. It was designed in the Art Deco style pre-1939 and constructed post-1945. The building is not statutorily or locally listed.	---
2	44–48 Croft Street, SE8 An evaluation carried out by the Museum of London Archaeology Service (MoLAS; now called MOLA) in 1992 revealed alluvial silt overlain by a layer of compacted chalk, possibly the floor of a building dating to the early 19th-century (GLHER 071260), and in another by a layer of mortar. Modern rubble sealed these deposits.	CFT92 071260 TQ365789
3	Land Adjacent to Crofter's Court, Croft Street, SE8 A MoLAS watching brief in 2003 revealed a considerable build up of Quaternary gravels, resulting from periods of high river level when the site was flooded for prolonged periods, and more recent sediments.	CFC03 TQ36097867
4	71–97 Plough Way, SE8 A MoLAS evaluation in 1996 recorded natural sands overlain by alluvial silts above peat deposits, suggesting a flooded marsh; one residual prehistoric struck flint was recovered from the peat. Victorian basements truncated	PWA96 TQ36107890

HEA Ref no.	Description	Site code/ HER ref/ List Entry Number
	the alluvium.	
5	305–319 Lower Road, SE8 A trial excavation was carried out by the Department of Greater London Archaeology (DGLA) in 1988. This revealed mainly topographical information, although five or six struck flints, areas of burning and several undated pits were located in natural sand and may represent limited prehistoric activity/occupation at the edge of an undefined sand island.	LR88 TQ35987864 091127 MLO17293
6	East Country Yard, Plough Way, Surrey Quays, SE16 An evaluation of the site was carried out by WA in 1994. Two trenches revealed a possible post-medieval relict watercourse (Greater London Historic Environment Record (GLHER) 092180), aligned east-west, filled with at least two layers of alluvial clay which both produced post-medieval and modern finds, as well as waterlogged timbers from the upper fill. The watercourse cut through the surface of a natural gravel island. All other finds and deposits represented modern building disturbance.	PLW94 TQ36507895 092180 MLO65945
7	Marine Wharf, Plough Way, SE8 A MoLAS evaluation in 1998 recorded sands and alluvial clays overlying natural gravel, and also organic silt. Above lay a great depth of re-deposited natural material from West Pond that had existed on the site at the beginning of the 19th century. This pond clearly extended further east than is indicated on contemporary maps.	PLU98 071576 TQ36507880
8	Grove Street (south end), Pepys Estate, SE8 A watching brief carried out by MoLAS in 1996 revealed modern made ground overlying natural gravels.	GVS96 071513 TQ36507860
9	Deepway, 85 Evelyn Street, SE8 An evaluation by MoLAS in 2001 revealed a series of fluvial deposits (MLO76022), possibly representing a period of transgression by the Thames in the Saxon period. A plough- or garden soil, dated to the 19th century (MLO77158), had been truncated by a stock brick wall. Victorian and modern rubbish pits (MLO77159) were also recorded.	EVL01 TQ36267846 MLO76022 MLO77158 MLO77159
10	Surrey Canal The canal was built in 1801–1807, between Rotherhithe and Mitcham, in what was then Surrey. The Rotherhithe end of the canal (which is situated within the assessment	MLO98360

HEA Ref no.	Description	Site code/ HER ref/ List Entry Number
	area, c. 85m to the east of the site) originally ended at the Stave Dock, which was connected to the Thames by a lock. In 1864 the complex became part of the Surrey Commercial Docks. During the second half of the 19th century, the canal was used by the South Metropolitan Gas Company to supply coal to its gas works site on the Old Kent Road. The canal was also heavily used to move timber. The final 460m of the canal were abandoned in the 1940s, and had been filled in by 1960. The timber trade to the docks ceased in the early 1970s, resulting in the docks closing and the canal being filled in.	
11	Howland Manor, Greenland Dock, Surrey Docks The site of a 17th century Manor house belonging to the Howland family. William Duke of Bedford constructed the Howland Great Wet Dock on the site in AD 1696–1700. An Act of Parliament vested property in the parish, which had belonged to the Howland family, in trustees, for the purpose of raising funds for its construction. In 1725 the dock was leased by the South Sea Company, and it was re-named the Greenland Dock.	090754
12	Plough Way, Southwark During excavations in 1867 for warehouses and a dock beside Plough Way, an earthenware vase was found containing coins from the Hadrianic period (AD 117–138). The hoard was found 5ft below the ground (*c.* –0.0m OD) on a bed of silty sand which lay above gravels. It was sealed by alluvial deposits.	090273 MLO11173
13	Chilton Grove, Southwark A Roman pot was discovered containing 269 coins of the Emperors Honorius and Arcadius (AD 388–402).	090274 MLO4257
14	Southwestern end of Greenland Dock, Surrey Docks A Palaeolithic struck flint (MLO15696) was discovered by chance.	091092 MLO15696
15	Greenland Dock, Surrey Docks, Southwark The site of a post-medieval warehouse noted on the GLEHR.	MLO74777
16	Plough Way, Lewisham The find spot of unclassified post-medieval remains, perhaps a floor surface or building material. No further information.	071048 MLO8188
17	Capstan, Greenland Dock. Grade II listed.	1385941

HEA Ref no.	Description	Site code/ HER ref/ List Entry Number
18	Surrey Docks The site of a late 17th-century dock complex (MLO12686), redeveloped in 1996.	213291 MLO12686
19	28–40 Croft Street, SE8 A MoLAS evaluation in 1994 revealed a sequence of peat deposits and timbers, dated to the turn of the millennium, which were overlain by sands and alluvial deposits. The site was covered in 19th-century concrete surfacing (GLHER 071277).	CRF94 071349
20	Cobbled hardstanding located immediately northeast of the site, noted on the MOLA site visit in 2011. Dating to the 19th century, this is a remnant of the former industrial area at this location.	---
21	Southwest of Earl Pumping Station A row of 2-storey terrace cottages, dating to the mid 19th century, noted on the MOLA site visit in 2011. The buildings are not statutorily or locally listed.	---

E.2 Site location, topography and geology

Site location

E.2.1 The site lies 520m west of the River Thames. The Surrey Docks lie 180m to the north and 220m to the east. Historically the site lay between, and on the outskirts of, the ancient parishes of St. Nicholas Deptford, to the south, and St. Mary Rotherhithe, to the north, and within the county of Surrey.

Topography

E.2.2 The ground level of the site and the surrounding area is fairly flat, at 101.4–102.0m ATD (above Tunnel Datum; the equivalent of 1.4–2.0m Ordnance Datum). There is a very gentle, imperceptible, slope down towards the River Thames, from 102.0m ATD around 85m to the southwest, to 100.0m ATD by the River Thames, 520m to the northeast. Across the site, levels do not vary considerably. Across the northern part of the site, occupied by the pumping station, ground level lies at between 101.7–102.0m ATD, with slightly lower ground levels of between 101.5–101.9m ATD in the southern part of the site. There is no visible indication of any artificial raising or levelling in relation to the construction of the pumping station.

Geology

E.2.3 The site is situated in an area of alluvial silts and clays overlying sand and gravel deposits associated with the River Thames floodplain[1]. Near the site are two noteworthy ancient topographical features: a tributary to the Thames known as the Earl's Sluice and an ancient depression feature in the landscape known as the Bermondsey Lake. The Earl's Sluice, now long redundant as a stream, was enclosed as an east-west sewer across the centre of the site in the early 19th century (Barton N, 1992)[2]. The Sluice was originally part of a much greater, older, west-east flowing tributary channel to the Thames originating in Bermondsey as indicated by the pattern of alluvium locally[3]. The former Bermondsey Lake is part of this ancient topography: a deep hollow in the surface of the gravels located some 700m to the west of the site; in which laminated calcareous and organic deposits were found dating to the Windermere Interstadial, c. 13–14,000 years ago (Thomas, C and Rackham, J., 1996)[4]. The lake has not been fully demarcated and as it lies near the confluence of the Earl Sluice and the Thames, in the wide area mapped simply as alluvium by the BGS, it could feasibly extend to, or at least influence, the site.

E.2.4 Examination of British Geological Survey borehole data and monitored geotechnical work on and around the site indicates that beneath the alluvium is an undulating gravel subsurface topography, with the site itself being positioned on gravel high points at 97.6m ATD[5] and 98.3m ATD (SR6459).

E.2.5 Areas of high gravel are important as they could have formed a focus for prehistoric human activity given their relationship to the river and the resources it provides, prior to rising water levels and the deposition of alluvium. Soils and vegetation are likely to have developed here, providing valuable evidence for the reconstruction of the early Holocene (10,000BP) environment. Overlying the gravel, the alluvium consists of 'clays and gravels' to 98.7m ATD, 'grey clay and wood' to 99.7m ATD and 'peaty clay' to 101.8m ATD[6]. Towards the centre of the site, one historic borehole (GLC1469 BH2) does suggest the surface of the gravels may drop to c. 90.0m ATD. Overlying the gravel are variable 'wetland peats to fluvial sands'. The surface of the peats and organic clays were previously encountered from c. 100.0m ATD (SR6459). The fluvial deposits were recorded from 98.6m ATD (SR4025) to 97.8m ATD (GLC1469 BH2). These sand and peat deposits are sealed by alluvium. The alluvium consists of 'upper weathered and lower grey clays', encountered from c. 98.0 to 100.0m ATD (SR4118 and SR6459).

E.2.6 Above these deposits is c. 1.0m of made ground, which forms the ground surface. The clay and gravel is likely to represent the prehistoric soil, which would have formed a dry landsurface, probably prior to the Bronze Age. Of greatest importance in geoarchaeological terms are the grey clay and wood and the peaty clay layers, which are likely to have better preservation of organic remains than the underlying soil. Given that the nearby sites of 28–40 Croft Street (**HEA 19**) and 71–97 Plough Way (**HEA 4**) as well as sites associated with the Bermondsey Lake such as Bramcote Grove (Thomas, C and Rackham, J., 1996)[7] had important

prehistoric timbers and other finds in similar layers, the underlying alluvium on the site has considerable palaeoenvironmental and archaeological potential.

E.3 Past archaeological investigations within the assessment area

E.3.1 No archaeological investigations have been carried out on the site. However, several have been carried out in the vicinity. The results of previous evaluations have revealed evidence of the development of the natural landscape in which the site is situated. Finds of prehistoric, Roman, and post-medieval remains, whilst relatively scarce, have contributed to understanding of the area in these periods. The nature of the early and later medieval activity in the area is less clear, as no known archaeological remains have been recorded in its immediate vicinity.

E.3.2 To date, nine investigations have been carried out within the assessment area. The three closest to the site (**HEA 2, 3** and **19**) are all located on Croft Street, within 90m of the site. Each recorded a geological make up of natural alluvium overlying gravel. An evaluation carried out at 28–40 Croft Street (**HEA 19**) revealed prehistoric peat deposits and timbers, whilst an evaluation at 44–48 Croft Street (**HEA 2**), and a watching brief at Crofter's Court (**HEA 3**), revealed no noteworthy archaeological remains. To the east of the site, evaluations at East Country Yard (**HEA 6**), Marine Wharf (**HEA 7**), and a watching brief carried out at Grove Street (**HEA 8**), revealed mainly modern deposits and possible post-medieval features. To the south of the site, an evaluation at Deepway, 85 Evelyn Street (**HEA 9**), recorded mainly Victorian and modern features.

E.3.3 The results of the investigations, along with other known sites and finds within the assessment area, are discussed by period, below.

E.4 Archaeological and historical background of the site

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

Prehistoric period (700,000 BC–AD 43)

E.4.2 There are no known archaeological remains dated to this period within the site.

E.4.3 Previous investigations at Plough Way (**HEA 4**) and Lower Road (**HEA 5**), c. 100m to the northwest and 195m to the west of the site respectively, have revealed prehistoric remains and suggest that by the Bronze Age much of the area of the site lay within intertidal marshes, prone to flooding,

although the area was part of a mosaic of wetland environments, with scattered islands of dry ground between a landscape of braided river channels from the early prehistoric (the early Mesolithic). Activity, perhaps related to hunting and fishing, may have been concentrated in drier, localised areas on the margins of the marshes or on islands within it. As the site was located on an area of high gravel, it may have formed a focus for prehistoric activity, particularly during periods of relatively low water levels. The marshland would have been exploited for a number of predictable resources, including, from the late prehistoric, reeds (for basketry), clay (pottery), fish, game and salt, which could be extracted through evaporation. Timber trackways have also been recorded in prehistoric marsh environments which would have provided access across waterlogged areas.

E.4.4 An evaluation of two trial trenches, carried out in 1996 at 71–97 Plough Way, (**HEA 4**), c. 100m to the northwest of the site, recovered a residual prehistoric struck flint, located within a waterlogged peat deposit. There were no signs of cut features or flint working *in situ*, and the undisturbed nature of alluvial build-up above the peat layer suggested the land surface at this location may have been too wet for habitation. A struck flint, also probably residual, and dated to the Palaeolithic period, was discovered c. 215m to the north of the site, at the southwestern end of Greenland Dock (**HEA 14**).

E.4.5 An evaluation, carried out in 1988 at 305–319 Lower Road, (**HEA 5**), c. 195m to the west of the site, revealed more conclusive evidence of prehistoric activity. Several undated pits, containing evidence of burning were discovered, along with five or six struck flints, on the edge of an undefined, weathered sand island. An evaluation, carried out in 1994 at 28–40 Croft Street, (**HEA 19**), recorded a sequence of peat deposits and timbers, dated to the turn of the BC/AD millennium, which were overlain by sands and alluvial deposits.

Roman period (AD 43–410)

E.4.6 There are no known archaeological remains dated to this period within the site. Recent investigations in the assessment area have revealed no evidence of Roman occupation. Rising water levels from the late prehistoric suggest that during the Roman period the area was prone to flooding and probably lay in open marshland. As such it would not have been suitable for settlement.

E.4.7 Within the assessment area, two Roman coin hoards have been discovered (**HEA 12** and **HEA 13**; see below). Such finds suggest dry, potentially habitable land existing to the north of the site. The area may have been exploited for a number of intertidal/marshland resources, in some places on an industrial scale (eg, pottery, kilns, fish processing etc). The projected line of the London-Dover road, known as Watling Street, is located c. 1.5km to the south of the site, and was probably the main focus of Roman settlement in the area to the south.

E.4.8 During excavations carried out in 1867 for warehouses and a dock near Plough Way, (**HEA 12**), c. 80m to the north of the site, an earthenware

vase was found containing 1300 coins dated to the Hadrianic period (AD 117–138). The hoard was found 1.5m below the ground (c. 99.0m ATD) on a bed of silty sand overlying natural gravels. Further to the north, at Chilton Grove (**HEA 13**), c. 215m from the site, another hoard was discovered during sewer excavations in 1946. This consisted of 269 coins, discovered in a pot.

E.4.9 Roman remains have been found on the Thames foreshore to the east and northeast of the site. An excavation at Rotherhithe Street, c. 1.6km to the north of the site, uncovered a substantial quantity of Roman finds, recovered from a sandy deposit overlying peat, including a coin, pottery, building materials (tile and cut stone) and animal bones, dated to around the 3rd century. The remains were well preserved and sealed by alluvium, which may indicate gradual silt deposition caused by subsequent flooding.

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

E.4.10 There are no known archaeological remains dated to this period within the site or assessment area. Previous investigations within the assessment area have revealed that following the Roman period there was a further rise in water levels which would have resulted in the floodplain to the south of the Thames becoming waterlogged. An evaluation carried out at Deepway, 85 Evelyn Street (**HEA 9**) c. 300m to the south of the site, revealed a sequence of fluvial deposits which may reflect this process. Flooding may explain the lack of archaeological evidence for Saxon activity in the area. Much of the area, including the location of the site, was marshland pasture throughout the period, with settlement located some distance to the north, in Rotherhithe, and south, in Deptford (both place names of Saxon origin).

E.4.11 The settlement at Rotherhithe was located on a higher and drier gravel island (eyot) which formed a gravel peninsula beside a great loop in the River Thames. The origins of the settlement at Rotherhithe are uncertain, but it is first mentioned in a charter of AD 898 and was probably a riverside maritime hamlet, probably centred on the later church of St Mary's Rotherhithe on the northern edge of the eyot, c. 1.4km to the northwest of the site. Later documentary sources suggest that the riverfront would have attracted activity such as fishing, and as a landing-place for boats.

E.4.12 The name Deptford, of Anglo-Saxon origin, refers to a deep ford crossing the River Ravensbourne (Gaimster M , 2005)[8]. The old Roman road which ran east-west across the parish, approximately on the course of modern New Cross Road, c. 2km to the south of the site, is likely to have continued in use as a route to Canterbury. A ford, and later a bridge, provided access across the river at the point just before it becomes tidal and widens into Deptford Creek, at the site of modern Deptford Bridge, c. 2.2km to the southeast of the site. Another Saxon settlement was Deptford Strand, in the area of St Nicholas' Church at Deptford Green, c. 1.6km to the southeast of the site.

Later medieval period (AD 1066–1485)

E.4.13 There are no known archaeological remains dated to this period within the site or assessment area. It is likely that during this period the marshland

occupying the site began to be drained and reclaimed for pastoral and agricultural use.

E.4.14 The site is located c. 1.4km from the location of the present 18th century church of the parish of St. Mary Rotherhithe. Documentary sources suggest that a church existed on this site from the 13th century onwards. The location of any manor house at this time is unknown, but may have been to the southwest of the church, on the site which was later occupied by Edward III as Rotherhithe Palace. The church and manor house would have formed the focus of the medieval village at Rotherhithe, the closest settlement to the site.

E.4.15 The landscape lay below high-water level, and was prone to periodic flooding – during the 13th century there were frequent notices of the necessity for embanking (Heard K and Goodburn D, 2003)[9]. Nevertheless, references to tenants, enclosures, reed-gathering, meadows, pastures and fisheries suggest that the area was economically useful, with occupation spreading along the riverfront (Victoria County History, 1912)[10]. It is likely that the site was used for similar purposes during this period, and the area reclaimed and drained.

E.4.16 The manor (estate) of West Greenwich (Deptford), bordering the site, continued to be held by the de Magminot family until 1191, when it passed to the de Say family and was given to the Knights Templar; it was later recovered by an exchange of land. The main settlement at Deptford Strand was focused on the church of St Nicholas, c. 1.6km to the southeast of the site. The manor house of Sayes Court lay to the northeast of the church, c. 1km to the southeast of the site.

Post-medieval period (AD 1485–present)

E.4.17 During the early post-medieval period the riverside area to the southeast and east of the site was occupied by docks. The area to the west of the docks, in which the site is situated, became increasingly urbanised in the 19th and early 20th centuries, with a number of industrial and residential buildings replacing open fields.

E.4.18 In 1696–1700, Howland Great Wet Dock was constructed on the site of the former Howland manorial estate (**HEA 11**), c. 260m to the north of the site. From the 1720s, Greenland whalers used the dock and substantial blubber boiling houses were built to produce oil on the south side (Victoria County History, 1912)[11]. In 1725, the dock was leased by the South Sea Company and extensive use by whaling ships led to its being re-named Greenland Dock. The dock is the oldest of London's riverside wet docks. The Greater London Historic Environment Record (GLHER) notes the site of an undated post-medieval warehouse (**HEA 15**), c. 220m to the northeast of the site, immediately to the south of the dock.

E.4.19 Rocque's map of 1746 (Vol 22 Plate E.1) shows the site as lying in an area of open fields, c. 385m to the west of the 'shipwrights' located on Grove Street, and the Upper Wet Dock (the current Greenland Dock), c. 220m to the northeast of the site. The area of the site is undeveloped pasture on reclaimed former marshland, which was drained following the construction of a series of drainage ditches across the area around the

site. 'Rogues Lane' to the north and 'Little Rogues Lane' to the south possibly followed the line of raised embankments across the former marsh, which formed part of flood management. The map shows the use of the Rotherhithe area, to the northwest of the site, for docks and riverside commerce.

E.4.20 Horwood's map of 1799 (Vol 22 Plate E.2) shows the site still within undeveloped land, immediately to the west of (outside the footprint of) West Pond, adjacent to the Surrey Canal (**HEA 10**). West Pond, along with East Pond, was dug in c. 1802 and had been infilled by 1862. Based on an evaluation carried out at Marine Wharf (**HEA 7**) where deposits related to the infilling of the pond were discovered, it was probably located further east than is shown on Horwood's map (ie further away from the site). The Earl's Sluice drain crosses the middle of the site running east to west. This is now contained within a modern sewer pipe.

E.4.21 The Surrey Canal was built in 1801–1807, between Rotherhithe and Mitcham. The canal lies c. 85m to the east of the site. It connected to the Thames by a lock. Although the site itself is undeveloped, houses have begun to be built c. 60m to the west, and the land is now bounded by the Surrey Canal to the east, 'Windmill Lane', leading to the Victualling Office, c. 130m to the south, and the 'Road to Greenland Dock' (named 'Commercial Dock' on Horwood's map), c. 220m to the northeast. In 1806, the dock was sold to William Richie, a Greenwich timber merchant and founder of the Commercial Dock Company (1807). The Company and its rivals continued to build a series of additional docks and yards to the north of Greenland Dock in the 19th century (Rotherhithe Guide , 2011)[12].

E.4.22 Greenwood's map of 1824–26 (not reproduced) shows no change within the site or the immediate vicinity, although Rogues Lane to the north is now named 'Plough Lane'. The Ordnance Survey 1st edition 25" map of 1862 (Vol 22 Plate E.3) shows considerable urban and industrial development within the site and its surrounding area. The northern part of the site is now occupied by terraced houses and yards fronting onto Chilton Street and backing onto the Earl Sewer. The southwestern corner of the site is undeveloped land. The southeastern corner is part of a 'Tar Pitch, Naphtha and Creosote Works' that extends to the south, beyond the site. The tar works to the east and a timber yard to the southeast, made up a large part of the area surrounding the site. The map also shows the development of the railways in the area. The London Brighton and South Coast Railway line is located c. 170m to the south of the site, and the East London Railway c. 415m to the west. Several smaller rail lines branch off from these to the surrounding commercial docks and yards. Areas between the docks and yards, formerly open land, are now occupied by terraced houses. To the east, on the riverbank, South Dock, c. 210m to the east of the site, has been constructed to the south of Greenland Dock. In 1865, the Commercial Dock Company merged with Surrey Docks to form the Surrey Commercial Docks (**HEA 18**), which came to control around 80% of London's timber trade (London Docklands Development Corporation, 2011)[13].

E.4.23 The Ordnance Survey 2nd edition 25" map of 1896 (Vol 22 Plate E.4) shows no change other than additional terraced housing in the southwest part of the site (formerly open land). The two-storey houses have since been demolished within the site but are still extant immediately south (**HEA 21**). Lower Road, c. 210m to the west of the site was now a main tramline, with a tramway depot c. 240m to the southwest of the site. Earl's Sluice has now been covered over.

E.4.24 The Ordnance Survey 3rd edition 25" map of 1909 (Vol 22 Plate E.5) shows no change other than the former tar works is no longer extant and is now occupied by the northern end of an athletics ground. Some of the buildings formerly occupying the southeastern corner of the site have been cleared, while some remain extant and presumably disused. By this time Greenland Dock had been greatly extended to the west, and had more than doubled in length and depth, making it the largest in London. A Grade II listed capstan (**HEA 17**), c. 350m to the north of the site, dated to c. 1898, is located at the northern end of the dock. Capstans were rotating machines used to apply force to ropes and cables, for loading and unloading ships.

E.4.25 The London County Council Bomb Damage Maps of 1939–1945 (not reproduced) show minor impact damage to most of the terraced houses situated on the site, with more severe (but repairable) damage to those on the western side.

E.4.26 The revised edition Ordnance Survey 25" map of 1947 (Vol 22 Plate E.6) shows considerable change within the area of the site. It has been cleared of houses and the northeastern part of the site is now occupied by the Thames Water Earl Pumping Station (**HEA 1**), with two tanks situated immediately to the south (Vol 22 Plate E.8). The pumping station was located immediately north of the line of the sewer. The outline of the proposed development site is now clearly defined, bounded by Chilton Grove to the north, Yeoman Street to the east, terraced houses immediately adjacent to the southwest corner, and a concrete works in place of the former athletic ground at the southeast corner.

E.4.27 The Ordnance Survey 1:1250 scale map of 1954 (Vol 22 Plate E.7) shows the site and the buildings occupying it in their current layout. Later maps (not reproduced) show no noteworthy changes to the site after this date.

The current site

E.4.28 The northeastern part of the site is currently occupied by the Thames Water Earl Pumping Station (**HEA 1**; Vol 22 Plate E.9–Vol 22 Plate E.11). The rest of the site is made up of industrial land, occupied by modern light industrial units/offices. Approximately one-third of the site is open hardstanding/tarmac. The pumping station is a T-shaped, single-storey 1940s municipal structure formed of red brick in header–stretcher formation with Art Deco motifs. It is flat roofed with stepped elevations. Fenestration consists of a series of tall, narrow windows, often in pairs, with concrete lintels and two tier tiled sills. The windows on the T-shape at the rear (southeast and southwest) of the building are of a smaller scale but are constructed in the same manner with a low plinth running around

the building. Some of the windows to the rear are blind. Access into the building is via a large two-leaf door with concrete surround on the northwest, northeast and southwest elevations. In the centre of the northeast elevation there is a rectangular concrete plaque with the words 'EARL PUMPING STATION' depicted in copper lettering above the doors. The building is surrounded by a low red brick wall with piers on the corners and low railings, which appear original. A further web-fencing has been installed alongside, topped with barbed wire.

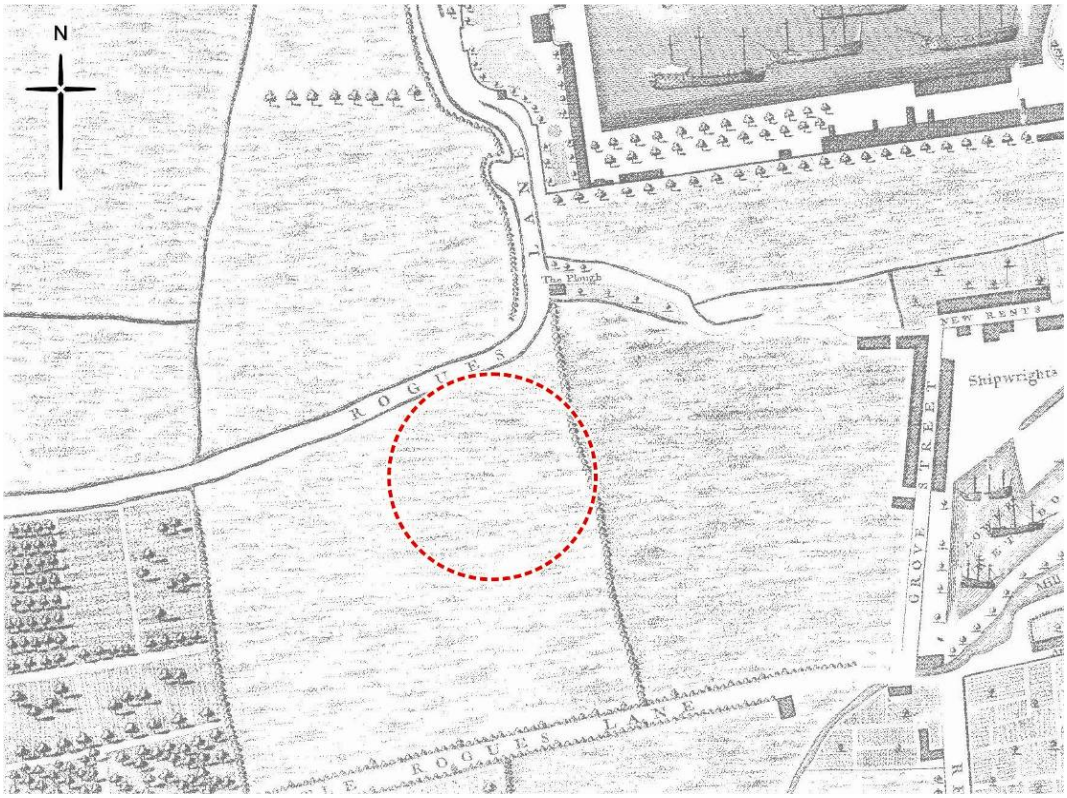
E.4.29 Internally, the pumping station contains a 13 bay camber lattice girder truss supporting a concrete form roof (Vol 22 Plate E.9), which is an unusual design for this period. The building also retains some original fixtures and fittings related to the first occupation of the building (Vol 22 Plate E.10).

E.4.30 The building is surrounded by a low red brick wall with piers on the corners and low railings, which appear original. A further web-fencing has been installed topped with barbed wire.

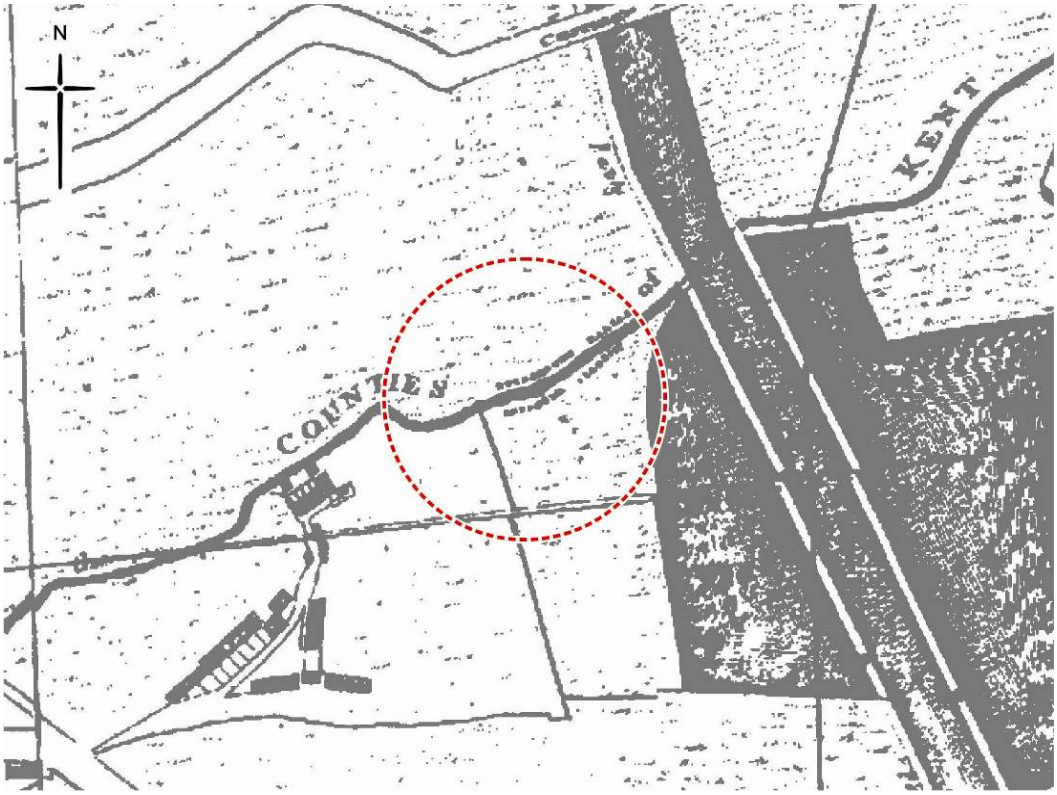
E.4.31 Within the area there is also a series of modern, low-set out-buildings relating to a water/sewage tank (Vol 22 Plate E.11). Five further buildings are located to the rear (south) of the pumping station. These consist of a steel-framed, covered shed, currently used for storage, fronting Croft Street, with hard-standing to the rear; two small yellow stock-brick structures fronting Yeoman Street and a canopy and further building in the centre of the group, whose position and condition are currently unknown.

E.5 Plates

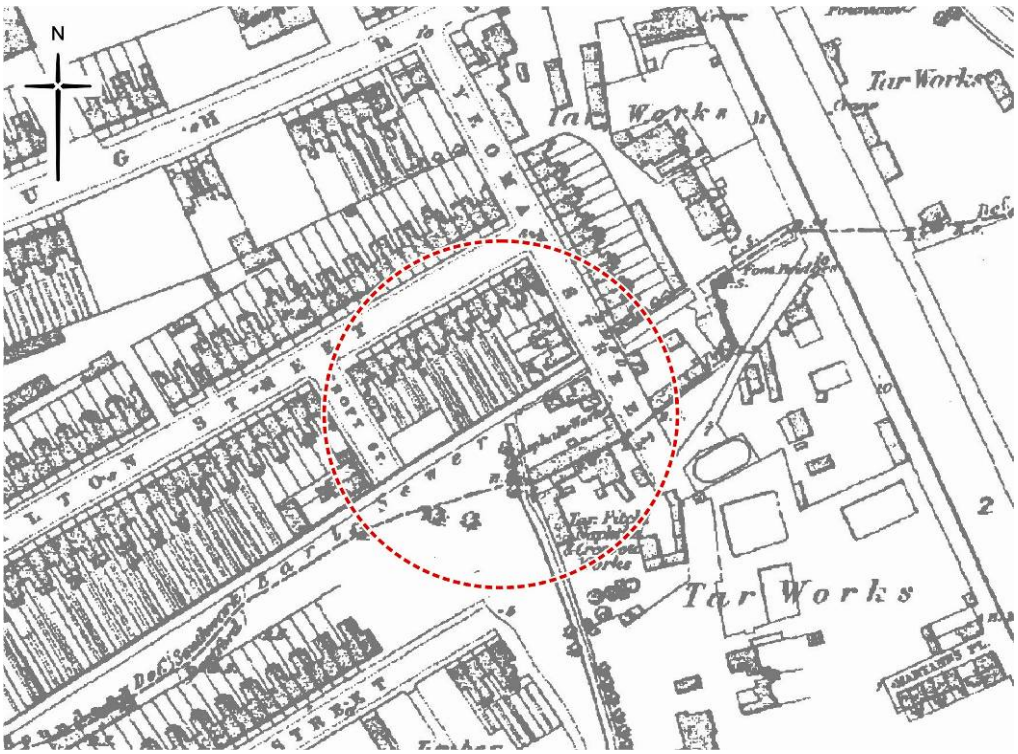
Vol 22 Plate E.1 Historic environment – Rocque's map of 1746



Vol 22 Plate E.2 Historic environment – Horwood's map of 1799



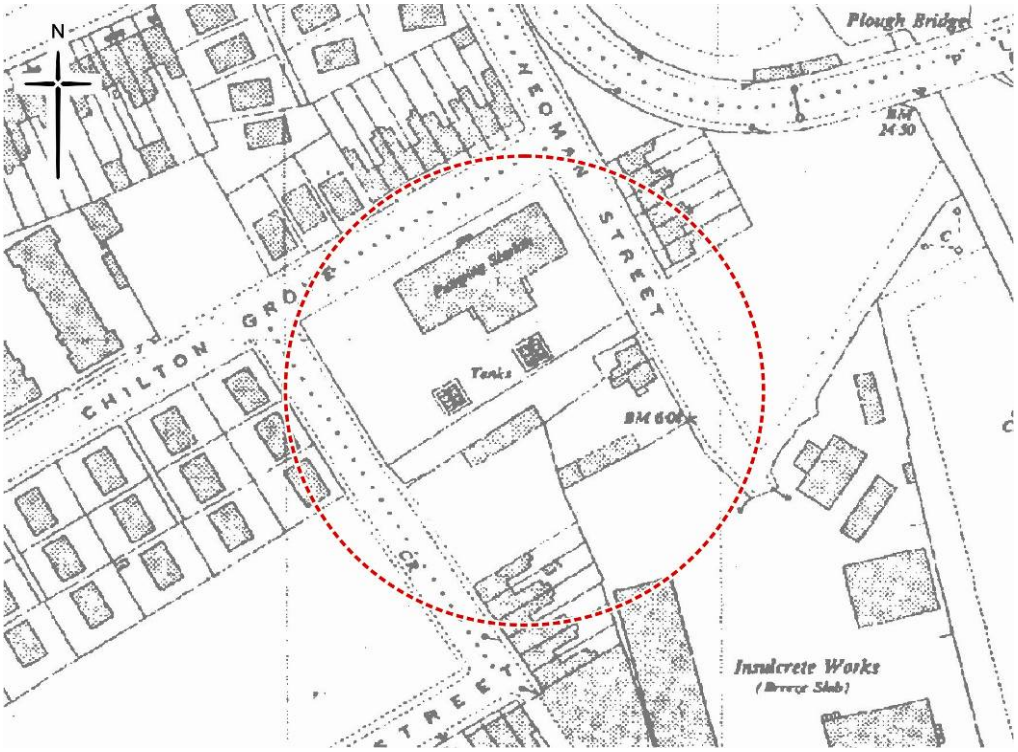
Vol 22 Plate E.3 Historic environment – Ordnance Survey 1st edition 25" : mile map of 1862 (not to scale)



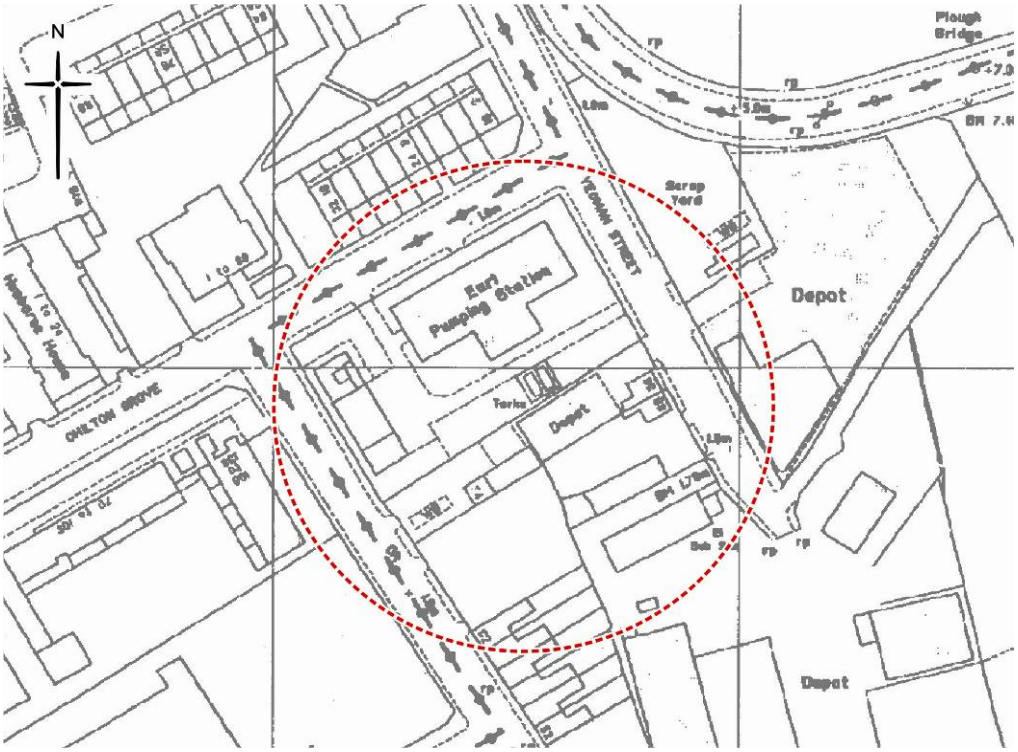
Vol 22 Plate E.4 Historic environment – Ordnance Survey 2nd edition 25" : mile map of 1896 (not to scale)

Vol 22 Plate E.5 Historic environment – Ordnance Survey 3rd edition 25" : mile map of 1909 (not to scale)

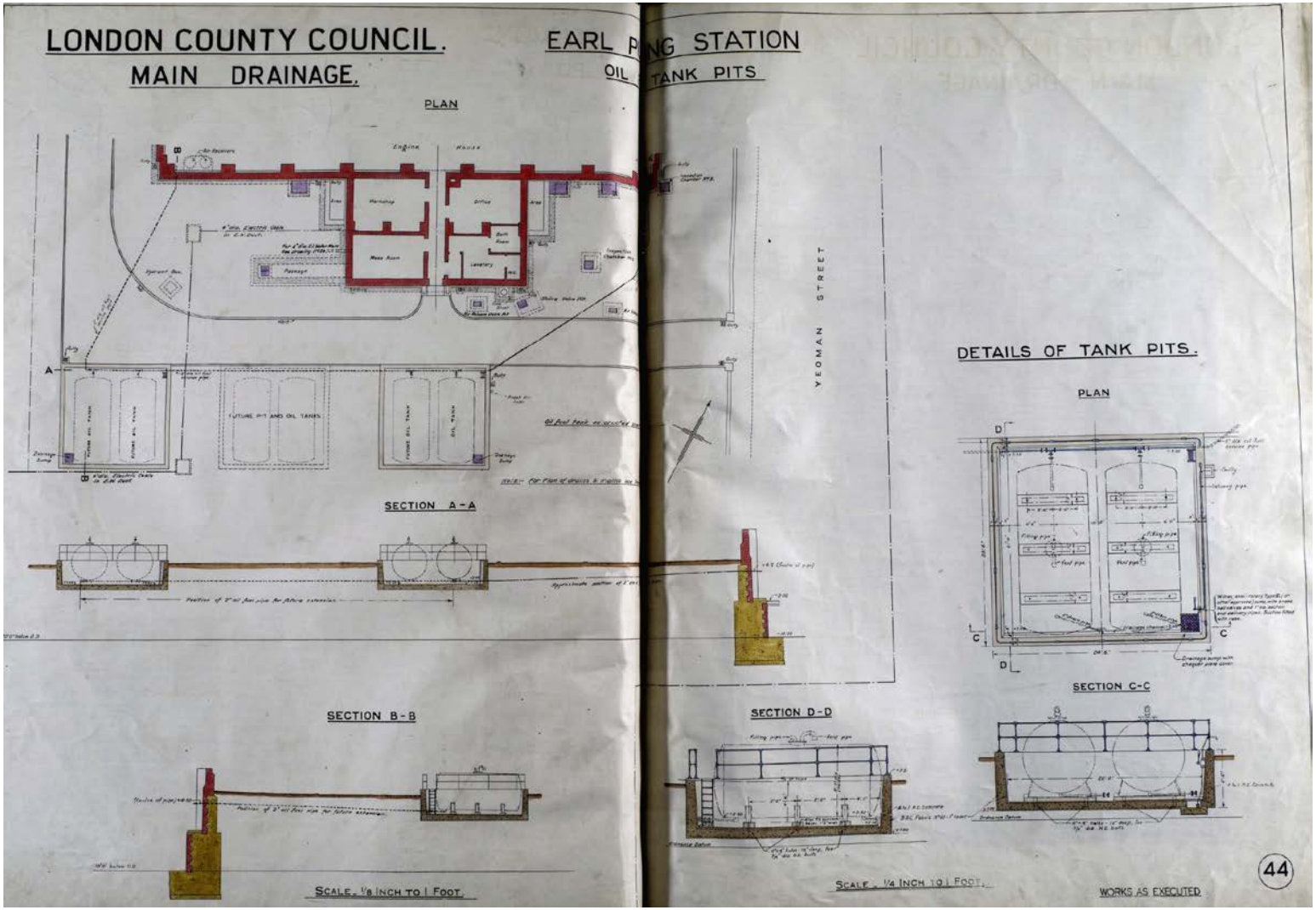
Vol 22 Plate E.6 Historic environment – Ordnance Survey 25" : mile map of 1947 (not to scale)



Vol 22 Plate E.7 Historic environment – Ordnance Survey 1:1250 scale map of 1954 (not to scale)



Vol 22 Plate E.8 Historic environment – Thames Water 'Abbey Mills Books' Earl Pumping Station

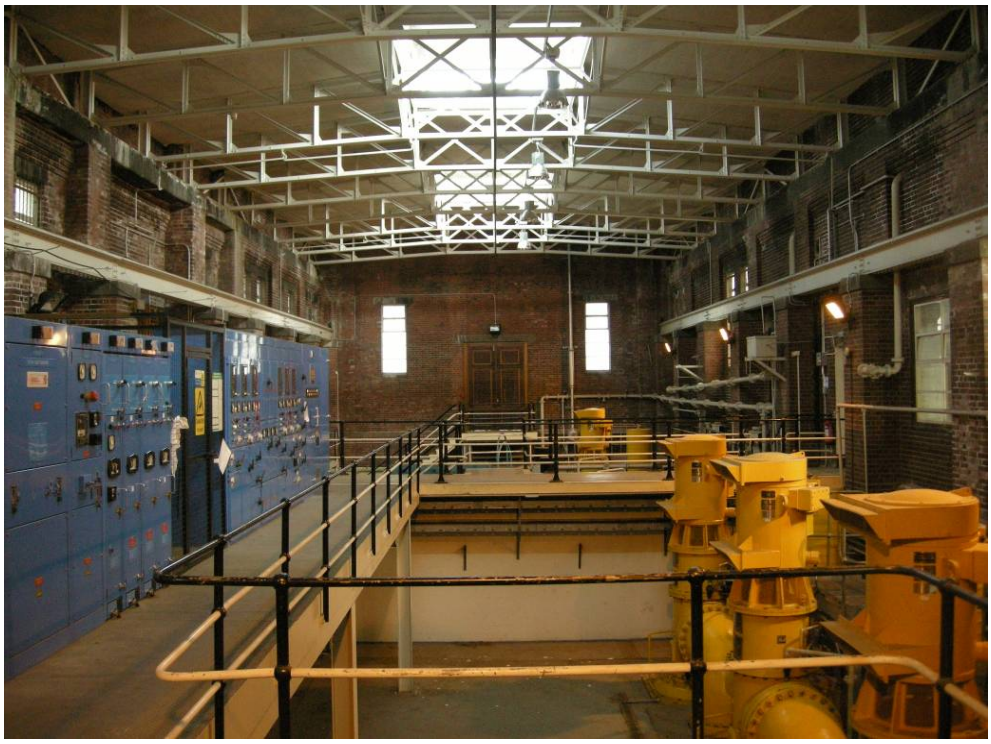


No. 151 archive plan (1939–43) showing details of tank pits south of the pumping station

Vol 22 Plate E.9 Historic environment – current setting of Earl Pumping Station

The corner of Chilton Grove and Croft Street looking east; standard lens; MOLA; 28th March 2011

Vol 22 Plate E.10 Historic environment – interior of Earl Pumping Station



Showing camber roof and lattice girder truss; southwest corner of the building looking northeast; MOLA; 28th March 2012

Vol 22 Plate E.11 Historic environment – view of work room

Showing original tool board, door and door frame dating to initial construction date: standard lens: MOLA: 28th March 2012

Vol 22 Plate E.12 Historic environment – view of the rear of Earl Pumping Station

The west of the site, looking northeast; standard lens; MOLA; 28th March 2012

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[1] British Geological Survey solid and drift geology digital data.

[2] Barton N. *The Lost Rivers of London.* Historical Publications, London (1992).

[3] British Geological Survey solid and drift geology digital data.

[4] Thomas, C and Rackham, J. 'Bramcote Green, Bermondsey: a Bronze Age trackway and palaeoenvironmental sequence' in *Proceedings of the Prehistoric Society* Vol 61 (1996), 221–253; Halsey, C. *Varcoe Road, London SE16: a geoarchaeological assessment* MOLA unpublished report (2010).

[5] British Geological Survey borehole BH TQ37NE1980.

[6] British Geological Survey.

[7] Thomas, C and Rackham, J. 'Bramcote Green, Bermondsey: a Bronze Age trackway and palaeoenvironmental sequence' in *Proceedings of the Prehistoric Society* Vol 61 (1996), 221–253.

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[10] Victoria County History, *A History of the County of Surrey*, Volume 4, 83–92 (1912).

[11] Victoria County History., *See citation above.*

[12] Rotherhithe Guide website; http://www.southlondonguide.co.uk/rotherhithe/history.htm ; accessed March 2011.

[13] London Docklands Development Corporation website: http://www.lddc-history.org.uk/surrey/index.html; accessed 21/02/2011.

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.22**

Volume 22: Earl 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 22 Earl Pumping Station appendices

Appendix F: Land quality

List of contents

Page number

List of tables

Page number

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Appendix F: Land quality

F.1 Baseline report

F.1.1 Baseline data is sourced from:

a. walkover survey

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

c. stakeholder consultation

d. the initial results from a preliminary intrusive ground investigation.

Site walkover

F.1.2 A site walkover was undertaken on 9th November 2010.

F.1.3 The aim of the walkover survey was to inspect the condition of the site and surrounding areas in order to identify evidence of historic or ongoing contamination sources, as well as any nearby sensitive receptors.

F.1.4 The site is formed by the existing Earl Pumping Station - a large brick building, a small electricity substation and a small pump house; together with two industrial units to the south.

F.1.5 No access was available to the southern part of the site at the time of the walkover survey, but it is understood that Japanese Knotweed was identified in one of the industrial units.

F.1.6 Off- site there are a number of industrial/commercial premises.

F.1.7 No ongoing sources of contamination were observed within the site boundaries or in the surrounding area.

F.1.8 Detailed site walkover notes are provided in Vol 22 Table F.1 below.

Vol 22 Table F.1 Land quality – site walkover report

Item (Site ref: PLM1X, Earl Pumping Station)		Details
Date of walkover	9th November 2010	
Site location and access	Site comprised of Thames Water operational land and industrial land located between Yeoman Street and Croft Street, consisting of storage sheds, containers and vehicles. Access across the pump station site exterior. No access to industrial land to south.	
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.
Neighbouring site	North	Residential properties situated

Item (Site ref: PLM1X, Earl Pumping Station)		Details
use (in particular note any potentially contaminative activities or sensitive receptors)		on Chilton Grove.
	South	A goods depot is located adjacent to the south of the site, which is in turn bordered by a private parking area with an electrical substation.
	East	A goods depot and storage yards and sheds located on Yeoman Street.
	West	Residences situated on Croft Street.
Site buildings	Record extent, size, type and usage. Any boiler rooms, electrical switchgear?	The site is occupied by a large brick building, a small electricity substation and a small pump house. The southern part of the site is formed from unspecified industrial units of brick and corrugated steel construction.
Surfacing	Record type and condition	Site covered entirely in hardstanding
Vegetation	Any evidence of distress, unusual growth or invasive species such as Japanese Knotweed?	No vegetation observed. (NB: It is understood that Japanese Knotweed is present in the southern part of the site, which was not accessed during the site walkover).
Services	Evidence of buried services?	None observed
Fuels or chemicals on-site	Types/ quantities?	None observed
	Tanks (above ground or below ground)	It is understood from Thames Water personnel that the site would previously have included diesel tanks associated with back-up power generation.
	Containment systems (eg, bund, drainage interceptors). Record condition and standing liquids	None observed
	Refill points located inside bunds or on impermeable	None observed

Item (Site ref: PLM1X, Earl Pumping Station)		Details
	surfaces etc?	
Vehicle servicing or refuelling onsite	Record locations, tanks and inspection pits etc.	None observed
Waste generated/stored onsite	Adequate storage and security? Fly tipping?	None observed
Surface water	Record on-site or nearby standing water	None observed
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 within the site during the survey. However no access to buildings and industrial activities would have occurred on land comprising southern extent of the site.
Summary of potential contamination sources		Presence of electrical substation and sewage pumping station on-site. Widespread industrial uses of surrounding area to the south, east and west including warehousing, depots, etc.
Any other comments	Eg access restrictions/ limitations	No

Review of historical contamination sources

F.1.9 Historical mapping (dated between 1874 and present day) was reviewed to identify potentially contaminating land-uses at the site and within the 250m assessment area.

F.1.10 Vol 22 Table F.2 tabulates the potentially contaminating land-uses, inferred dates of operation and typical contaminants associated with theland-uses in question. Potential contaminants are sourced from CLR8: *Potential contaminants for the assessment of land* (Defra and EA, 2002)[1] and former Department of the Environment industry profiles (Department of the Environment , 2011)[2].

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

F.1.12 Items listed in the table are also shown on Vol 22 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 22 Appendix E.

Vol 22 Table F.2 Land quality – potentially contaminating land-uses

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item1,2
On-site			
1	Sewage pumping station	c late1940s/1950-present	Heavy metals, arsenic, free cyanide, nitrates, sulphates, sulphides, asbestos, oil/fuel hydrocarbons, chlorinated aliphatic hydrocarbon, chlorinated aromatic hydrocarbons, polychlorinated biphenyls (PCBs), pathogens (eg, faecal coliforms)
2	Asphalt/naphtha works	c1874-c1880	Heavy metals, arsenic, sulphides, asbestos, acetone, oil/fuel hydrocarbons, polyaromatic hydrocarbons (PAHs), PCBs, tars, cyanide and related compounds
Off-site			
3	Commercial Basin (190m northwest)	c1874	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphides, sulphates, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, alpha, beta, gamma hexachlorocyclohexane
4	Tar works and associated tanks (15m southeast and 100m northeast)	c1874-c1896	Heavy metals, arsenic, boron, sulphates, phenol, oil/fuel hydrocarbons, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
5	(a) Floor cloth manufacturer	c1874–c1880	Heavy metals, arsenic, boron, nitrates, sulphates, sulphides,

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item1,2
	(185m southwest)		asbestos, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs
	(b) Engineering works (185m southwest)	c1970	Heavy metals, arsenic, boron, nitrates, sulphates, sulphides, asbestos, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs
6	(a) Timber yard (115m east)	c1874–c1970	Heavy metals, arsenic, boron, sulphates, phenols, acetone, aromatic hydrocarbons, PAHs, cresols
	(b) Railway yard (115m east)	c1896–c1967	Heavy metals, sulphates , asbestos, PAHs, chlorinated aliphatic hydrocarbons, PCBs
7	Timber yard and saw mill (35m south)	c1896-present	Heavy metals, arsenic, boron, sulphates, phenols, acetone, aromatic hydrocarbons, PAHs, cresols
8	Dock (205m northeast)	c1896-present	Heavy metals, arsenic, asbestos, phenols, oil/fuel hydrocarbons, PAHs, PCBs, sulphides, sulphates, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, alpha, beta, gamma hexachlorocyclohexane
9	India Rubber Works (110m south)	c1896	Zinc, sulphur, sulphates, phenol, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs
10	Whiting Works (145m southeast)	c1896-c1972	Heavy metals, arsenic, boron, free cyanide, nitrates, sulphates, sulphide, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
11	Commercial Yard and warehouse (120m northwest)	c1896-c1985	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds. heavy metals and

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item1,2
			asbestos
12	Canal lock (165m north)	c1916-present	Heavy metals, arsenic, asbestos, phenols, oil/fuel hydrocarbons, PAHs, PCBs, sulphides, sulphates, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, alpha, beta, gamma hexachlorocyclohexane
13	Warehouse (165m northeast)	c1916-c1981	Contents unknown
14	Swedish Yard (115m northeast)	c1916-c1985	Heavy metals, sulphates , asbestos, PAHs, chlorinated Aliphatic Hydrocarbons, PCBs
15	(a) Timber yard (202m southeast)	c1949-c1960	Heavy metals, arsenic, boron, sulphates, phenols, acetone, aromatic hydrocarbons, PAHs, cresols
	(b) Works (202m southeast)	c1960-c1970	Heavy metals, arsenic, boron, nitrates, sulphates, sulphides, asbestos, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs
16	Canon Wharf timber yard and associated mills and works (120m south)	c1950-c1970	Heavy metals, arsenic, boron, sulphates, phenols, acetone, aromatic hydrocarbons, PAHs, cresols
17	Insulcrete works (breeze blocks) (70m southeast)	c1950-present	Heavy metals, arsenic, sulphide , asbestos, acetone, oil/fuel hydrocarbons, PAHs, PCBs
18	Surrey Commercial Docks (160m northeast)	c1970-c1985	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphides, sulphates, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, alpha, beta, gamma hexachlorocyclohexane

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item1,2
19	Laundrette (120m south)	c1985	Heavy metals, arsenic, selenium, free cyanide, nitrates, sulphates, asbestos, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs
20	Engineering works (205 southwest)	c1970	Heavy metals, arsenic, boron, nitrates, sulphates, sulphides, asbestos, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs
21	Transport depot and garage (adjacent southwest)	c1970	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds, heavy metals and asbestos
22	Timber yard (5m east)	c1970	Heavy metals, arsenic, boron, sulphates, phenols, acetone, aromatic hydrocarbons, PAHs, cresols
23	Historical railway (Deptford Wharf Branch) (205m south)	c1916	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds, heavy metals and asbestos
24	Whiting Works (220m southeast)	c1916	Heavy metals, arsenic, boron, free cyanide, nitrates, sulphates, sulphide, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
25	Primus works (engineering) (75m south)	c1950	Heavy metals, arsenic, boron, nitrates, sulphates, sulphides, asbestos, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, PCBs

On-site

F.1.13 The northern section of the Earl Pumping Station site was developed with housing during the late 19th Century, as shown by the earliest map reviewed. The southern section was shown to be occupied by part of a large tar works which extended beyond the southern boundary. The site area is specifically labelled as tar, pitch, naphtha, and creosote works.

F.1.14 The pumping station was constructed prior to c1950 and is marked as having included tanks (known to be diesel tanks) which were located along the southern boundary of the pumping station. The southern section of the site and previously marked athletics ground were redeveloped as an insulcrete (concrete block) manufacturing site at this time.

F.1.15 By the 1960s a garage (possibly motor vehicle repair) had been constructed in the southwestern section of the site. Land on the opposite side of Croft Street was first developed for a depot at this time. This was subsequently labelled as a transport depot.

Off-site

F.1.16 Within the 250m assessment area, the earliest map reviewed from the late 19th century indicates substantial timber works and tar works that existed to the south and east of the Earl Pumping Station site. The Grand Surrey Canal was present approximately 90m to the east.

F.1.17 By the 1910s much of the adjoining tar works was redeveloped as an athletics ground.

F.1.18 By the mid 1980s, the railway yard which existed since the 19th century had been converted to a warehouse and a large laundry had been built 200m south of the site. The concrete works, transport depot, pumping station, docks and timber yard all still existed.

F.1.19 In the present day, the concrete works, transport depot, pumping station, docks and timber yard all still exist though it is noticeable that there are many more residential properties in the surrounding area, particularly along the edge of the docks.

Geology

F.1.20 Data from the Thames Tideway Tunnel project ground investigation indicates the anticipated geological succession, as summarised in Vol 22 Table F.3 below.

Vol 22 Table F.3 Land quality – anticipated site geology

Geological Unit/ Strata	Description	Approximate depth below ground level (m)
Made Ground	Varies	0.0-2.9
River Terrace Deposits	Medium dense to dense to dense sand and gravel (predominantly quartz sand and flint gravel).	2.9--8.1
Lambeth Group (Upnor Formation)	Dense silty glauconitic sand with bands of rounded black pebbles.	8.1--10.0
Thanet Sand Formation	Generally dense glauconitic silty fine sand with occasional rounded flint gravel. The Bullhead Beds mark the base of	10.0-14.80

Geological Unit/ Strata	Description	Approximate depth below ground level (m)
	the formation and comprise gravel and cobbles of flint.	
Seaford Chalk	Weak fine grained limestone with nodular and tabular flints.	14.8-50.8
Lewes Chalk		50.8-unproven

Unexploded ordnance

F.1.21 During World Wars I and II, the London area was subject to bombing. In some cases bombs failed to detonate on impact. During construction works Unexploded Ordnance (UXO) are sometimes encountered and require safe disposal.

F.1.22 A desk based assessment for UXO threat was undertaken for the Earl Pumping Station site, (see Vol 22 Appendix F.2). The report reviews information sources such as the Ministry of Defence, Public Records Office and the Port of London Authority.

F.1.23 The report establishes that there were numerous Luftwaffe targets in the area and that bomb strikes were recorded mainly to the north east and damage to properties within the site area. In addition a V1 strike is recorded approximately 50m west of the site.

F.1.24 Taking into account the findings of this study, known extent of the proposed works and that subsequent redevelopment works have taken place at the Earl Pumping Station site, it was considered that there is an overall low/moderate threat from UXO.

Thames Tideway Tunnel ground investigation data

F.1.25 This section summarises the ground investigation undertaken by the Thames Tideway Tunnel project.

F.1.26 In addition to the project-wide ground investigation, a supplementary investigation to gain additional information on geotechnical and hydrogeological properties and contamination was undertaken at Earl PS in 2012.

F.1.27 The boreholes (refs: CP6454, CP6455, CP6455A, CP6456, CP6456A, CP6456B, CP6458, CP6459, SA6450, SA6451, SA6452, SA6453, SA6453A, SA6460, SR4025, SR4118) are shown on Vol 22 Figure F.1.2 (see separate volume of figures).

Soil contamination

F.1.28 During intrusive site investigation visual and olfactory evidence of contamination was noted in several borehole locations. The table below summarises this information.

Vol 22 Table F.4 Land quality - summary of visual and olfactory contamination

Borehole location	Strata	Evidence of Contamination

Borehole location	Strata	Evidence of Contamination
CP6454	RTD TSF	Strong hydrocarbon odour, sheen and staining at 11m. Heavy hydrocarbon contamination observed at 13m
CP6458	ALL/RTD RTD/TSF	Slight hydrocarbon odour noted between 3 and 8m. Heavy hydrocarbon contamination observed on boundary strata boundary (~11.20m)
CP6459	RTD	Heavy hydrocarbon contamination observed at 10.4m
SA6450	RTD/TSF	Heavy phenol contamination including odour, sheen and staining at 11m
SA6451	RTD/TSF	Slight hydrocarbon odour noted from 7m to depth.
SA6453	RTD TSF	Hydrocarbon odour noted at 7m increasing with depth. Strong hydrocarbon odours and sheen noted at 13.5m
SA6460	RTD TSF	Hydrocarbon odour noted at 7m increasing with depth. Hydrocarbon sheen noted at 11.2m
SR4025	RTD/TSF	Strong phenolic odour, sheen and staining noted from 4.5m continuing to depth
SR4118	RTD	Phenolic odour noted at 6m. Heavy phenol contamination observed at 11m.
SR4118	TSF	Heavy phenol contamination observed between 14 and 16.5m.
SR6457	RTD TSF SCF	Slight hydrocarbon odour between 5 and 10m, notably increasing with depth. Heavy hydrocarbon contamination noted at 13.5m Slight hydrocarbon odour noted in Seaford Chalk between 20 and 38m.

F.1.29 Contamination sampling was undertaken in selected holes and based visual/olfactory evidence of contamination observed during fieldwork.

F.1.30 Samples were taken from immediately below hard cover, 0.5m depth, 1m depth and at 1m intervals in boreholes SA6450, SA6451, SR4025, SR4118, SA6453A, SR6457 and SA6460.

F.1.31 Sampling was scheduled by Thames Tideway Tunnel Design Team (TTTDT) and carried out by Environmental Scientific Group (ESG).

F.1.32 Soil samples from the strata encountered were analysed for the contaminants detailed in Vol 22 Table F.4.

Vol 22 Table F.5 Land quality - contamination suites

Heavy Metals	Arsenic, water soluble boron, cadmium, total & hexavalent chromium, copper, lead, mercury, nickel, selenium, zinc
Organics	Speciated polyaromatic hydrocarbons, total petroleum hydrocarbons with aromatic & aliphatic split, volatile organic compounds, semi-volatile organic compounds, total organic carbon and BTEX and MTBE.
Inorganics and other organics	Speciated phenols, poly chlorinated biphenyls, asbestos, free & total cyanide, thiocyanate, total phenols, ammoniacal nitrogen, sulphate, sulphide and sulphur

F.1.33 The results of the laboratory analysis were compared to widely used screening values which assess long term risk to human health for site end users in a commercial/light industrial setting.

F.1.34 Exceedances of these screening values are presented in Table F6.

Vol 22 Table F.6 Land quality - summary of soil assessment criteria exceedances

Determinand	Max (mg/kg)	Min (mg/kg)	Mean (mg/kg)	Location of maximum value	No. samples tested	UCL (mg/kg)	GAC* (mg/kg)	No > GAC	Pass/ Fail
Naphthalene	11800	0.09	718.1	SR4118, 17m	81	738.7	200[1]	13	***Fail***
1,2,4-Trimethylbenzene	440	0.001	21.8	SR4118, 17m	65	29.8	42[1]	5	**Pass**
Benzo[a]anthracene	571	0.1	41.9	SR4118, 17m	81	39.9	90[1]	4	**Pass**
Chrysene	478	0.1	35.9	SR4118, 17m	81	32.4	140[1]	4	**Pass**
Benzo[b]fluoranthene	293	0.2	24.6	SR4118, 17m	81	20.7	100[1]	4	**Pass**
Benzo[a]pyrene	205	0.15	17.8	SR4118, 17m	81	15.0	14[1]	8	***Fail***
Indeno[1,2,3-cd]pyrene	96.5	0.1	9.5	SA6460, 17m	81	7.5	60[1]	2	**Pass**
Dibenzo[a,h]anthracene	31.1	0.12	3.8	SR4118, 17m	81	2.3	13[1]	3	**Pass**
Aromatics >C10 - C12	25200	6.4	2262.7	SR4118, 17m	81	1277.7	17000[1]	1	**Pass**
Aromatics >C12 - C16	54200	4.69	3046.7	SR4118, 17m	81	3018.7	36000[1]	1	**Pass**
Aromatics >C16 - C21	48800	4.88	2435.5	SR4118, 17m	81	2790.5	28000[1]	1	**Pass**

Key: GAC – Generic Assessment Criteria, UCL – Upper Confidence Limit, SGV – Soil Guideline Value

[*1] LQM/CIEH GAC – light industrial/commercial screening value

F.1.35 As indicated in the table, the site has been impacted by several organic contaminants, notably various polyaromatic hydrocarbons (PAH), light to middle range petroleum hydrocarbons, and 1,2,4-Trimethylbenzene.

F.1.36 The highest concentrations of contaminants were found below 12m bgl in the northwestern part of the site where up to 11800mg/kg of naphthalene (and a total PAH of 41490mg/kg) was recorded at 17m bgl. The identified contamination generally extended to the base of the Thanet Sand Formation at approximately 19m bgl. Migration into the Chalk appears to have been retarded by the silty and locally clayey nature of the basal Thanet Formation.

F.1.37 There is also a local less severe area of contamination at a shallow depth on the northwestern boundary. At this location a maximum naphthalene concentration of 580mg/kg (and a total PAH of 1995mg/kg) was recorded at 4m bgl.

F.1.38 The recorded concentrations of PAH and total petroleum hydrocarbons are above 1% (10000 mg/kg) and indicate the potential presence of mobile free phase hydrocarbons at the site.

F.1.39 The contaminants recorded are representative of those that may be associated with the previous land uses (tar/naphtha/creosote works that existed at the site and on land extending further to the south).

F.1.40 The exceedances of the generic screening values and potential presence of free phase hydrocarbons indicates that further detailed risk assessment is required to fully quantify risks to end users, off-site receptors, and groundwater. Remedial measures may also be employed in order to mitigate risks during both construction and in the final completed scheme.

F.1.41 Outline remedial options include in-situ chemical oxidation of contamination at the locations of deep excavations to reduce the impacts of soil vapour migration to off-site receptors as soils are excavated and a cover system to provide a barrier between the contamination and end users (which would simply comprise the proposed hardstanding).

Soil gas testing

Bulk gases

F.1.42 Ground gas monitoring was undertaken in ground monitoring wells installed in boreholes SR4118, SA6450, SA6452, CP6459, CP6454, CP6458 and SR6457 between February and July 2012.

F.1.43 Readings were generally taken during periods of high atmospheric pressure although one low pressure reading (993mb) was taken.

F.1.44 The majority of the monitoring results (up to July 2012) do not show elevated concentrations of methane and carbon dioxide within the standpipes.

F.1.45 There are, however, a few isolated results where slightly elevated concentrations of methane (and carbon dioxide) were detected on one or more occasions: SA6452 (7.2% v/v carbon dioxide); CP6458 (1.1% v/v methane) and CP6458 (2.7% methane).

F.1.46 A Gas Screening Value (GSV) for these results was calculated in accordance with CIRIA C665[3]. The GSVs were all calculated to be below <0.07 l/hr which, based on Table 8.5 of CIRIA C665, equates to Characteristic Situation 1.

F.1.47 However, where methane exceeds 1% by volume and/or carbon dioxide exceeds 5% by volume, the guidance suggests that Characteristic Situation 2 should be considered. Therefore Characteristic Situation 2 is considered appropriate for the site. This indicates that some basic gas protection measures would be needed in buildings (although the proposed Thames Tunnel Tideway structures themselves would not be sensitive to land gas due to the potentially gassing nature of their contents).

F.1.48 Elevated methane/carbon dioxide values are considered to be attributable to minor gas emissions from the underlying organic alluvial deposits.

Vapour assessment

F.1.49 Ground gas sampling undertaken on 1st and 15th June 2012 from boreholes SA6452, CP6454 and CP6459 included analysis for VOCs.

F.1.50 The majority of determinands were recorded as below the limit of detection, with the exception of the BTEX compounds and tetrachloroethene.

F.1.51 Analysis from the gas sampling on 1st June indicated that only tetrachloroethene was present in sufficient concentrations to exceed the limit of detection. A maximum concentration of 610 µg/m^3 was recorded.

F.1.52 Analysis of the samples collected from the second round of sampling on 15th June identified only the BTEX compounds to be present: benzene (100 µg/m^3), toluene (1300 µg/m^3), ethylbenzene (61 µg/m^3) and m and p-xylenes (180 µg/m^3).

F.1.53 For the protection of human health, VOCs can be compared against the Environment Assessment Levels for Air (EALs) outlined within the Environment Agency publication, H1 Annex F for Air Emissions[4].

F.1.54 Contaminants detected in samples from SA6452, CP6454 and CP6459 were all recorded at concentrations considerably lower than their respective EAL value with the exception of benzene, for which no value is currently available.

F.1.55 The assessment shows that low concentrations of a small number of organic compounds are present in vapour phase in near surface soils, above the water table.

Groundwater contamination data

F.1.56 Groundwater from standpipes installed at or in the vicinity of the site were tested for a similar suite to the soils (refer to Table F4).

F.1.57 The data also shows numerous exceedances of the relevant standards with respect to heavy metals, pesticides, hydrocarbons and a range of organic substances in the River Terrace Deposits and the Thanet Sands. In particular within the onsite ground investigation boreholes in the River Terrace Deposits (SA6455, SA6450 and SR4118) showed some high

exceedances of anthracene, benzene, fluoranthene, naphthalene, phenol, polycyclic aromatic hydrocarbon (PAH) and xylene compounds.

F.1.58 The Thanet Sands boreholes on site (SA6451 and SA6455) showed exceedances of anthracene, benzene, heavy metals, naphthalene, phenol, PAHs and xylene compounds.

F.1.59 In general, the number of substances exceeding standards were fewer in the Thanet Sand than the River Terrace Deposits. PAHs and the various organic compounds detected may be formed during a range of human activities, including incomplete combustion of carbon-based fuels and other industrial processes[5]. Phenols may be formed naturally by the decomposition of organic materials but are also a constituent of coal tar6. In addition, PAHs and phenols are considered to be Priority Hazardous Substances under the Water Framework Directive[7].

F.1.60 The concentrations for a majority of these organic compounds are highest in the River Terrace Deposits at SA6450, and there is a reduction in concentration within the Thanet Sands at SA6453A and SA6451. These exceedances are likely to be linked to the identification of creosote (the main constituents of which are PAHs, phenols and creosols – all of which are harmful to health) in on site ground investigation boreholes drilled in March 2012 at the base of the River Terrace Deposits and the top of the Upnor Formation.

F.1.61 The presence of these substances, although at lower concentrations in the Thanet Sands, indicates some degree of hydraulic connection between the River Terrace Deposits, Upnor Formation and Thanet Sands at this site. None of the Chalk boreholes, lying 455m down hydraulic gradient (SR1049), nor any of the up hydraulic gradient boreholes (SR1048, SR1047, PR1027 and SR1028), showed any exceedances of the respective water quality standards.

F.1.62 Refer to Section 13 Water resources – groundwater of this volume for information on groundwater quality.

Third party ground investigation data

F.1.63 An investigation at Cannons Wharf (the large industrial site immediately to the south) was undertaken by Environ in 2007. The investigation comprised the drilling of four boreholes by cable percussive techniques and 15 boreholes by window sampler technique.

F.1.64 The investigation recorded a cover of Made Ground overlying a variable and possibly discontinuous thickness of clayey and organic alluvium in turn directly overlying the Thanet Sand Formation (TSF). Impacts to soils and perched and deeper groundwater were noted, with petroleum hydrocarbons (TPH) and PAHs, metals, and low levels of other Semi-Volatile Organic Compounds (SVOCs), mostly comprising phenolic compounds.

F.1.65 Groundwater within the TSF was recorded to be significantly impacted by TPH and to a lesser extent by PAHs, phenols and the Volatile Organic Compounds (VOCs) 1,2,4 and 1,3,5 trimethylbenzene. The groundwater surface in the TSF was recorded to lie between 2.98m and 4.67mbgl.

F.1.66 No free phase hydrocarbons were recorded during the two monitoring visits although oily sheens and odours were noted across the site.

F.1.67 Soils were recorded as exhibiting strong hydrocarbon odours to the full depth of investigation at 10m bgl in the borehole adjacent to proposed Thames Tideway Tunnel project construction site.

Other environmental records

F.1.68 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 22 Table F.7. Pertinent records are discussed in further detail below.

F.1.69 The location of these records is shown on Vol 22 Figure F.1.3 (see separate volume of figures).

Vol 22 Table F.7 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	2
LA pollution prevention and control	0	0
Licensed waste management facility	0	0
Notification of installations handling hazardous substances	0	0
Past potential contaminated industrial uses	Areas of past potential contaminated industrial uses are present on-site and within 250m.	
Pollution incident to controlled water*	0	0
Registered waste transfer site	0	1
Registered waste treatment or disposal site	0	0

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

F.1.70 Inspection of the data has identified areas both on-site and within 250m of the Earl Pumping Station site that are classified as being of past potential contaminated industrial use. From an analysis of the historical mapping, it can be inferred that the past potential contaminating industrial uses could

be attributed to two former tar works, a former timber yard to the south of the site and the former floor cloth manufacturer as shown on Vol 22 Figure F.1.1 (see separate volume of figures). Likely contaminants associated with these types of previous land-use are identified in Vol 22 Table F.2.

F.1.71 Within 250m of the Earl Pumping Station site, inspection of the data has identified the presence of two historical landfill sites. One of these is the former (now infilled) Surrey Canal which runs approximately 100m east of the site. The other is 100m to the south of the site on the existing concrete works site – there are no details on the materials accepted by either of these facilities.

F.1.72 There is also one registered waste transfer site immediately east of the site. This is adjacent to a depot and it may be that the depot is used for waste transfer.

Thames water operational records

F.1.73 Thames Water records of potentially contaminating substance storage at the Earl Pumping Station site within the last five years were reviewed.

F.1.74 No bulk storage of hydrocarbons or other potentially contaminating liquids were currently taking place at the site.

F.1.75 No spillages of any potentially contaminating substances to ground were recorded.

Land quality data from local authority

F.1.76 The site is located within the London Borough (LB) of Lewisham at the boundary with LB of Southwark. As such, both local authorities were consulted with respect to any information they may have in relation to the land condition at the site.

F.1.77 The LB of Lewisham did not have any data, but advised that a search of their planning portal be carried out for possible relevant documents.

F.1.78 This search revealed two sites within the 250m buffer that had information relating to land quality.

F.1.79 The site at 7–17 Yeoman Street, Surrey Quays is located immediately opposite the Earl Pumping Station site and was subject to desk study work by Card Geotechnics.

F.1.80 The report generally supports the findings of the present baseline report but concludes that there was a low to moderate risk from contamination at the site. The report references site investigations to the south which recorded extensive hydrocarbon contamination, although the nature of the contamination and the location of the boreholes were not given.

F.1.81 The second site is located at Marine Wharf approximately 80m to the east (the location of former timber yard highlighted by the historical mapping).

F.1.82 Phased investigations of the site have taken place over a number of years. The earlier (1990s) investigations revealed localised gross contamination of the shallow (River Terrace) aquifer with petroleum hydrocarbons. Free phase (floating product) up to 50mm in thickness was noted locally. Additionally creosote impacted groundwater within the River Terrace

Deposits was noted by a later (2008) phase of work. No contamination of the underlying TSF was identified. Soils at the site were also recorded to be contaminated with a variety of substances including asbestos, arsenic and creosote.

F.1.83 LB Southwark had no information that was relevant to land quality at the Earl Pumping Station site.

Summary of contamination sources

F.1.84 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. sewage pumping station (contamination with pathogens)

b. residual contamination from previous site usage (including tar/creosote/naphtha works and former diesel storage). Contaminants associated with the historical land-uses and those found by intrusive investigations include: TPH; VOCs; PAHs, phenols and BTEX

c. potential UXO

d. Japanese Knotweed.

F.1.85 Off- site sources of contamination include adjacent current and former industrial land use to the south and east (timber yards, tar works, whiting works).

F.2 Detailed Unexploded Ordnance (UXO) risk assessment

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Detailed Unexploded Ordnance (UXO) Risk Assessment

Study Site: Work Area PLM1X, Borehole 4025.
Client Name: Thames Water
6 Alpha Project Number: P2278_R27_V1.0
Date: 26th November 2010

Originator: Gary Hubbard (26th November 2010)
Quality Review: Lee Gooderham 26th November 2010)
Released by: Simon Cooke (26th November 2010)

Contents

Figures

EXECUTIVE SUMMARY	
Study Site	Defined as Work Area PLM1X and Borehole Location 4025. The borehole is to be positioned at National Grid Reference 536153, 178752. For the purposes of this study, a 50m assessment radius will be applied to the work area, to provide flexibility should works need to be relocated.
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	• There are numerous Luftwaffe bombing targets within the immediate vicinity of this study site such as docks, rail yards and storage facilities. Accordingly, the site is located within a region of London with a high bomb density. • Bombing activity is evidenced by bomb strikes mainly to the north east of the site, and damage to properties within the study area. Furthermore a V1 strike is recorded approximately 50m west of the work area. • Given the site usage during the war years, it is possible that a UXB entry hole would have been witnessed. Firstly, the eastern and western boundaries are occupied with residential properties, the remainder of the site consisted of rear gardens to the properties surrounding the site. • Made ground and River Terrace Deposits (presumed as gravel) present across the site significantly reduces bomb penetration depth, any potential UXBs are likely to be between WWII ground level to a maximum burial depth of 5m. • There has been a significant amount of post-war redevelopment across the site. It may be possible that this development may have mitigated the majority of UXO risk horizon on this site, although this would depend on scale and depth of the works. • In light of the potential risk on site and the ground conditions, 6 Alpha would recommend “reactive” risk mitigation specified below. It should be noted that 6 Alpha have assessed that the tunnelling will be conducted at depths in excess of the maximum bomb penetration depth, thus there is a negligible risk to this activity.
Risk Level	**LOW/MODERATE**
Risk Mitigation For 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.

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 PLM1X and Borehole Location 4025. The borehole is to be positioned at National Grid Reference 536153, 178752. For the purposes of this study, a 50m assessment radius will be applied to the work area, to provide flexibility should they need to be relocated.
Location Description	The site is located in the London Borough of Deptford approximately 200m south of Greenland Dock. The London Catering Yard currently occupies the site, which is bounded by Yeoman Street to the east, Earl Pumping Station to the north and Croft Street to the west. The surrounding area is predominately commercial with some residential buildings. The main site working area is 3,000m^2. Outside of this area there is a smaller short term working area, which will be used to construct the interception chamber and to construct the site hoarding.
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: • Ground investigation will involve drilling a borehole (Ref No. 4025); • Demolition of existing industrial buildings adjacent to the pumping station. • A 12m internal diameter shaft 34m deep. The shaft is anticipated to be constructed with a secant pile support with an in-situ concrete secondary lining. Ground treatment or dewatering will be required. The cover slab will be approximately 3m higher than existing ground level and incorporated into a single rectangular 'building' approximately 20m x 14m in plan area. • An interception chamber within the existing Earl Pumping Station compound. • A culvert from the interception chamber to the drop shaft, including a valve chamber near the drop shaft. • A 10m high ventilation column • A control kiosk containing equipment to operate a penstock. Within the construction compound there will be offices/welfare facilities, a storage area for shaft segments and a storage and handling area for excavated material.
Ground Conditions	Thames Water have informed 6 Alpha that the ground conditions for this preferred site are expected to be: • **Made Ground** – Ground Level to 2.90m below ground level (bgl); • **River Terrace Deposits** – 2.90m to 8.10m bgl; • **Lambeth Group** – 8.10m to 10.00m bgl; • **Thanet Sand** - 10.00m to 14.50m bgl.

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**	During WWII the area was dominated by terrace residential properties with associated rear gardens. The assessment area partially covers the former Bronze Athletic Ground and an Oil Works to the east of the proposed work area.
	Bombing Targets	There were no major bombing targets within the immediate vicinity of the site, although there was the dock complex located to the north. Generally the site is located within an area which contained densely packed residential properties. As the Blitz progressed these areas too became intended targets for the Luftwaffe.
	HE Bomb Strikes (*Figure 3*)	There are no high explosive (HE) bomb strikes recorded on the actual work site although there is one bomb noted to the north of the site within the assessment area.
	WWII HE Bomb Density (*Figure 4*)	The assessment buffer is within two administrative districts; Bermondsey Metropolitan Borough - 458 HE bombs per 1,000 acres and Deptford Metropolitan Borough – 453 HE bombs per 1,000 acres
	WWII Bomb Damage (*Figure 5*)	The site can be crudely divided in to two areas, the properties to the southern section of the work area suffered Serious Damage, while those in the north only suffered "Blast Damage, Minor in Nature". It is possible this damage was caused by the "V1" strike within 50m of the work area.
	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?	Yes, there is a large dock complex located 200m north of the site, also the area as a whole became a generic bombing target for the Luftwaffe during the Blitz.
Is there firm evidence that ordnance landed on site?	There is one HE bomb strike recorded in the immediate vicinity. There are a further seven located outside the assessment buffer particularly to the northwest. The LCC bomb damage maps indicate damage on site. This may have been caused by the V1 strike, incendiary devices or uncharted HE bombs.
Would an UXB entry hole have been observed and reported during WWII?	As there was only minor blast damage recorded to residential properties on the northern section of the site there is a strong chance that UXB entry-holes would have been witnessed if present. However the probability is reduced in the south where the level of bomb damage had increased.
Was the ground undeveloped during WWII?	Much of the area was terrace housing with associated rear gardens.
Is there any reason to suspect that Live Firing or military training may have occurred at this location?	No live firing practices would have been conducted in this area as it would have posed a direct risk to the local population and also the area is unsuited for live firing practices.
Is there any reason to suspect that other activities on site may have resulted in ordnance and / or explosives being present?	No records could be found to suggest that ordnance or accessories were stored or trialled on the proposed site.
Would previous earthwork have removed the potential for UXO to be present?	There has major development on site post WWII, therefore some of the UXO risk may have been ameliorated although the quantity will depend on site to the scale and depth of these works.

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 5m below ground level (m bgl). This may be greater in areas covered by the subsurface tanks during WWII.
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			
Activity	**Probability** (SHxEM=P)	**Consequence** (DxPSR=C)	**Risk Rating** (PxC=RR)
Borehole	1x3=3	2x2=4	3x4=12
Enabling Works	1x1=1	3x2=6	1x6=12
Secant Piling	1x3=3	2x2=4	3x4=12
Open Excavations	1x2=2	2x2=4	2x4=8
Tunnelling	1x1=1	1x1=1	1x1=1
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 assessed UXB penetration depth and expected thicknesses of fill material on site.

MITIGATION MEASURES TO REDUCE RISK TO 'ALARP'		
Activity	**Risk Mitigation Measures**	**Final Risk Rating (Post Mitigation)**
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 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
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

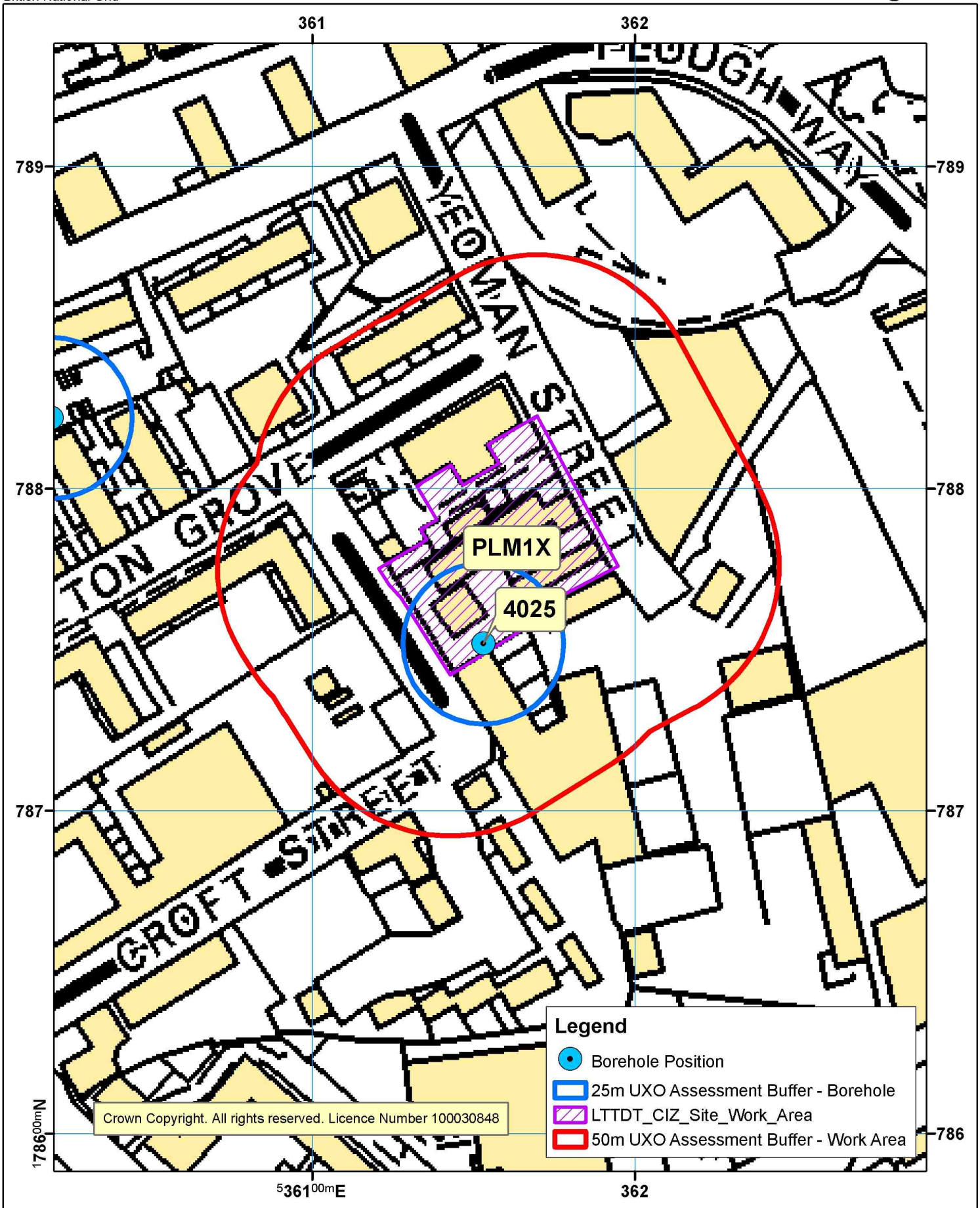
Figure One

Location of the Proposed Works

Thames Tideway Tunnel - Work Area PLM1X. Borehole 4025
Work Area and Borehole Locations

Figure 1

British National Grid



BOMB SEARCH

6 Alpha Associates Ltd.
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0203 371 3900

0 10 20 40 60 80 Meters

N

Project Number: P2278_R27

Drawn By: Gary Hubbard

Checked by: Lee Gooderham

Date: 5th November 2010

Figure Two

Current Aerial Photography

Thames Tideway Tunnel - Work Area PLM1X. Borehole 4025
Current Aerial Photography

Figure 2

British National Grid

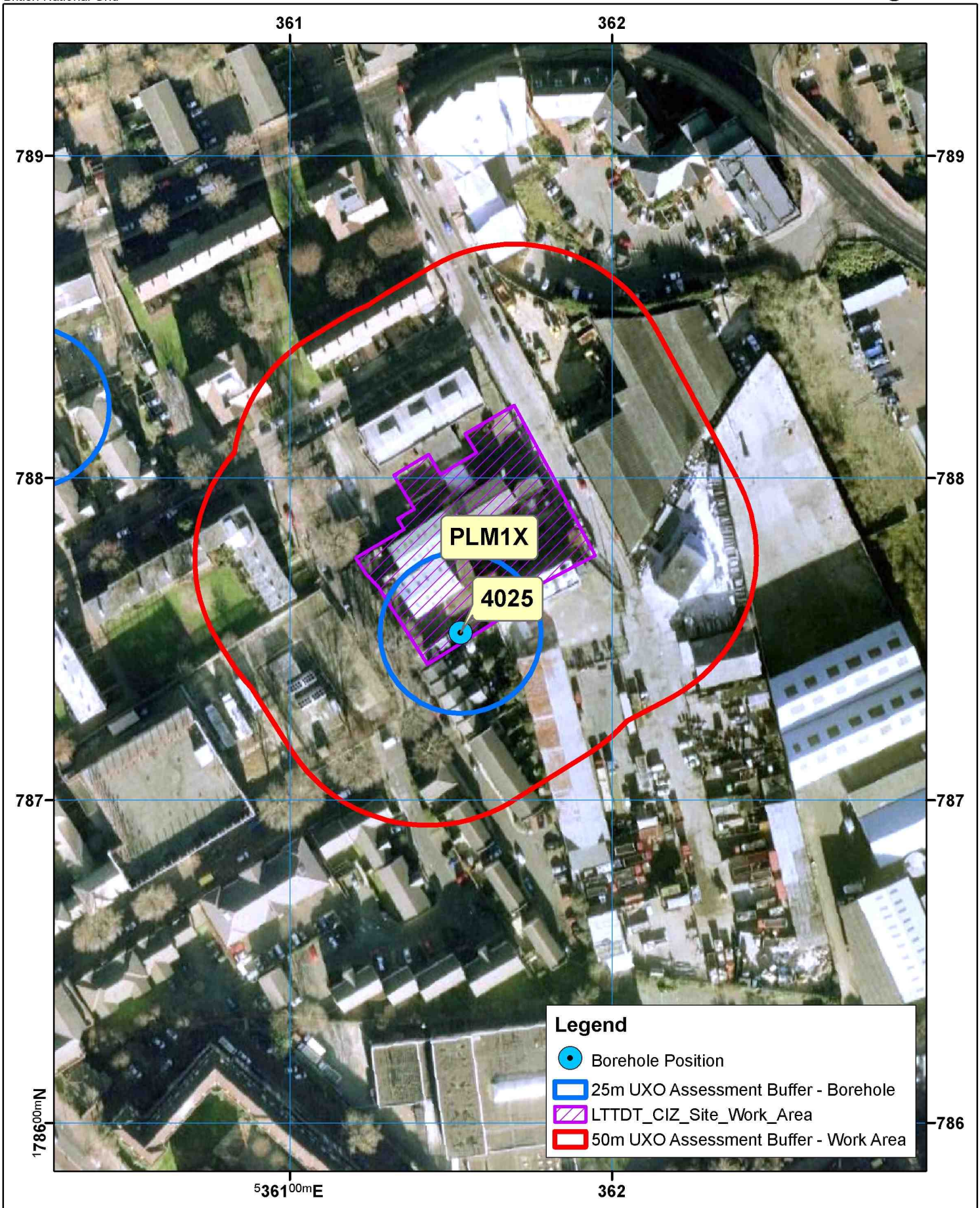

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Figure Three

WWII High Explosive Bomb Strikes

Thames Tideway Tunnel - Work Area PLM1X. Borehole 4025
WWII High Explosive Bomb Strikes

British National Grid

Figure 3

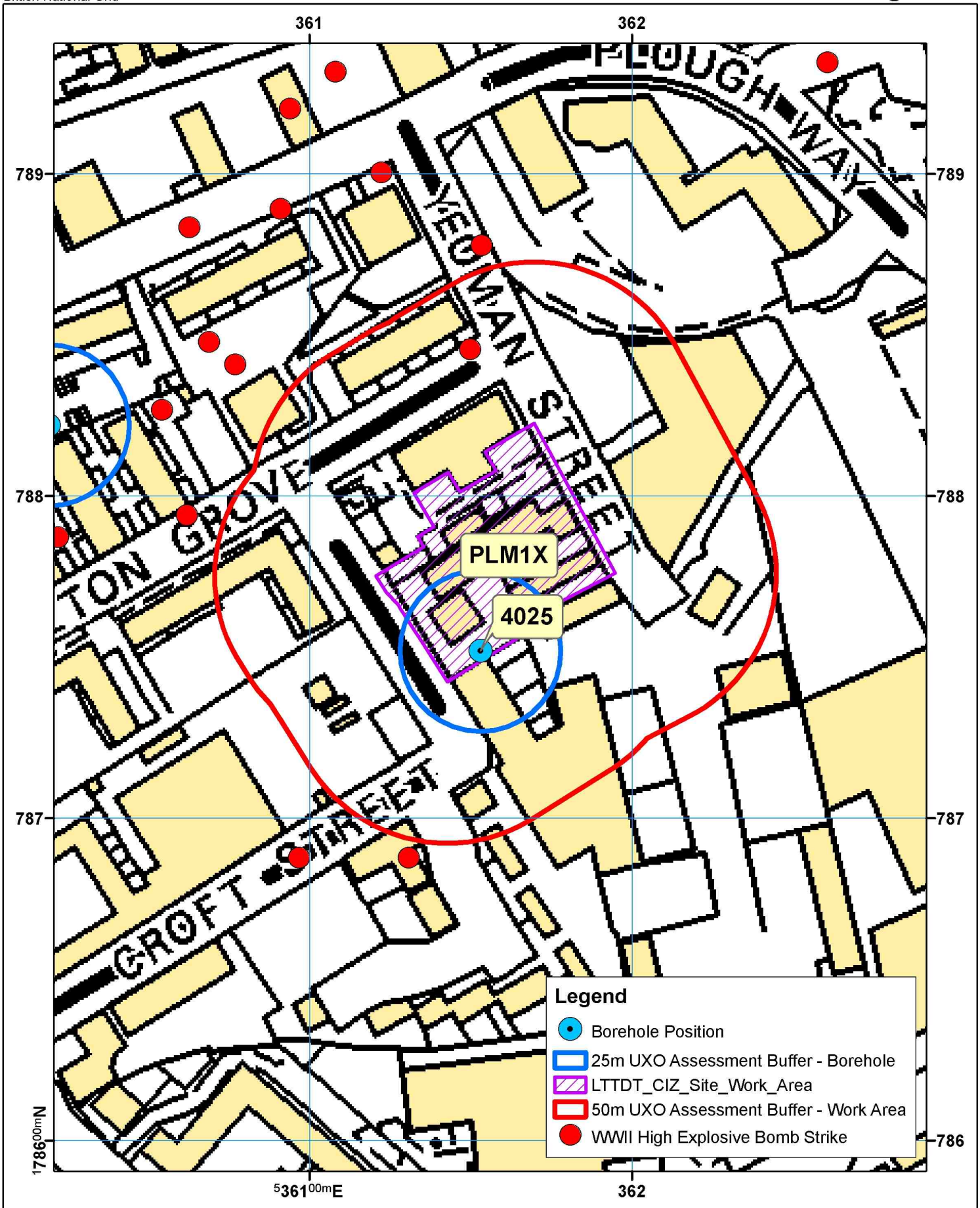

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Figure Four

WWII High Explosive Bomb Density

Thames Tideway Tunnel - Work Area PLM1X. Borehole 4025
WWII High Explosive Bomb Density

Figure 4

British National Grid

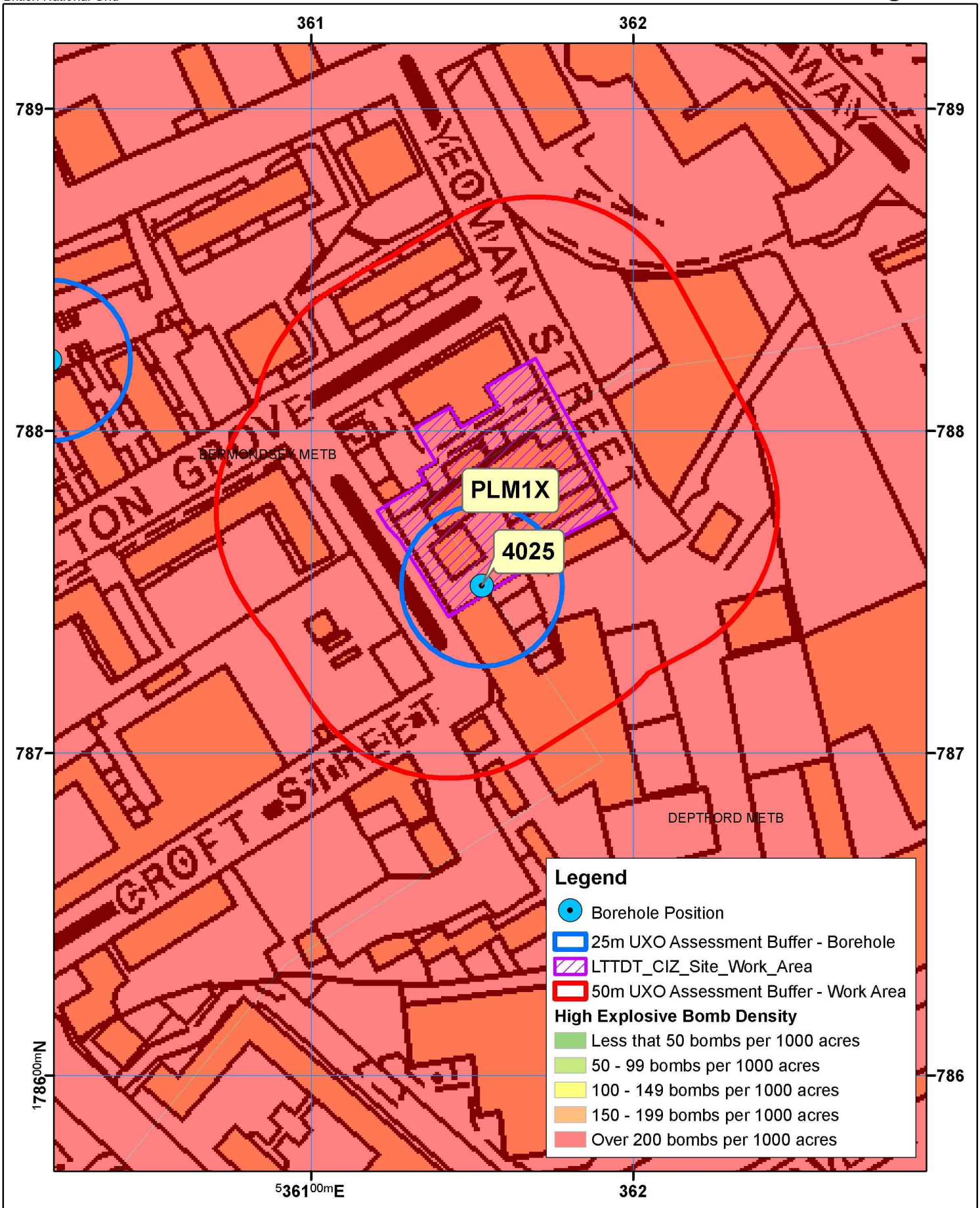

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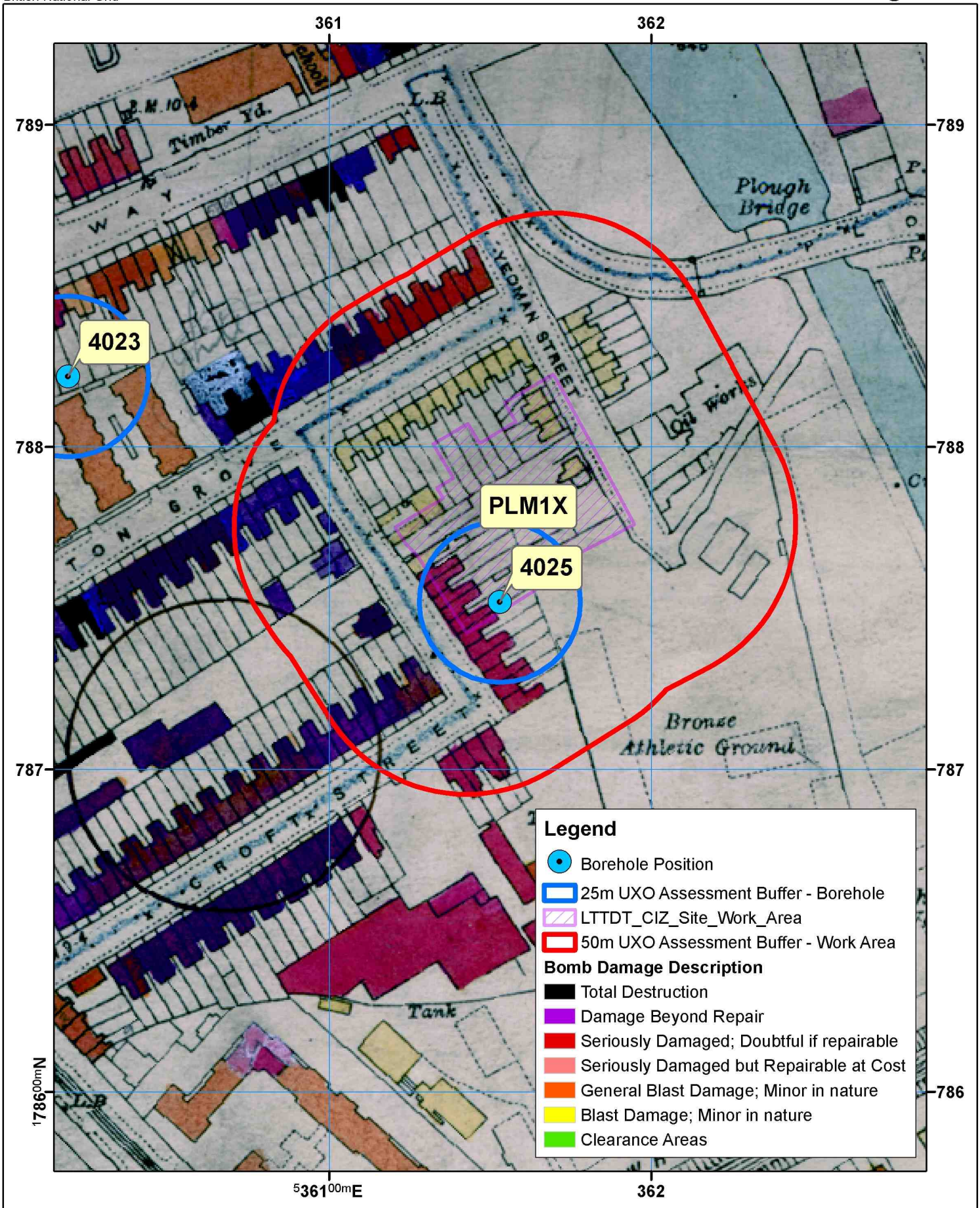
Figure Five

London County Council Bomb Damage Mapping

Thames Tideway Tunnel - Work Area PLM1X. Borehole 4025
London County Council Bomb Damage Mapping

British National Grid

Figure 5



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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.22**

Volume 22: Earl Pumping Station appendices

Appendix G: Noise and vibration

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

Hard copy available in

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Thames Tideway Tunnel

Environmental Statement

Volume 22 Earl Pumping Station appendices

Appendix G: Noise and vibration

List of contents

Page number

List of plates

Page number

List of tables

Page number

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 receptors to Earl Pumping Station are the four storey residential properties on Yeoman Street (18-32) located north of the proposed development, adjacent to these are a much taller block of flats on Chilton Grove (1-39), to the west of the site are residential flats along Chilton Grove (108-136) and to the south of the worksite the end-terrace property 62 Croft Street is adjacent to the boundary wall of the worksite. Other noise sensitive receptors which have been assessed are the offices which form part of the industrial units on Yeoman Street.

Survey methodology

G.1.3 The London Borough of Lewisham 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 30th March and 1st April, 2011. Additional data was collected 10th October, 2011. The initial survey comprised short term attended measurements taken during the daytime at all measurement locations. The additional data collection comprised further short term attended measurements taken during the evening.

G.1.5 During the initial baseline surveys, measurements were undertaken during the interpeak periods of 10:00-12:00 and 14:00-16:00 on a typical weekday, so that the baseline data is representative of the quieter periods where any disturbance from construction would be most noticeable.

G.1.6 For the additional baseline survey, further short term attended noise monitoring was completed at all locations. Measurements were undertaken during the interpeak period of 20:00-22:00 on a typical weekday.

G.1.7 Vol 22 Table G.1 describes the survey equipment that was used to collect the baseline data at the site.

Vol 22 Table G.1 Noise – survey equipment

Item	Type	Manufacturer	Serial Number(s)	Laboratory Calibration Date
Initial Baseline Survey: 30th March 2011				
Hand-Held Analyzers	2250	Brüel & Kjær	2626232 2626233	15/02/2010* 15/02/2010*
½ " Microphones	4189	Brüel & Kjær	2621211 2621212	15/02/2010* 15/02/2010*
B&K Sound Calibrator	4231	Brüel & Kjær	2619374	21/02/2011**
Additional Baseline Survey: 1st April 2011				
Hand-Held Analyzers	2250	Brüel & Kjær	2626230 2446918	19/01/2010* 01/07/2010**
½ " Microphones	4189	Brüel & Kjær	2621209 2440900	20/01/2010* 01/07/2010**
B&K Sound Calibrator	4231	Brüel & Kjær	2619373	10/02/2011**
Additional baseline survey: 10th October 2011				
Hand-Held Analyzers	2250	Brüel & Kjær	2626230 2626231	19/01/2010* 20/01/2010*
½ " Microphones	4189	Brüel & Kjær	2621208 2621209	19/01/2010* 20/01/2010*
B&K Sound Calibrator	4231	Brüel & Kjær	2619372	13/01/2011**

**Hand-held analyser(s) and ½ inch microphone(s) valid for two years from the date listed*

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

G.1.8 Prior to and on completion of the surveys, the sound level meters and microphone calibration was checked using a Brüel and Kjær sound level meter calibrator. On-site calibration checks were performed before and after all measurements with no significant deviation being observed. The sound level meters and calibrators have valid laboratory calibration certificates.

G.1.9 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 The prevailing weather conditions observed for the baseline surveys are described in Vol 22 Table G.2.

Vol 22 Table G.2 Noise – weather conditions during baseline noise surveys

Wind Speed (ms^{-1})	Wind Direction	Temperature (°C)	Precipitation?	Description
Initial baseline survey – 30th March, 2011 (daytime, 10:00-12:00)*				
Maximum: 1.7-3.7 Average: 0.3-0.8	SW; SSW	12-14	No	Cloudy
Additional baseline survey – 1st April, 2011 (daytime, 14:00-16:00)				
Maximum: 2.4-3.8 Average: 0.5-1.0	SW	16-17	No	Cloudy with a moderate wind
Additional baseline survey – 10th October, 2011 (evening, 20:00-22:00)				
Maximum: 1.9-5.2 Average: 0.6-1.3	W	17-18	No	Overcast with strong breeze

**The afternoon measurements (14:00-16:00) were abandoned due to heavy rain.*

Measurement locations

G.1.11 Vol 22 Table G.3 details the measurement locations which are also presented in Vol 22 Figure G.1 Noise – measurement locations (see separate volume of figures), and shown in Plates G.1 to G.4.

Vol 22 Table G.3 Noise – measurement locations

Measurement Location Number	Description	Co-ordinates	
		X	Y
EPS01	On public footpath adjacent to Chilton Grove, near to junction with Yeoman Street	536148	178844
EPS02	On public footpath adjacent to Chilton Grove, due northwest of the main building of Earl Pumping Station	536106	178822
EPS03	On public footpath adjacent to Croft Street, due west of the main building of Earl Pumping Station	536106	178779
EPS04	On public footpath adjacent to Croft Street, due south of the main building of Earl Pumping Station	536141	178741

Results

G.1.12 The range of values for each of the parameters collected during the baseline surveys are summarised in Vol 22 Table G.4 to Vol 22 Table G.7.

Vol 22 Table G.4 Noise – sampled noise survey results - EPS01

Location Detail: EPS01, on public footpath along Chilton Grove, adjacent to back gardens of residential dwellings						
Measurement period	**Noise level (dB(A) free-field)**			**Averaged ambient noise level, $dBL_{Aeq,15min}$**		**$dBL_{Aeq,15min}$ (rounded to nearest 5dB)**
	L_{AFmax}	**$L_{A90,15min}$**	**$L_{Aeq,15min}$**	**Free field**	**Façade**	**Façade**
Daytime (10.00-12.00, 14.00-16.00)	88	49	59-64	59*	62	60
Evening (20.00-22.00)	74	47	56	53*	56	55

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

Vol 22 Table G.5 Noise – sampled noise survey results - EPS02

Location Detail: EPS02, on public footpath adjacent to Chilton Grove, north-west of Earl Pumping Station						
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)	85	49	56-59	58	61*	60
Evening (20.00-22.00)	81	49	55-58	57	60*	60

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

Vol 22 Table G.6 Noise – sampled noise survey results - EPS03

Location Detail: EPS03, on public footbath adjacent to Croft Street, in front of high rise residential flats						
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)	85	49	54-63	59	62*	60
Evening (20.00-22.00)	76	49	57-58	57	60*	60

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

Vol 22 Table G.7 Noise – sampled noise survey results - EPS04

Location Detail: EPS04, on public footpath adjacent to Croft Street, adjacent to front entrance of residential dwelling						
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)	86	50	55-59	57	60*	60
Evening (20.00-22.00)	77	49	57-61	59	62*	60

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

Plates of noise measurement locations

G.1.13 The following plates (Plates G.1 to G.4) illustrate the noise measurement locations.

Vol 22 Plate G.1 Noise measurement location EPS01

Note: On public footpath along Chilton Grove, looking northeast towards Yeoman Street (façade measurement)

Vol 22 Plate G.2 Noise measurement location PEPS02

Note: On public footpath along Chilton Grove, looking northwest towards residential flats

Vol 22 Plate G.3 Noise measurement location EPS03

Note: On public footpath along Croft Street, looking east towards residential flats

Vol 22 Plate G.4 Noise measurement location EPS04

Note: On public footpath along Croft Street, looking north towards industrial units and residential dwelling

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 22 Table G.8.

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

Vol 22 Table G.8 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 D.7, Item 71	Circular bench saw,
	Cutting equipment (diamond saw)	1	108	10	BS5228-1: Table C.4, Item 93	Angle grinder (grinding steel), 4.7 kg
	Nail guns for erection of hoarding	2	101	10	BS5228-1: Table C.4, Item 95	Handheld cordless nail gun, 15 to 50 mm nails
	Compressor 250cfm	1	93	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	10	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,
	Dewatering Pump	1	96	100	BS5228-1: Table C.4, Item 88	Water pump
	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
	Well drilling Rig	1	107	50	Manufacturer	BauerBBA well drilling rig,
Demolition	Service Crane 25T mobile Crane	1	98	30	BS5228-1: Table C.4,	Wheeled mobile crane,

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
General site equipment also applicable during this phase					Item 43	35 t
	22T Excavator c/w hydraulic hammer	1	116	30	BS5228-1: Table C.5, Item 1	Backhoe mounted hydraulic breaker,
	Site dumper	1	104	30	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	Pneumatic breaker	1	111	20	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker,
	Vibrating rollers	2	101	50	BS5228-1: Table C.2, Item 38	Roller, 18 t
	Concrete crusher	1	101	80	BS5228-1: Table C.2, Item 15	Tracked crusher, 32 t
Piling for culvert support	100t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
General site equipment also applicable during this phase	25 tonne mobile crane	1	98	50	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	Small secant piling rig	1	107	80	BS5228-1: Table C.3, Item 16	Crane mounted auger
Diaphragm wall construction	Diaphragm wall rig (grab)	1	114	10	BS5228-1: Table D.4, Item 10	D wall rig,
	Diaphragm wall rig (hydrofraise)	1	110	90	Manufacturer	Hydrofraise D wall rig,
General site equipment	Diaphragm wall slurry treatment plant	1	100	100	Manufacturer	Slurry treatment plant,

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
also applicable during this phase	Concrete deliveries (discharging)	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
	Concrete pump	1	95	20	BS5228-1: Table C.4, Item 24	Concrete pump + cement mixer truck (discharging), 8 t / 350 bar
	Waste water treatment plant	1	104	100	Measured	Dirty water plant,
	Compressor 400cfm	1	93	90	BS5228-1: Table C.5, Item 5	Compressor for hand-held pneumatic breaker, 1 t
	Dumper	1	104	50	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	100t crawler crane	2	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
Shaft excavation General site equipment also applicable during this phase	Ventilation fans	1	90	100	Measured	Ventilation fans,
	Dewatering pump	1	96	100	BS5228-1: Table C.4, Item 88	Water pump
	Long reach excavator	1	106	80	BS5228-1: Table C.7, Item 2	Long reach tracked excavator, 2136 t
	20t excavator with breaker	1	116	50	BS5228-1: Table D.5, Item 1	Backhoe mounted hydraulic excavator,
	25t excavator	1	105	80	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t

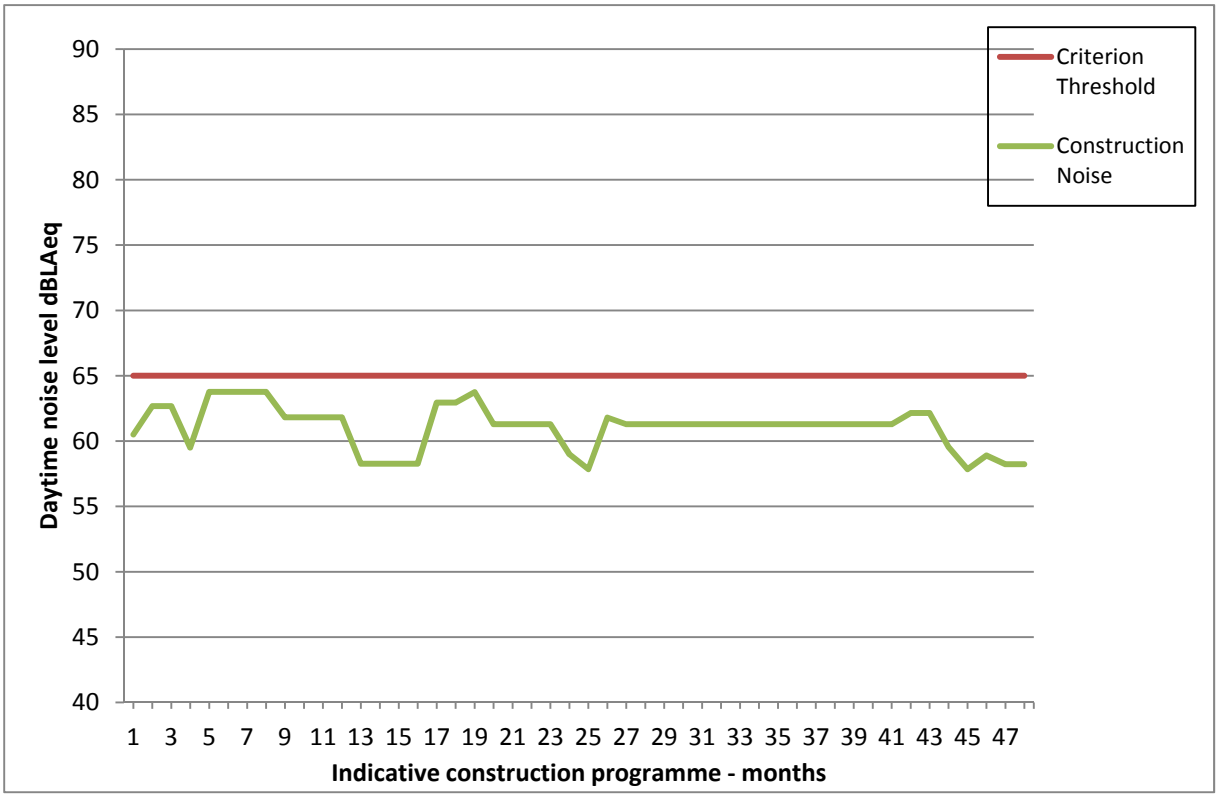
Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
	Dumper	1	104	50	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	40t crawler crane	1	98	55	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	100t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
Shaft secondary lining General site equipment also applicable during this phase	Concrete deliveries (discharging)	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
	Concrete pump	1	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,
	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
Culvert and chamber works General site equipment also applicable during this	Service crane - 100T mobile crane	1	95	50	BS5228-1: Table C.4, Item 14	Wheeled backhoe loader, 9 t
	25t excavator	1	105	50	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t
	Fixed and portable concrete vibrators	4	106	20	BS5228-1: Table C.4, Item 33	Poker vibrator,

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
phase	Concrete deliveries (discharging)	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
	Concrete boom pump	1	108	20	BS5228-1: Table C.4, Item 29	Truck mounted concrete pump + boom arm, 26 t
	Dumper	1	104	50	BS5228-1: Table C.4, Item 3	Dumper, 7 t
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, Item 38	Roller, 18 t

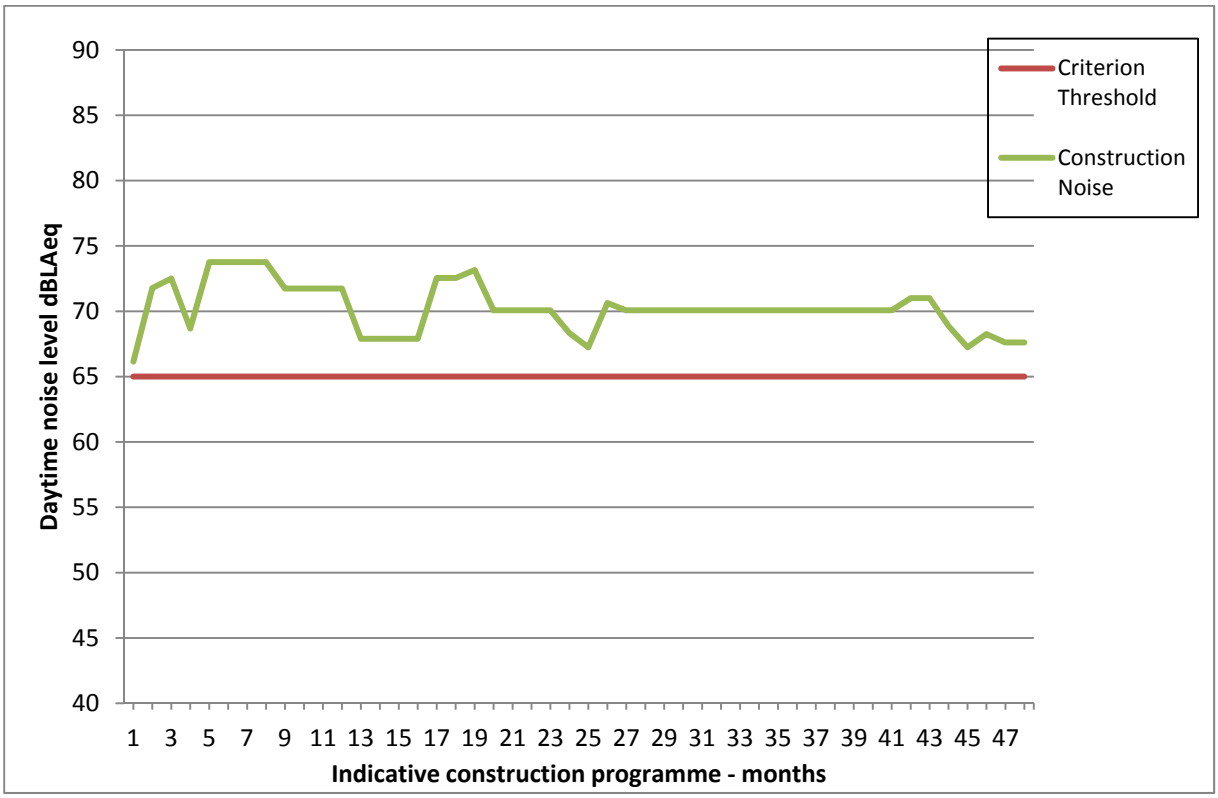
Note: This schedule provides an illustration of typical plant that could be used in the construction of the Thames Tideway Tunnel at this site. The appointed Contractor must comply with section 6 of the CoCP but may vary the method and plant to be used. This schedule therefore represents the most reasonable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

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

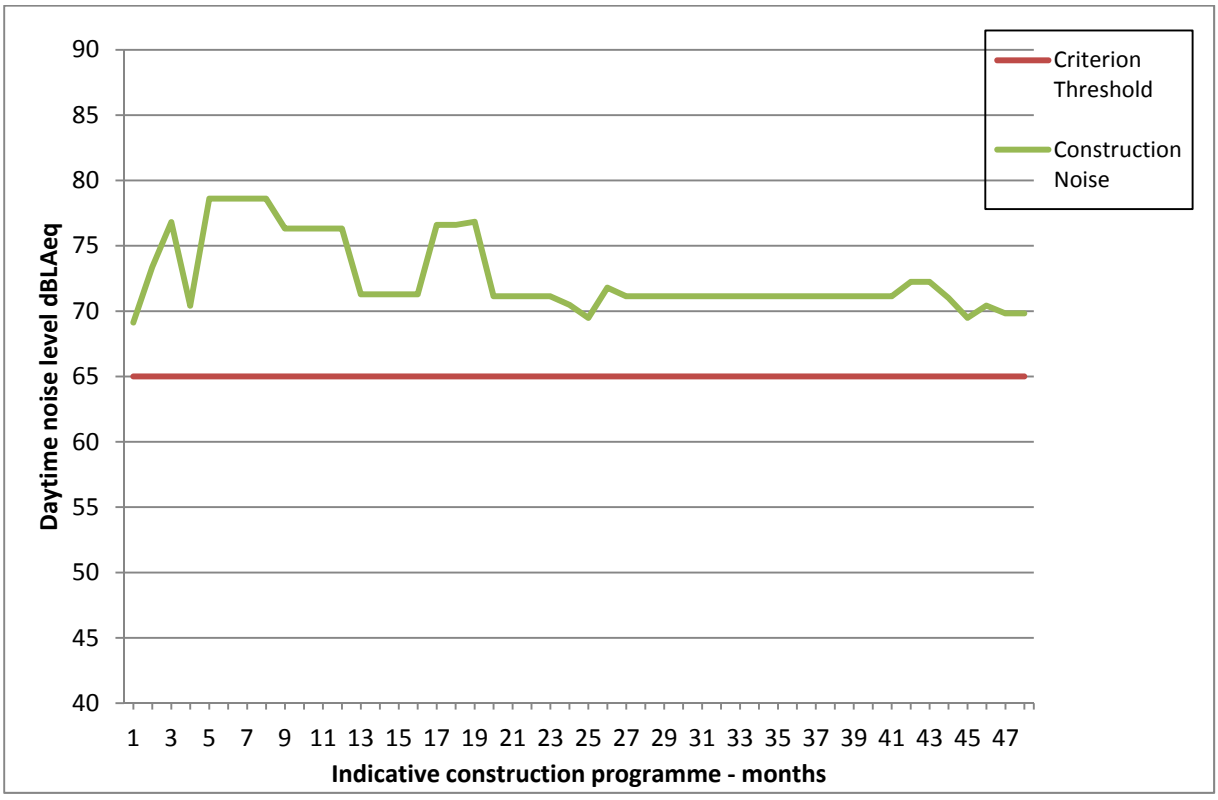
Vol 22 Plate G.5 Average monthly daytime noise level over duration of construction – 18-32 Yeoman Street (EP1)



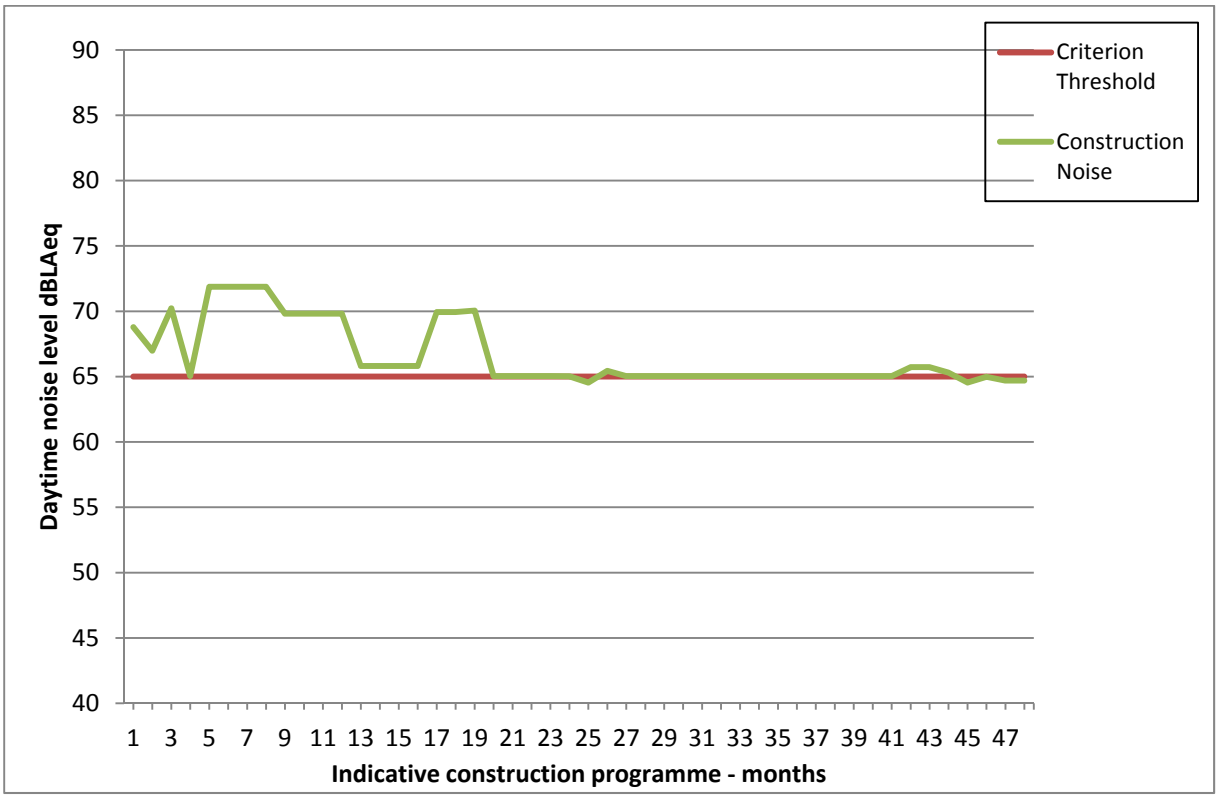
Vol 22 Plate G.6 Average monthly daytime noise level over duration of construction – 1-39 Chilton Grove (EP2)



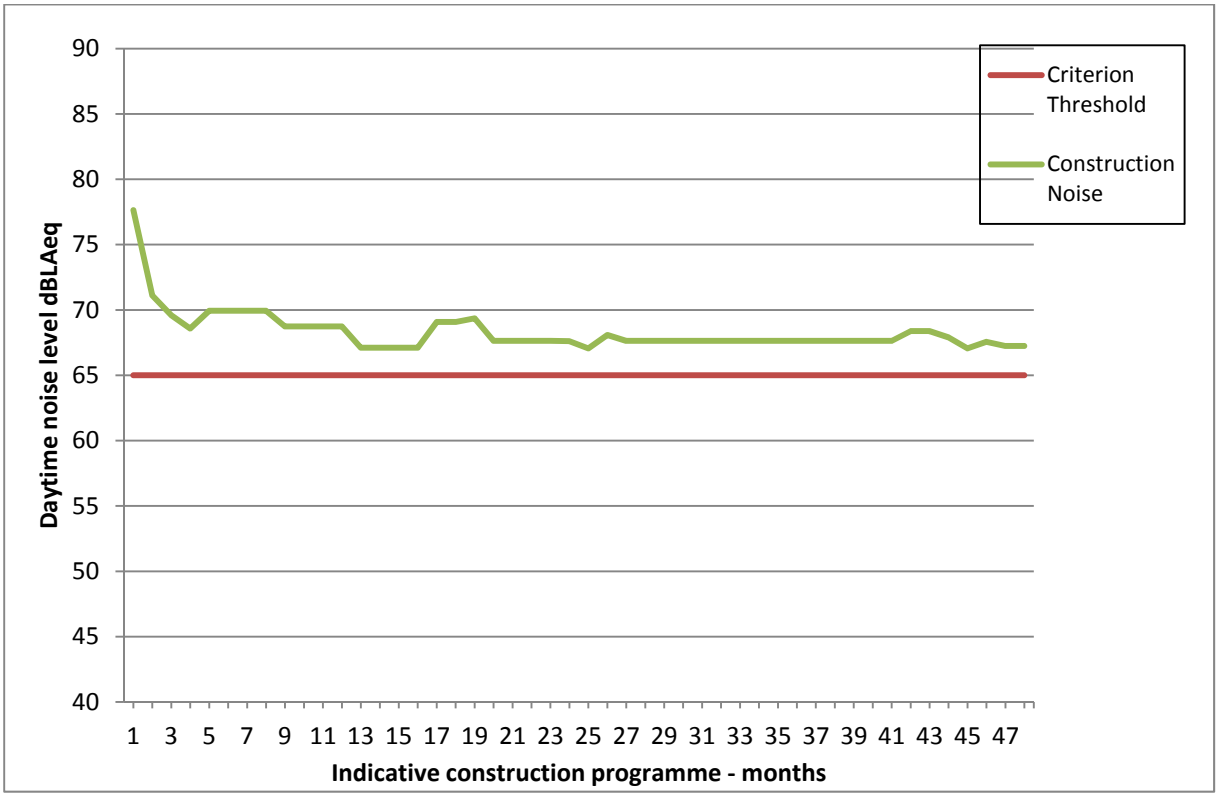
Vol 22 Plate G.7 Average monthly daytime noise level over duration of construction - 108-136 Chilton Grove (EP3)



Vol 22 Plate G.8 Average monthly daytime noise level over duration of construction – 52-62 Croft Street (EP4)



Vol 22 Plate G.9 Average monthly daytime noise level over duration of construction –Cannon Wharf Block J (EP5)



References

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

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.22**

Volume 22: Earl Pumping Station appendices

Appendix H: Socio-economics

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

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Thames Tideway Tunnel

Environmental Statement

Volume 22 Appendices: Earl Pumping Station site assessment

Appendix H: Socio-economics

List of contents

Page number

List of tables

Page number

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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) and the overall borough level (which in this case is the London Borough [LB] of Lewisham).

H.1.3 The main protected characteristic groups concentrated[iii] within the immediate area surrounding the proposed construction site are persons who suffer from income and overall deprivation.

Resident population

H.1.4 Within 250m of the site the resident population was 2,625 at the time of the last census.

Gender and age

H.1.5 Of the total population within 250m of the site, 52.9% of residents are male. This contrasts with a slight predominance of females within the LB of Lewisham (51.8%) and Greater London (51.6%).

H.1.6 Vol 22 Table H.1 outlines age breakdown by assessment area, it illustrates that the proportion of under 16 year olds within 250m (16.0%) is moderately lower than within the LB of Lewisham (21.1%) and Greater London (20.2%). Within 250m, the proportion of over 65 year olds (6.2%) is considerably lower than within the LB of Lewisham (11.0%) and Greater London (12.4%).

[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] 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.

Vol 22 Table H.1 Socio-economics – age breakdown by assessment area

Age group	Assessment area		
	Immediate area (250m)	Borough wide (LB of Lewisham)	Greater London
Under 16 years old	16.0%	21.1%	20.2%
Over 65 years old	6.2%	11.0%	12.4%

Ethnicity

H.1.7 Vol 22 Table H.2 outlines ethnicity by assessment area, showing that within 250m of the site, White residents make up approximately two thirds of the population (66.8%), with Black and Minority Ethnic (BME) groups comprising the remaining 33.2% residents. This is broadly in line with the LB of Lewisham level of White residents (65.9%) and slightly lower than the Greater London average (71.2%).

H.1.8 Within 250m, Black residents account for 21.4% of residents, broadly in line with the LB of Lewisham (23.4%) and considerably higher than the Greater London average (10.9%). By contrast, residents of Asian ethnicity account for 3.4% of the population within 250m, in line with the borough (3.8%) but considerably lower than within Greater London (12.1%).

Vol 22 Table H.2 Socio-economics – ethnicity by assessment area

Ethnicity	Assessment area		
	Immediate area (250m)	Borough wide (LB of Lewisham)	Greater London
White	66.8%	65.9%	71.2%
BME	33.2%	34.1%	28.8%
Asian	3.4%	3.8%	12.1%
Black	21.4%	23.4%	10.9%
Other	5.3%	2.7%	2.7%
Mixed	3.1%	4.2%	3.2%

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

Religion and belief

H.1.9 Within 250m of the site, Christians are the predominant religious group (59.9%); broadly in line with the borough wide proportion (61.2%) and the Greater London level (58.2%). Muslims are the second most predominant religious group accounting for 5.1% of residents within 250m of the site, slightly higher than the LB of Lewisham proportion (4.6%) however moderately lower than the Greater London average (8.5%).

H.1.10 Within 250m, the proportion of residents who do not follow a religion (30.9%) is broadly in line with the borough wide level (30.1%) and somewhat higher than the Greater London average (24.3%).

Health indicators

H.1.11 Vol 22 Table H.3 outlines health indicators by assessment area, noting that within 250m, the proportion of residents with a long term or limiting illness (12.5%) is somewhat lower than within the LB of Lewisham (15.6%) and Greater London (15.5%). The proportion of residents who claim disability living allowance within 250m (5.9%) is broadly in line within the LB of Lewisham level (5.2%) and slightly higher than the Greater London average (4.5%).

Vol 22 Table H.3 Socio-economics – health indicators by assessment area

Health indicator	Assessment area		
	Immediate area (250m)	Borough wide (LB of Lewisham)	Greater London
Long term limiting sick	12.5%	15.6%	15.5%
Disability living allowance	5.9%	5.2%	4.5%

H.1.12 The local Middle Layer Super Output Area (MSOA)[iv] within which the construction site falls ranks within the highest quintile (ie, the highest being the worst) in comparison with all MSOAs across Greater London for levels of adult obesity. For child obesity, the entire borough ranks within the middle quintile compared to other London boroughs.

H.1.13 Data available at a borough level only indicates that the borough ranks within the middle quintile relative to all London boroughs for adults undertaking physical activity and within the lowest quintile (ie, lowest being the worst) for children undertaking physical activity.

H.1.14 For death rates by heart disease, circulatory disease and respiratory disease, the local MSOA ranks within the second highest quintile (ie, the highest being worst) relative to Greater London overall. Death rates by cancer and stroke are less prevalent and as such the local MSOA ranks within the second highest and middle quintiles respectively.

H.1.15 For female life expectancy, the local MSOA[5] falls within the second lowest quintile (ie, the lowest being the worst) and for male life expectancy, it ranks within the lowest quintile relative to Greater London overall. Average life expectancy for female residents is 80.3 to 81.9 years old and for males is 74.6 to 80.3.

[iv] 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.

Lifestyle and deprivation indicators

H.1.16 Vol 22 Table H.4 outlines lifestyle and income deprivation indicators by assessment area, showing that almost half of all households within 250m of the site do not own cars (49.5%), moderately higher than the LB of Lewisham (42.8%) and somewhat higher than the Greater London (37.5%) average.

H.1.17 The incidence of deprivation[v] measured by both income deprivation and overall deprivation within 250m (both 85.1%) is much higher than within the LB of Lewisham (36.3% and 32.7% respectively) and higher still than within the Greater London (30.8% and 24.5% respectively). This suggests there are substantial incidences of deprivation within 250m of the site.

Vol 22 Table H.4 Socio-economics – lifestyle and income deprivation levels by assessment area

Indicators	Assessment area		
	Immediate area (250m)	Borough wide (LB of Lewisham)	Greater London
No car households	49.5%	42.8%	37.5%
Income deprivation	85.1%	36.3%	30.8%
Overall deprivation	85.1%	32.7%	24.5%

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

H.2 Baseline economic profile

H.2.1 This section presents a profile of the economy local to the proposed construction site at the Earl 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 Lewisham) 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[vi].

Employment and businesses

H.2.4 Within approximately 250m of the site there are approximately 1,200 jobs.[vii] Vol 22 Table H.5[viii] illustrates the breakdown of employment by sector based on the UK Standard Industrial Classification (SIC) 2007[7]. It presents data for those sectors which account for more than 7% of total employment within 250m. It can be seen that:

a. Professional, Scientific and Technical Activities account for 12% of employment within 250m, which is double that within the LB of Lewisham (6%) and slightly more than within Greater London (11%).

b. Administrative and Support Service Activities account for 12% of employment within 250m of the site which is considerably greater than within both the LB of Lewisham (7%) and Greater London (8%).

c. Accommodation and Food Service Activities account for 12% of employment within 250m of the site, double that within the LB of Lewisham (6%) and considerably more than within Greater London (8%).

d. Information and Communication accounts for 9% of employment within 250m which is somewhat more than within the LB of Lewisham (5%) and Greater London (7%).

e. Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles accounts for 9% of employment within 250m, almost half that within the LB of Lewisham (16%) and Greater London (16%).

f. Education accounts for 7% of employment within 250m of the site, considerably less than within the LB of Lewisham (13%) but comparable to within Greater London (7%).

[vi] 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.

[vii] 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.

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

Vol 22 Table H.5 : Socio-economics – employment by top six sectors (2012)

	Assessment area		
Sector (Standard Industrial Code 2007)	**Immediate area (250m)**	**Borough wide (LB of Lewisham)**	**Greater London**
Professional, Scientific and Technical Activities	12%	6%	11%
Administrative and Support Service Activities	12%	7%	8%
Accommodation and Food Service Activities	12%	6%	8%
Information and Communication	9%	5%	7%
Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles	9%	16%	16%
Education	7%	13%	7%
Other (including unclassified)	39%	47%	43%

H.2.5 Within approximately 250m of the site there are approximately 270 businesses (defined here as business locations[ix]). The split of businesses by sector within 250m generally reflects the breakdown of employment by sector set out in Vol 22 Table H.5, with a relatively high proportion of businesses engaged in Professional, Scientific and Technical Activities (11%), Information and Communication (11%), Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles (10%) and Administrative and Support Service Activities (8%). However, Accommodation and Food Service Activities account for 5% of businesses, while accounting for 17% of employment, and Education accounts for 3% of businesses (eg, schools) but 7% of employment.

H.2.6 Vol 22 Table H.6 illustrates the size of businesses in terms of the number of employees at each business location / unit. At all geographical levels, businesses within the smallest size band (1 to 9 employees) account for the greatest proportion. However, there are a slightly greater proportion of businesses within the one to nine employee size band within approximately 250m (94%) than within the LB of Lewisham (92%) and Greater London (88%). Overall, the size banding profile of businesses within 250m of the site is generally similar to the LB of Lewisham and Greater London.

H.2.7 For the sectors accounting for the greatest proportions of jobs and businesses within approximately 250m, the size banding profile of businesses is generally similar. Between 90% to 93% of Information and Communication Activities, Wholesale and Retail Trade / Repair of Motor

[ix] 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.

Vehicles and Motorcycles and Administrative and Support Activities have one to nine employees compared to an average across all sectors of 94%; whereas 87% of Professional, Scientific and Technical businesses are of this size.

H.2.8 Within the Professional, Scientific and Technical Activities sector the proportion of businesses within approximately 250m with ten to 24 employees is 10%, compared to an average across all sectors of 4%. In the Administrative and Support Service Activities sector, 5% of businesses employ 50 to 99 employees, which is considerably greater than the averages for this size band at all three geographical levels.

Vol 22 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)	94%	4%	1%	1%	0%	0%
Professional, Scientific and Technical Activities	87%	10%	3%	0%	0%	0%
Information and Communication	93%	7%	0%	0%	0%	0%
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	93%	7%	0%	0%	0%	0%
- *Administrative and Support Service Activities*	90%	5%	0%	5%	0%	0%
Borough wide (LB of Lewisham)	92%	5%	2%	1%	0%	0%
Greater London	88%	8%	2%	1%	1%	0%

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.22**

Volume 22: Earl Pumping Station appendices

Appendix I: Townscape and visual

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

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Environmental Statement

Volume 22 Earl Pumping Station appendices

Appendix I: Townscape and visual

List of contents

Page number

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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
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Appendix J: Transport

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Thames Tideway Tunnel

Environmental Statement

Volume 22 Earl Pumping Station appendices

Appendix J: Transport

List of contents

Page number

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Appendix J: Transport

J.1 Introduction

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

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Appendix K: Water resources - groundwater

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Thames Tideway Tunnel

Environmental Statement

Volume 22 Earl Pumping Station appendices

Appendix K: Water resources − groundwater

List of contents

Page number

List of plates

Page number

List of tables

Page number

Appendix K: Water resources – groundwater

K.1 Geology

K.1.1 A summary of the anticipated geological succession to be encountered at the Earl Pumping Station is shown in Vol 22 Table K.1.

Vol 22 Table K.1 Groundwater – anticipated geological succession

Period	Series	Group	Formation
Quaternary	Holocene	Superficial Deposits	Made Ground
			Alluvium
			Langley Silt
	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 Formation
		No group	Thanet Sand
Cretaceous	Upper Cretaceous	White Chalk Subgroup	Seaford Chalk**
			Lewes Nodular Chalk
			New Pit Chalk
			Holywell Nodular Chalk

** Not a Formation but an important depositional feature*
*** Subdivided into the Haven Brow, Cuckmere and Belle Tout members.*

K.1.2 The superficial and solid geology in the vicinity of the site, as published by British Geological Survey (BGS)1, is shown in Vol 22 Figure 13.4.1 and Vol 22 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. Initial drilling took place during

2009 in the vicinity of Earl Pumping Station. Ground investigation was also undertaken in 2012 at the proposed shaft site location.. The depths and thicknesses of geological layers has been derived from a large number of boreholes drilled within the locality, including from boreholes SA6450, SR4118, SA6455A, SA6453A and SA6451 on site, SR1046 to SR1049 inclusive and PR1027 and SR1028 in the general site area. The locations of all these boreholes are shown in Vol 22 Figure 13.4.1 (see separate volume of figures). The information on the depths and thicknesses of the geological layers based on these boreholes is summarised in Vol 22 Table K.2 below.

Vol 22 Table K.2 Groundwater - anticipated ground conditions

Formation	Top elevation* (mATD)**	Depth below river bed (m)	Thickness (m)
Superficial Deposits/ Made Ground***	101.70	0.00	2.90
River Terrace Deposits	98.80	2.90	5.20
Lambeth Group (Upnor Formation only)****	93.60	8.10	1.90
Thanet Sand (including Bullhead Bed at base)	91.70	10.00	4.80
Seaford Chalk	86.90	14.80	36.0
Lewes Nodular Chalk	50.9	50.8	Not proven

** Based on assumed ground level of 101.4mATD.*
*** 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).*
**** Alluvium has been found on site between the Made Ground and River Terrace Deposits, with thicknesses of up to 2.1m.*
***** Lambeth Group (Upnor Formation) is absent on site ie River Terrace Deposits overlie the Thanet Sands directly*

K.1.4 The shaft and the base slab at the Earl Pumping Station site would extend down to 54. 08mATD and 51. 08mATD respectively and, according to the extrapolated depths and thicknesses of the geological layers, would extend into the Seaford Chalk Formation and to within 1.3m of the top of the Lewes Nodular Chalk.

K.1.5 The tunnelling excavation at the Earl Pumping Station site would pass through the Seaford.

K.1.6 The interception chamber and culvert approximately 11.5m, as assumed for the purpose of this assessment, would extend down to 90mATD into the River Terrace Deposits.

K.1.7 The superficial deposits, containing sandy gravely silt or sandy gravely clay with occasional brick and concrete fragments, is expected to be approximately 2.9m thick at the site. The Alluvium contains organic clay

and peat at ground investigation boreholes PR1027 and SR1028 adjacent to the River Thames. Alluvium has been recorded at the on site boreholes, with thicknesses of up to 2.1m.

K.1.8 The River Terrace Deposits are formed of extensive alluvial sand and gravel deposits laid down in river terraces by a braided river system of approximately 5km width, since the Anglian glaciation. Seven river terraces are distinguishable in London in terms of their altitude, rather than their lithological features, and range in thickness from approximately 2.5 to 28m. The River Terrace Deposits is expected to be 5.2m thick at the site.

K.1.9 Of the Lambeth Group, only the Upnor Formation is found within the locally area. The Upnor Formation forms the basal beds of the Lambeth Group and is described by the BGS as "mainly variably glauconitic fine- to medium-grained sand with beds and stringers of well-rounded, black flint pebbles" with "a persistent pebble bed at the top" and "a basal flint pebble bed"[2]. The Lambeth Group (Upnor Formation) has been found to be absent at the on site boreholes.

K.1.10 The Thanet Sand Formation is described by the BGS as "marine glauconitic clayey silts and fine sands, varying in thickness" (BGS, 2012) and only occurs in the London Basin[3].

K.1.11 The base of the Thanet Sands is a unit known as the "Bullhead Bed" and is described by the BGS as "a pale to medium-grey to brownish-grey, fine to coarse-grained sand; and a conglomerate up to 0.5m thick comprising rounded to angular flint cobble and gravel sized clasts set in a clayey, fine to coarse-grained sand matrix with glauconite pellets forming the basal bed of the Thanet Sand formation" (BGS, 2000). The Bullhead Bed marks the boundary between the Palaeocene deposits and the Cretaceous Chalk formed by an unconformity or break in sedimentation. The Thanet Sands Formation, including the Bullhead Bed, is expected to be 4.8m thick at site.

K.1.12 The Seaford Chalk is the upper layer of the White Chalk Subgroup and is described by the BGS as "firm white chalk with conspicuous semi-continuous nodular and tabular flint seams. Hardgrounds and thin marls are known from the lowest beds. Some flint nodules are large to very large" (BGS, 2012). This layer of Chalk is expected to be up to 36m thick at the site and is underlain by the Lewes Nodular Chalk Formation.

K.2 Hydrogeology

K.2.1 A summary of the anticipated hydrogeological conditions to be encountered at the Earl Pumping Station site is shown in Vol 22 Table K.3.

Vol 22 Table K.3 Groundwater - anticipated main hydrogeological units

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

Group	Formation		Hydrogeology
			confining layer
	River Terrace Deposits		Upper aquifer
Lambeth	Upnor Formation		Lower aquifer
No group	Thanet Sand		
White Chalk Subgroup	White Chalk	Undivided mainly Seaford Chalk	
		Lewes Nodular Chalk	
		New Pit Chalk	
		Holywell Nodular Chalk	

K.2.2 The Superficial Deposits formed of the Made Ground and Alluvium, overlie the River Terrace Deposits. The Superficial Deposits are likely to be in hydraulic continuity with the River Terrace Deposits in the vicinity of ground investigation boreholes SR1046 to SR1049 inclusive where they consist of sandy gravely silt or clay; however the Superficial Deposits are likely to act as a confining layer above the upper aquifer in the vicinity of ground investigation boreholes PR1027 and SR1028, where organic clay and peat were recorded. Site conditions are to be confirmed when the onsite ground investigation results are available during 2012.

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"[4].

K.2.4 The lower aquifer usually 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). The Upnor Formation has been found to be absent at the on site boreholes. 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 website, 2012).

K.2.5 Hydraulic continuity between the upper and lower aquifers is likely at the Earl Pumping Station site.

K.2.6 The drop shaft would pass through the upper aquifer and into the lower aquifer comprised of the Thanet Sands and the Chalk at Earl Pumping Station (the Upnor Formation is absent the site). The total thickness of lower aquifer material through which the shaft would pass would be approximately 35m.

K.2.7 The hydrogeological properties of the Chalk are defined by its transmissivity (the ability of rock to transmit water, which is a function of its permeability and aquifer thickness) and its storativity (the amount of water which the aquifer releases per unit change in water level). The Seaford Chalk, into which the shaft would extend and through which the tunnel would pass, forms a highly transmissive aquifer. It is characterised by rapid preferential flow commonly established along fissures and enhanced fractures, often along or above flint and marl layers within the Chalk. However transmissivity and groundwater storage therefore vary considerably both laterally and vertically within this formation, depending on the development of fissures. The Chalk in the Earl Pumping Station area is expected to have a low transmissivity value of approximately $10m^2/d$ on average[5]. The storativity value is expected to be approximately 1 x10-4 (EA & ESI, 2010).

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 across London, mainly in the lower aquifer, for which records are available dating back over 50 years.

K.3.2 Information on groundwater levels for this assessment was therefore collected from the six ground investigation boreholes located within 0.5km of the site. These boreholes have response zones in the River Terrace Deposits, Thanet Sands and the Chalk and are monitoring groundwater levels in both the upper and lower aquifers. The response zone depths, the monitored strata and the frequency of monitoring are detailed in Vol 22 Table K.4. The manual dip and logger data collected from these monitoring boreholes is shown in Vol 22 Table K.5.

Vol 22 Table K.4 Groundwater - monitoring boreholes

Borehole	Response zone depths mATD	Strata*	Monitoring
PR1027	90.32-76.32	Thanet Sand Formation (TSF)	Fortnightly dips and logger
	44.32-29.32	Lewes Chalk (LCK)	Fortnightly dips and logger
SR1028	94.64-85.64	River Terrace Deposits (RTD)	Fortnightly dips and logger
	69.64-57.64	Seaford Chalk (SCK)	Fortnightly dips and logger
SR1046	37.36-27.36	Lewes Chalk	Fortnightly dips

Borehole	Response zone depths mATD	Strata*	Monitoring
SR1047	46.86-36.86	Seaford Chalk	Fortnightly dips
SR1048	46.86-36.86	Lewes Chalk	Fortnightly dips
SR1049	53.18-43.18	Seaford Chalk	Fortnightly dips

** The drop shaft at the Earl Pumping Station site penetrates the River Terrace Deposits, the Thanet Sands and the Seaford Chalk*

Vol 22 Table K.5 Groundwater – summary level data

Borehole	Period of record	Maximum Month Year		Minimum Month Year		Average over period of record	
		mbgl	mATD	mbgl	mATD	mbgl	mATD
PR1027 –TSF	17/11/2009 – 16/11/2011	5.12 (February 2010)	99.20 (February 2010)	5.71 (November 2009)	98.62 (November 2009)	5.36	98.96
PR1027 –LCK	13/10/2009 – 02/10/2011	4.96 (September 2011)	99.36(September 2011)	5.56 (May 2011)	98.79 (May 2011)	5.30	99.02
SR1028 – RTD	22/05/2009 – 11/07/2012	5.24 (October 2010)	99.40 (October 2010)	7.08 (October 2010)	97.56 (October 2010)	5.71	98.93
SR1028 –SCK	22/05/2009 – 11/07/2012	4.82 (October 2010)	99.82 (October 2010)	6.33 (March 2012)	98.31 (March 2012)	5.40	99.24
SR1046 –LCK	01/06/2009 - 12/07/2012	3.37 (July 2012)	98.99 (July 2012)	3.76 (November 2009)	98.60 (November 2009)	3.58	98.78
SR1047 –SCK	01/06/2009 – 07/12/2011	3.27 (January 2011)	98.59 (January 2011)	3.81 (June 2009)	98.05 (June 2009)	3.54	98.32
SR1048 –LCK	01/06/2009 - 11/07/2012	3.55 (May 2012)	98.31 (May 2012)	4.12 (November 2009)	97.74 (November 2009)	3.83	98.03
SR1049 –SCK	22/10/2009 – 11/07/2012	3.78 (November 2010)	99.40 (November 2010)	5.62 (July 2012)	97.56 (July 2012)	4.25	98.93

K.3.3 The recorded water levels in the River Terrace Deposits at SR1028 range between 97.56 and 99.40mATD, fluctuating above and below the top of the formation at 98.8mATD. This suggests that the upper aquifer has the potential to be confined, by the overlying Made Ground and Alluvium, which predominantly consists of clay and peat in this area.

K.3.4 The water level records for the River Terrace Deposits and the Seaford Chalk, as measured at SR1028, while at different levels, show very similar fluctuations, suggesting that these units are in hydraulic continuity. The proximity of this monitoring borehole to the River Thames and the magnitude of fluctuation suggest that these fluctuations are tidal. The monitoring boreholes SR1046 to SR1049 inclusive also show tidal fluctuations but at a reduced magnitude to SR1028, due to the increased distance from the River Thames.

K.3.5 The recorded water levels for the Thanet Sand at PR1027 range between 98.62 and 99.20mATD, indicating that groundwater levels are consistently above the top of this formation at 91.7mATD.

K.3.6 The water level records for the Thanet Sand and the Lewes Nodular Chalk, as measured at PR1027, show very similar fluctuations, suggesting that these units are in hydraulic continuity. The geological conditions encountered here also indicate that there is no confining layer between these units.

K.3.7 The water level (piezometric head) in the Chalk, as measured at PR1027, SR1028, SR1048, SR1047, SR1048 and SR1049, is consistently above the top of the Chalk (87.2mATD) and show that this unit is fully saturated. A hydrograph, showing these recorded water levels or piezometric head, is shown in Vol 22 Figure 13.4.3 (see separate volume of figures).

K.3.8 The nearest EA groundwater level monitoring borehole is located within the site (TQ37/268), approximately 40m to the west of the shaft. This borehole records levels in the lower aquifer (mainly Chalk). A hydrograph showing the recorded water levels or piezometric head levels at this regional observation borehole is shown in Vol 22 Figure 13.4.4 (see separate volume of figures).

K.3.9 The EA have produced regional groundwater contour plots which display the groundwater flowing in a northwest direction across site[6]. As the River Terrace Deposits, the Thanet Sands and the Seaford and Lewes Nodular Chalk appear to be in hydraulic continuity, the groundwater flow direction in the River Terrace Deposits is likely to be in a northwest direction in this area.

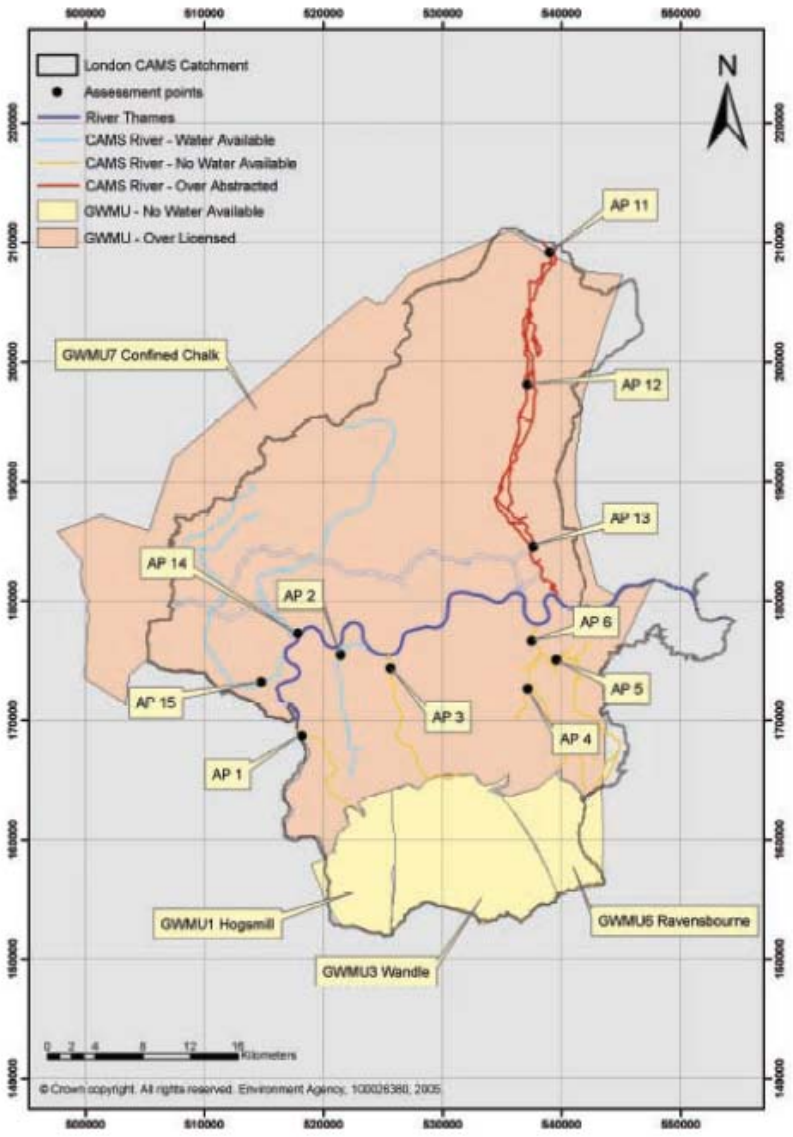
K.4 Groundwater abstractions and protected rights

Groundwater licensing policy

K.4.1 The EA has defined a policy, through its London Catchment Abstraction Management Strategy (CAMS), that restricts new abstractions in central, east and south London and further abstraction in areas approaching their sustainable limit[7]. The Earl Pumping Station site is within the Chalk groundwater management unit GWM7, which is classified as being over-

licensed (see Vol 22 Plate K.1) (EA, 2006). Within this area, there is a limit on the availability of groundwater resources such that large abstractions (>1-2Ml/d) would generally not be granted unless the applicant can demonstrate that the resources are available (EA, 2006). In addition, large abstractions may also have a time limit shorter than the London CAMS common end date of 2013 (EA, 2006).

Vol 22 Plate K.1 Groundwater - confined chalk licensing



**Reproduced from EA, 2006*
Note: GWMU – groundwater management unit, AP – assessment point

K.4.2 The CAMS policy also states that, "every application would be assessed on its own merits, be subject to a detailed local hydrogeological assessment and require the submission of the necessary supporting justification and reports for a decision to be made on an individual scheme" (EA, 2006). A preliminary hydrogeological assessment, following guidance provided in the CAMS policy, is completed for the proposed development in Vol 22 Table K.6.

Vol 22 Table K.6 Groundwater - licensing assessment

No.	Question	Preliminary response
1.	Has there been any long-term (several years) downward trend in the groundwater level in the vicinity of the application?	The hydrograph in Vol 22 Figure 13.4.4 for an EA observation borehole at the site shows the groundwater level to have been stable with no downward trend since 2000.
2.	The groundwater level in relation to the base of the London Clay. If the groundwater level is near the base of the London Clay, then the EA would be unlikely to grant the abstraction licence. The EA would use discretion if there is a significant thickness of the Lambeth Group below the London Clay, but the aim is to manage abstractions to keep groundwater levels above the Thanet Sands.	There is no London Clay Formation at the site and therefore the test applied would be whether the Thanet Sands would dewater since this could create groundwater quality issues. Groundwater levels are historically between approximately 96.5 and 99.6mATD; between 4.8m and 7.9m above the top of the Thanet Sands at 91.7mATD. More recently groundwater levels have remained constant at around 98m therefore, if the dewatering impact is less than approximately 6m, groundwater levels would remain above the Thanet Sands.
3.	Any recent abstraction development in the same area. If groundwater levels have not yet responded to a recent change in abstraction, the EA may not grant further licences in that area.	No recent developments are known.
4.	Other proposals in the area that have been refused for water resource reasons in the last five years.	No refusals known.
5.	Proximity of the proposal to an existing or proposed Artificial Recharge Scheme (ARS). Artificial Recharge scheme proposals would be treated as a special case as they involve the management of groundwater levels to provide additional resource to the scheme operator.	No known ARS in the vicinity.

K.4.3 The estimated amounts of dewatering needed at Earl Pumping Station, less than 200m^3/d, are 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 a radius of influence of up to 1km around the site have been identified.

K.4.5 There are two Chalk groundwater abstractions located within 1km of the Earl Pumping Station site. These licensed abstractions are located approximately 0.6km to the north (28/39/42/0073) and 0.8km to the northwest (28/39/42/0048) of the site.

K.4.6 Further details of these licensed abstractions are given in Vol 22 Table K.7.

Vol 22 Table K.7 Groundwater - licensed abstractions

Licence Number	Licence Holder	Purpose	Aquifer	Licensed Volume [m^3/annum]
28/39/42/0073	Harmsworth Quays Printing Limited	Industrial, commercial and public services including drinking, cooking and sanitary	Chalk	52,000
28/39/42/0048	London Borough of Southwark	Industrial, commercial and public services including amenity	Chalk	67,500

K.4.7 There are no licensed abstractions from the River Terrace Deposits or known unlicensed abstractions within 1km of the Earl 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. These are designed to safeguard groundwater resources from potentially polluting activities.

K.5.2 The nearest SPZ to the site for a Chalk source is approximately 1.4km to the southeast.

K.6 Other designations

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

K.7 Groundwater quality and land quality

K.7.1 Historical mapping at the Earl Pumping Station site identifies asphalt works at the site between c1874 – c1880, which are considered a potentially contaminative land use (Vol 22 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.

Groundwater quality

K.7.2 The groundwater quality data presented in Vol 22 Table K.8 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 on site (SA6450, SR4118, SA6455A, SA6453A and SA6451) which were drilled in 2012 and those located within 1km of the site (SR1048, SR1047, SR1049, SR1046, PR1027, SR1028, SR1045, SR1050, SR1042, SR1040 and SR1041) which were drilled in 2009 (for locations see Vol 22 Figure 13.4.1). The origin of these boreholes and groundwater quality data is detailed in Vol 22 Table K.8. Any exceedances of the UK drinking water standards[8] or relevant Environmental Quality Standards (EQS)[9] are shaded in blue in this table.

K.7.3 The data shows numerous exceedances of the relevant standards with regard to brackish conditions in the River Terrace Deposits, Thanet Sands and in the Chalk. The occurrence of brackish conditions is indicated by high sodium or chloride concentrations both on site and across the wider area around Earl Pumping Station.

K.7.4 The data also shows numerous exceedances of the relevant standards with respect to heavy metals, pesticides, hydrocarbons and a range of organic substances in the River Terrace Deposits and the Thanet Sands. In particular the onsite ground investigation boreholes in the River Terrace Deposits (SA6455, SA6450 and SR4118) showed some high exceedances of anthracene, benzene, fluroanthene, naphthalene, phenol, polycyclic aromatic hydrocarbon (PAH) and xylene compounds. The Thanet Sands boreholes on site (SA6451 and SA6455) showed exceedances of anthracene, benzene, heavy metals, naphthalene, phenol, PAHs and xylene compounds. In general, the number of substances exceeding standards were fewer in the Thanet Sand than the River Terrace Deposits. PAH's and the various organic compounds detected may be formed during a range of human activities, including incomplete combustion of carbon-based fuels and other industrial processes[10]. Phenols may be formed naturally by the decomposition of organic materials but are also a constituent of coal tar[11]. In addition, PAH's and phenols are considered to be Priority Hazardous Substances under the Water Framework Directive[12].

K.7.5 The concentrations for a majority of these organic compounds are highest in the River Terrace Deposits at SA6450, and there is a reduction in concentration within the Thanet Sands at SA6453A and SA6451. These exceedances are likely to be linked to the identification of creosote (the main constituents of which are PAH, phenols and creosols – all of which

are harmful to health) in on site ground investigation boreholes drilled in March 2012 at the base of the River Terrace Deposits and the top of the Upnor Formation. The presence of these substances, although at lower concentrations in the Thanet Sands would indicate some degree of hydraulic connection between the River Terrace Deposits, Upnor Formation and Thanet Sands at this site. None of the Chalk boreholes, lying 455m down hydraulic gradient (SR1049), nor any of the up hydraulic gradient boreholes (SR1048, SR1047, PR1027 and SR1028), showed any exceedances of the respective water quality standards.

K.7.6 The EA monitors groundwater quality at a number of locations across London. The nearest EA groundwater quality monitoring location to the site is at the Greenwich Deepwater Terminal. The distance of this location from the site (approximately 3km) makes it unreliable as a predictor of groundwater quality conditions around the Earl Pumping Station site.

K.7.7 The land quality data from the ground investigation boreholes used in the groundwater quality assessment shows exceedances of the human health screening values[13] (soil guideline values designed to be protective of human health) within the Thanet Sand at SA6453A and SA6451 (both of which are located on site) with respect to hydrocarbons and PAH's. Further detail is provided in the land quality assessment (see Vol 22 Appendix F).

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Vol 22 Table K.8 Groundwater - groundwater quality

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210 m	210m	210m	210m	210m	210m	210m	255 m	455 m	474 m	507 m	538 m	717 m	778 m	960 m	970 m	970 m	995 m	1007 m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
>C6 - C7	-	mg/l	None	0.1	0.1	<0.5	<0.5	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
>C7 - C8	-	mg/l	None	0.1	0.1	<0.5	<0.5	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
>C8 - C10	-	mg/l	None	0.4	0.3	1.2	1.0	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1 - Dichloroethane	10	ug/l	WFD 2010	1	1	<100	<100	1	-	<0.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1 - Dichloroethene	30	ug/l	WHO 2004	1	1	<100	<100	1	-	<0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1 - Dichloropropene	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1,1 - Trichloroethane	100	ug/l	SW Regs 98	1	1	<100	<100	1	-	<0.1	<0.08	<0.08	-	< 0.08	<0.08	-	-	-	-	-	-	-	-	-	-	-	-
1,1,1,2 - Tetrachloroethane	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1,2 - Trichloroethane	400	ug/l	SW Regs 98	1	1	<100	<100	1	-	<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	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2 - Dibromo - 3 – Chloropropane	0.1	ug/l	DWS 2010	5	5	<500	<500	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2 - Dibromoethane	0.1	ug/l	DWS 2010	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2 - Dichlorobenzene	1000	ug/l	WHO 2004	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2 - Dichloroethane {Ethylene Dichloride}	3	ug/l	WS Regs 20	1	1	<100	<100	1	-	<0.12	<0.12	<0.12	-	< 0.12	<0.12	-	-	-	-	-	-	-	-	-	-	-	-
1,2 - Dichloroethene (Trans)	30	ug/l	WHO 2004	1	1	<100	<100	1	-	<0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2 - Dichloropropane	0.1	ug/l	DWS 2010	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3 - Trichlorobenzene	-	ug/l	None	5	5	<7	<500	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3 - Trichloropropane	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2,4 - Trichlorobenzene	-	ug/l	None	5.0	5.0	<500	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2,4 - Trimethylbenzene	-	ug/l	None	116	62	252	225	2	-	-	-	-	-	-	-	-	-	-	<1.7	<1.7	-	-	-	-	-	-	-
1,3 - Dichlorobenzene	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,3 - Dichloropropane	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,3 - Dichloropropene (Trans)	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,3,5 - Trimethylbenzene	-	ug/l	None	48	29	110	106	1	-	-	-	-	-	-	-	-	-	-	<1.8	<1.8	-	-	-	-	-	-	-
1-Methylnaphthalene	-	mg/l	None	0.531	0.19	993	1100	0.019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 - Chloronaphthalene	-	ug/l	None	2.0	2.0	<3	<2	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 – Chlorophenol	50	ug/l	WFD 2010	20.0	20.0	<26	<24	20.0	-	<0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 – Chlorotoluene	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 - Methylnaphthalene	-	ug/l	None	537.0	200.0	1430	1510	17.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 - Methylphenol {O-Cresol}	-	ug/l	None	5.0	11.0	<7	<6	5.0	-	<0.021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 – Nitroaniline	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 – Nitrophenol	-	ug/l	None	20.0	20.0	<26	<24	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,2 - Dichloropropane	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,3 - Dimethylphenol {2,3-Xylenol}	-	ug/l	None	-	-	-	-	-	-	<0.05	-	-	<0.0500	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-
2,3,5,6 - Tetrachloroaminobenzene {2,...Aniline}	-	ug/l	None	-	-	-	-	-	-	0.01000	-	-	0.00800	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,3,6 - TBA {2,3,6-Trichlorobenzoic Acid}{Cas Rn 50-31-7}	-	ug/l	None	-	-	-	-	-	-	<0.01600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210 m	210m	210m	210m	210m	210m	210m	210m	255 m	455 m	474 m	507 m	538 m	717 m	778 m	960 m	970 m	970 m	995 m	1007 m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
2,4 - Dichlorophenol	20	ug/l	WFD 2010	20.0	20.0	<26	<24	20.0	<0.1	-	-	-	-	-	-	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	<0.4	<0.4	<0.1	<0.1	<0.1
2,4 - Dimethylphenol {2,4-Xylenol}	-	ug/l	None	20.0	20.0	72	34	20.0	<0.1	<0.024	-	-	-	-	-	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	<0.4	<0.4	<0.1	<0.1	<0.1
2,4 - Dinitrotoluene	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4,5 - Trichlorophenol	-	ug/l	None	20.0	20.0	<26	<24	20.0	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4,6 - Trichlorophenol	-	ug/l	None	20.0	20.0	<26	<24	20.0	<0.1	<0.028	-	-	-	-	-	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	<0.4	<0.4	<0.1	<0.1	<0.1
2,4-D {2,4-Dichlorophenoxyacetic acid}	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4-DB {4-(2,4-dichlorophenoxy)butyric acid}	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4-Dinitrophenol	-	mg/l	None	0.01	0.01	<0.013	<0.012	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,6 - Dichlorophenol	-	ug/l	None	-	-	-	-	-	<0.1	<0.05	-	-	-	-	-	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	<0.4	<0.4	<0.1	<0.1	<0.1
2,6 - Dimethylphenol {2,6 Xylenol}	-	ug/l	None	-	-	-	-	-	-	<0.05	-	-	<0.0500	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-
2,6 - Dinitrotoluene	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3 – Chlorophenol	-	ug/l	None	-	-	-		-	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3 - Methylphenol {M-Cresol}	-	ug/l	None	-	-	<26	<24	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3 – Nitroaniline	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3,3'-Dichlorobenzidine	-	mg/l	None	0.02	0.02	<0.026	<0.024	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3,4 - Dimethylphenol {3,4 Xylenol}	-	ug/l	None	-	-	-	-	-	-	<0.05	-	-	<0.0500	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-
3,5 - Dimethylphenol {3,5-Xylenol}	-	ug/l	None	-	-	-	-	-	-	<0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 - Bromophenylphenyl ether	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 - Chloro - 3- Methylphenol {P-Chloro-M-Cresol}	40	ug/l	WFD 2010	5.0	5.0	<7	<6	5.0	<0.1	<0.05	-	-	-	-	-	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	<0.4	<0.4	<0.1	<0.1	<0.1
4 – Chloroaniline	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 – Chlorophenol	-	ug/l	None	20.0	20.0	<26	<24	20.0	-	<0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 - Chlorophenyl phenyl ether	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 – Chlorotoluene	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 – Nitroaniline	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 – Nitrophenol	-	ug/l	None	50.0	50.0	<65	<59	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4,6-Dinitro-2-methylphenol	-	mg/l	None	0.05	0.05	<0.065	<59	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Methylphenol {para-Cresol}	-	ug/l	None	20.0	20.0	<26	<24	20.0	-	0.028	-	-	<0.0500	-	0.18	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthene	-	ug/l	None	156	156	10400	4650	17.5	<0.01	-	-	-	-	-	-	<0.01	<0.01	<0.01	<0.015	<0.015	58	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	-	ug/l	None	24.1	2.68	82.7	27.9	0.466	<0.01	-	-	-	-	-	-	<0.01	<0.01	<0.01	<0.011	0.0188	0.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenapthene	-	ug/l	None	643.0	174.0	1350		30.0	-	5.4	-	-	0.05	-	5.9	-	-	-	-	-	-	-	-	-	-	-	-
Acenapthylene	-	ug/l	None	4.0	2.0	<3	9	2.0	-	0.05	-	-	<0.01	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-
Aldicarb	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aldicarb Sulphone	-	ug/l	None	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aldrin	0.03	ug/l	DWS 2010	-	-	-	-	-	-	<0.00300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aliphatics >C10-C12	-	ug/l	None	10.0	10.0	1760	191	10.0	1	-	-	-	-	-	-	1	1	<1	<10	<10	1	3	3	2	42	3	<1
Aliphatics >C12-C16 (Aqueous)	-	ug/l	None	10.0	10.0	4880	383	10.0	3	-	-	-	-	-	-	3	2	<1	<10	<10	<1	6	5	5	2	6	4
Aliphatics >C16-C21 (Aqueous)	-	ug/l	None	10.0	10.0	3400	240	10.0	6	-	-	-	-	-	-	5	4	<1	<10	<10	2	15	5	5	1	7	8
Aliphatics >C21-C35 (Aqueous)	-	ug/l	None	10.0	10.0	2210	168	10.0	8	-	-	-	-	-	-	8	5	<1	<10	<10	4	120	12	4	17	11	12
Aliphatics >C6-C8	-	ug/l	None	-	-	-		-	<0.1	-	-	-	-	-	-	<0.1	<0.1	<0.1	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210m	210m	210m	210m	210m	210m	210m	255m	455m	474m	507m	538m	717m	778m	960m	970m	970m	995m	1007m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
Aliphatics >C8 - C40	-	mg/l	None	0.01	0.01	12.9	1.1	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aliphatics >C8-C10	-	ug/l	None	10.0	10.0	579	110	10.0	<0.1	-	-	-	-	-	-	<0.1	<0.1	<0.1	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatics C5-C6	-	ug/l	None	-	-	-	-	-	<0.1	-	-	-	-	-	-	<0.1	<0.1	<0.1	<10	<10	7.6	<0.1	<0.1	<0.1	<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	-	-	-	-	-	400	415	437	404	-	412	408	410	370	320	-	-	270	360	300	230	310	240	230
Aluminium Dissolved	200	ug/l as Al	DWS 2010	-	-	-	-	-	-	<80	-	-	0.042	-	0.013	-	-	-	-	-	-	-	-	-	-	-	-
Aluminium Total	200	ug/l as Al	DWS 2010	-	-	-	-	-	-	50	2500	0.27	-	0.076	0.016	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia - As N	0.39	mg/l as N	WS Regs 20	-	-	-	-	-	-	0.86	0.86	0.78	-	0.89	0.77	-	-	-	-	-	-	-	-	-	-	-	-
Ammoniacal nitrogen	-	mg/l	None	3.1	2.1	<0.01	3.4	0.6	1.1	-	-	-	-	-	-	0.35	4	0.94	0.256	12	0.02	2.6	1.9	0.3	4.5	2.6	0.64
Anions	-	meq/l	None	-	-	-		-	-	19.046	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	0.1	ug/l	SW WFD	31	5.81	1830	818	1.23	<0.01	<0.01	-	-	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.015	0.162	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony Total	5	ug/l	DWS 2010	-	-	-	-	-	-	0.5	-	-	0.3	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-
Aromatics >C7-C8	50	ug/l	WFD 2010	-	-	-	-	-	<0.1	-	-	-	-	-	-	<0.1	<0.1	<0.1	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics >C8 - C40	-	mg/l	None	8.27	7.11	676	52.4	0.324	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aromatics >EC10-EC12	-	ug/l	None	4,380.0	5,230.0	117000	13200	170.0	6	-	-	-	-	-	-	11	2	<1	<10	<10	2.6	4	5	6	9	2	1
Aromatics >EC12-EC16 (Aqueous)	-	ug/l	None	2,720.0	1,080.0	267000	17500	86.0	12	-	-	-	-	-	-	15	3	1	<10	<10	8	6	6	7	5	4	3
Aromatics >EC16-EC21 (Aqueous)	-	ug/l	None	778.0	225.0	209000	14600	36.0	11	-	-	-	-	-	-	11	4	5	<10	<10	10	7	27	9	8	5	7
Aromatics >EC21-EC35 (Aqueous)	-	ug/l	None	73.0	15.0	70500	5600	17.0	16	-	-	-	-	-	-	18	4	5	<10	<10	19	15	22	20	15	10	15
Aromatics >EC8-EC10	-	ug/l	None	320.0	563.0	9200	1280	14.0	<0.1	-	-	-	-	-	-	<0.1	<0.1	<0.1	<10	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatics C6-C7	1	ug/l	DWS 2010	-	-	-	-	-	<0.1	-	-	-	-	-	-	<0.1	<0.1	<0.1	<10	<10	6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic Total	10	ug/l as As	DWS 2010	16	3	-	-	32	<1	6.1	2.9	6.1	-	4.1	5.2	4	<1	2	1.46	5.68	3	<1	3	5	<1	<1	<1
Asulam	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Atrazine { }	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00300	<0.00300	<0.08000	-	<0.00800	<0.00800	-	-	-	-	-	-	-	-	-	-	-	-
Atrazine Desethyl {De-Ethyl Atrazine}	-	ug/l	None	-	-	-	-	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Atrazine Desisopropyl	-	ug/l	None	-	-	-	-	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Azinphos-Ethyl	-	ug/l	None	-	-	-	-	-	-	<0.00700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Azinphos-Methyl	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium Dissolved	100	ug/l as Ba	SW Regs 96	-	-	-	-	-	-	120	-	-	110	-	39	-	-	-	-	-	-	-	-	-	-	-	-
Barium Total	100	ug/l as Ba	SW Regs 96	523	396	-	-	2	-	130	-	-	110	-	47	-	-	-	-	-	-	-	-	-	-	-	-
Benazolin	-	ug/l	None	-	-	-	-	-	-	<0.00900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bendiocarb	-	ug/l	None	-	-	-	-	-	-	<0.00900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bentazone	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0080	<0.0080	<0.0080	-	<0.0080	<0.0080	-	-	-	-	-	-	-	-	-	-	-	-
Benz[a]-Anthracene	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	<0.01	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	1	ug/l	DWS	418.0	300.0	403	238	5.0	<1	<0.07	<0.07	<0.07	<0.07	0.14	<0.07	<1	<1	<1	<10	<10	0.48	<1	<1	<1	<1	<1	<1

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210 m	210m	210m	210m	210m	210m	210m	255 m	455 m	474 m	507 m	538 m	717 m	778 m	960 m	970 m	970 m	995 m	1007 m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
			2010																								
Benzene (1,2,3 Trichlorobenzene)	-	ug/l	None	-	-	-	-	-	-	<0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene (1,2,4 Trichlorobenzene)	-	ug/l	None	-	-	-	-	-	-	<0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene (1,3,5 Trichlorobenzene)	-	ug/l	None	-	-	-	-	-	-	<0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene (Ethylbenzene)	20	ug/l	FW List II	-	-	-	-	-	-	0.08	-	-	<0.06	-	<0.06	-	-	-	-	-	-	-	-	-	-	-	-
Benzo (a) anthracene	-	ug/l	None	2.9	0.261	699	355	0.219	<0.01	-	-	-	-	-	-	<0.01	<0.01	<0.01	<0.009	0.193	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo[a]Pyrene	0.01	ug/l	DWS 2010	0.675	0.053	270	148	0.054	<0.01	<0.01	<0.00500	0.00830	<0.01	<0.00500	<0.01	<0.01	<0.01	<0.01	<0.009	0.145	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo[b]Fluoranthene	0.03	ug/l	WFD D 10	0.897	0.064	354	191	0.099	<0.01	<0.01	-	-	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.023	0.181	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo[g,h,i]Perylene	0.002	ug/l	WFD D 10	0.163	0.016	86.9	55.2	0.022	<0.01	<0.01	-	-	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.016	0.0435	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo[k]Fluoranthene	0.03	ug/l	WFD D 10	0.36	0.027	149	76.7	0.034	<0.01	<0.01	-	-	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.027	0.102	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzoic Acid	-	mg/l	None	0.1	0.1	<0.130	<0.118	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzyl alcohol	-	mg/l	None	0.005	0.005	<0.007	<6	0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beryllium Total	0	ug/l as Be	GW Regs 98	-	-	-	-	-	-	<3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bifenthrin	-	ug/l	None	-	-	-	-	-	-	0.00900	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biphenyl	25	ug/l	WFD 2010	163.0	34.0	377	407	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis (2 - chloroethoxy) methane	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis (2 - chloroethyl) ether	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-chloroisopropyl)ether	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl) phthalate	1.3	ug/l	WFD 2010	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron Dissolved	1000	ug/l as B	DWS 2010	-	-	260	290	-	-	174	-	-	210	-	190	-	-	-	-	-	-	-	-	-	-	-	-
Boron Total	1000	ug/l as B	DWS 2010	490	350	-	-	320	180	190	200	190	-	0.17	0.2	180	<100	<100	256	636	120	470	400	110	220	510	<100
Bromate	10	ug/l as BrO3	DWS 2010	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	< 1.0	<0.5	-	-	-	-	-	-	-	-	-	-	-	-
Bromide ion	2	ug/l as Br	FW List II	-	-	-	-	-	-	860	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromobenzene	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromochloromethane	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromodichloromethane	100	ug/l	WS Regs 20	1	1	<100	<100	1	-	<0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromoform	100	ug/l	WS Regs 20	1	1	<100	<100	1	-	<0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromomethane	-	ug/l	None	5	5	<500	<500	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromoxynil	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bupirimate	-	ug/l	None	-	-	-	-	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Butyl benzyl phthalate	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C5 - C6 >C6 - C7 >C7 - C8 >C8 - C10 C5 - C6	-	mg/l	None	0.1	0.1	<0.5 <0.5 <0.5 1.2	<0.5 <0.5 <0.5 1.0	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium Dissolved	5	ug/l as Cd	DWS 2010	-	-	<0.1	<0.1	-	-	<1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium Total	5	ug/l as Cd	DWS	0.1	0.1	-	-	1	<2	<1.5	<1.5	<1.5	<1.5	< 1.5	<1.5	<2	<2	<2	<0.2	<0.2	<2	<2	<2	<2	<2	<2	<2

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210m	210m	210m	210m	210m	210m	210m	255m	455m	474m	507m	538m	717m	778m	960m	970m	970m	995m	1007m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
			2010																2	2							
Calcium Dissolved	250	mg/l as Ca	DWS 2010	-	-	-	-	-	-	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calcium Total	250	mg/l as Ca	DWS 2010	-	-	-	-	-	-	160	190	150	-	160	140	-	-	-	-	-	-	-	-	-	-	-	-
Carbaryl	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbendazim / Benomyl	0.1	ug/l	FW List II	-	-	-	-	-	-	<0.00300	<0.00300	-	-	<0.00500	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-
Carbetamide	-	ug/l	None	-	-	-	-	-	-	<0.00600	<0.00600	-	-	<0.01000	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-
Carbofuran	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbon Dioxide	-	ug/l	None	-	-	-	-	-	-	48400	-	-	62500	-	45500	-	-	-	-	-	-	-	-	-	-	-	-
Carbon Organic Dissolved	-	mg/l as C	None	-	-	-	-	-	-	7.72	-	-	8.9	-	8.8	-	-	-	-	-	-	-	-	-	-	-	-
Carbon tetrachloride	3	ug/l	DWS 2010	1	1	<100	<100	1	-	<0.07	<0.07	<0.07	-	<0.070	<0.070	-	-	-	-	-	-	-	-	-	-	-	-
Carbophenothion	-	ug/l	None	-	-	-	-	-	-	<0.01300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cations	-	meq/l	None	-	-	-	-	-	-	17.537	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (cis)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane Trans	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorfenvinphos	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00900	<0.00900	<0.00900	-	<0.00900	<0.00900	-	-	-	-	-	-	-	-	-	-	-	-
Chloridazon	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloride	250	mg/l as Cl	DWS 2010	-	-	-	-	-	330	311	330	262	-	306	228	39	370	160	-	-	120	400	720	110	1300	900	440
Chlormequat	-	ug/l	None	-	-	-	-	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorobenzene	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorodibromomethane	-	ug/l	None	-	-	-		-	-	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloroethane	-	ug/l	None	5	5	<500	<500	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloroform	100	ug/l	WS Regs 20	5	5	<500	<500	5	-	<0.6	<0.6	<0.6	-	<0.600	<0.600	-	-	-	-	-	-	-	-	-	-	-	-
Chloromethane	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloroxuron	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorpropham	-	ug/l	None	-	-	-	-	-	-	<0.03600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorpyrifos	0.03	ug/l	WFD 2010	-	-	-	-	-	-	<0.00700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorpyriphos-Methyl	-	ug/l	None	-	-	-	-	-	-	<0.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorthalonil	-	ug/l	None	-	-	-	-	-	-	<0.01800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlortoluron	2	ug/l	FW List II	-	-	-	-	-	-	<0.00400	<0.00400	<0.20000	-	<0.01000	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-
Chlostridia	0		WFD 2010	0	0	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium Dissolved	50	ug/l as Cr	DWS 2010	10	5	14	9	69	-	14	-	-	13	-	15	-	-	-	-	-	-	-	-	-	-	-	-
Chromium Total	50	ug/l as Cr	DWS 2010	10	10	-		10	<5	15	20	14	-	13	-	<5	<5	5	4.44	4.59	<5	<5	<5	<5	<5	<5	<5
Chrysene	-	ug/l	None	2.11	0.183	599	312	0.218	<0.01	<0.01	-	-	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.013	0.56	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
cis-1,3 - Dichloropropene	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
cis-1-2-Dichloroethene	-	ug/l	None	1	1	<100	<100	1	-	<0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clopyralid	-	ug/l	None	-	-	-	-	-	-	<0.01900	<0.01900	<0.01900	-	<0.01900	<0.01900	-	-	-	-	-	-	-	-	-	-	-	-

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210m	210m	210m	210m	210m	210m	210m	255m	455m	474m	507m	538m	717m	778m	960m	970m	970m	995m	1007m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
Cobalt - As Co	0	ug/l	GW Regs 98	-	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coliform Bacteria QUANTITRAY (COLILERT)	0	MPN/100 ml	WS Regs 20	23	8500	>10000	62	2700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Conductivity @ 20°C	2500	uS/cm	WS Regs 20	-	-	-	-	-	1740	-	-	-	-	-	-	1280	923	1240	799	-	1220	1720	2550	769	4920	3040	1970
Copper Dissolved	2000	ug/l as Cu	DWS 2010	-	-	5	<1	-	-	<5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper Total	2000	ug/l as Cu	DWS 2010	6	3	-	-	46	2	<5.5	5.8	<5.5	-	< 5.5	<5.5	2	<2	7	8.57	10.5	<2	<2	3	<2	<2	<2	<2
Coumaphos	0.1	ug/l	DWS 2010	-	-	-	-	-	-	0.00840	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresols	-	ug/l	None	6.0	12.6	5.1	3.4	0.5	<0.1	-	-	-	-	-	-	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	<0.4	<0.4	<0.1	<0.1	<0.1
Cyanazine	0.1	ug/l	DWS 2010	-	-	-		-	-	<0.00700	<0.00700	<0.12000	-	<0.00800	<0.00800	-	-	-	-	-	-	-	-	-	-	-	-
Cyanide (Free)	50	ug/l as CN	DWS 2010	-	-	<20	<20	-	<20	-	-	-	-	-	-	<20	<20	<20	<50	218	<20	<20	<20	<20	<20	<20	<20
Cyanide (Total)	50	ug/l as CN	DWS 2010	20	20	<20	<20	20	<40	<1	-	-	-	-	-	<40	<40	<40	-	-	<40	<40	<40	<40	<40	<40	<40
Cyfluthrin	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cypermethrin	0.00001	ug/l	WFD 2010	-	-	-	-	-	-	0.006	<0.1	<0.1	-	< 0.100	<0.1000	-	-	-	-	-	-	-	-	-	-	-	-
Cypermethrin ID	-	Code	None	-	-	-	-	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dalapon	-	ug/l	None	-	-	-	-	-	-	<0.05000	<0.05000	<0.05000	-	<0.05000	-	-	-	-	-	-	-	-	-	-	-	-	-
DDD (OP)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDD (PP)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDE (OP)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDE (PP)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT (OP)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT (PP)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Deltamethrin	-	ug/l	None	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diazinon	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00900	<0.00900	<0.00900	-	<0.00900	<0.00900	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz-[A,H]-Anthracene	-	ug/l	None	0.058	0.01	32.1	22.6	0.01	<0.01	<0.01	-	-	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.016	0.016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenzofuran	-	ug/l	None	400.0	92.0	1101	1040	12.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibromochloromethane	100	ug/l	WS Regs 20	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibromomethane	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dicamba {3,6-Dichloro(O-Methoxybenzoic Acid)}	-	ug/l	None	-	-	-	-	-	-	<0.01300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichlobenil	-	ug/l	None	-	-	-	-	-	-	<0.02500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichlor(2,4+2,5)phenols	-	ug/l	None	-	-	-	-	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichlorodifluoromethane	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichloromethane	20	ug/l	WFD 2010	-	-	-	-	-	-	<3	<3	<3	-	< 3.0	<3.0	-	-	-	-	-	-	-	-	-	-	-	-
Dichlorprop	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01100	<0.01100	<0.01100	-	<0.01100	<0.01100	-	-	-	-	-	-	-	-	-	-	-	-
Dichlorvos	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin	0.03	ug/l	DWS 2010	-	-	-	-	-	-	<0.00300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210m	210m	210m	210m	210m	210m	210m	255m	455m	474m	507m	538m	717m	778m	960m	970m	970m	995m	1007m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
Diethyl phthalate	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diflurobenzuron	-	ug/l	None	-	-	-	-	-	-	<0.02000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dimethoate	-	ug/l	None	-	-	-	-	-	-	<0.01500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dimethyl phthalate	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dimethylphenols	-	mg/l	None	0.2578	0.4111	0.1380	0.0632	0.0005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-octylphthalate	-	mg/l	None	0.002	0.002	<0.003	<2	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diphenyl ether	-	mg/l	None	0.002	0.002	<0.003	<0.002	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diuron	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0050	<0.0050	<0.0500	-	<0.0100	<0.0100	-	-	-	-	-	-	-	-	-	-	-	-
Endosulphan Alpha	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulphan Beta	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0030	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Enterococci (Species)	-	Nr/100ml	None	-	-	-	-	-	-	0	-	-	-	-	70	-	-	-	-	-	-	-	-	-	-	-	-
Escherichia coli (Confirmed)	0	Nr/100ml	WS Regs 20	-	-	0	0	-	-	3	-	-	1	-	9	-	-	-	-	-	-	-	-	-	-	-	-
Ethiofencarb	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethion	-	ug/l	None	-	-	-	-	-	-	<0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethofumesate	-	ug/l	None	-	-	-	-	-	-	0.01	-	-	<0.01	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-
Ethyl Tertiary Butyl Ether (ETBE)	-	ug/l	None	-	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	ug/l	None	93.0	112.0	331	267	5.0	<1	-	-	-	-	-	-	<1	<1	<1	<10	<10	<1	<1	<1	<1	<1	<1	<1
Faecal Coliforms	0	cfu/100ml	WFD 2010	14	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fenchlorphos {Ronnel.}	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0030	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fenitrothion	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0090	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fenoprop	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fenpropimorph	-	ug/l	None	-	-	-	-	-	-	<0.0060	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fenthion	-	ug/l	None	-	-	-	-	-	-	<0.0110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fenuron	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	<0.01	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-
Flumethrin	-	ug/l	None	-	-	-	-	-	-	<0.0050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	0.2	ug/l	EEC MAC	36.8	4.04	5530	2600	1.83	0.01	<0.01	-	-	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.014	0.0678	<0.01	0.01	<0.01	<0.01	0.02	<0.01	<0.01
Fluorene	-	ug/l	None	60.5	60.5	7000	3230	6.84	<0.01	<0.1	-	-	<0.01	-	<0.01	0.02	<0.01	<0.01	<0.014	0.029	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	1.5	mg/l as F	DWS 2010	-	-	-	-	-	-	0.49	0.6	0.49	-	0.65	0.775	-	-	-	-	-	-	-	-	-	-	-	-
Fluroxypyr	-	ug/l	None	-	-	-	-	-	-	<0.0100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flutriafol	-	ug/l	None	-	-	-	-	-	-	<0.0070	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fonofos	-	ug/l	None	-	-	-	-	-	-	<0.0050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glyphosate	-	ug/l	None	-	-	-	-	-	-	<0.0140	<0.0140	0.05800	-	<0.0140	<0.0140	-	-	-	-	-	-	-	-	-	-	-	-

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210 m	210m	210m	210m	210m	210m	210m	255 m	455 m	474 m	507 m	538 m	717 m	778 m	960 m	970 m	970 m	995 m	1007 m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
GRO C4-C12	-	ug/l	None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	-	-	-	-	-	-	-
Hardness Total - As CaCO3	-	mg/l as CaCO3	None	-	-	-	-	-	-	487	-	-	482	-	400	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor	0.03	ug/l	DWS 2010	-	-	-	-	-	-	<0.0030	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachloro 1,3 Butadiene	0.1	ug/l	WFD 2010	5.0	5.0	<7	<6	5.0	-	<0.0100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene	0.01	ug/l	WFD 2010	5.0	5.0	<7	<6	5.0	-	<0.0010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorocyclohexane (alpha)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorocyclohexane (beta)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorocyclohexane (delta)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorocyclohexane (gamma)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorocyclopentadiene	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachloroethane	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno-[1,2,3-Cd]-Pyrene	0.002	ug/l	WFD D 10	0.243	0.023	113	64.9	0.024	<0.01	<0.01	-	-	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.014	0.0338	0.23	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iodide Ion	-	ug/l as I	None	-	-	-	-	-	-	66	-	-	53	-	77	-	-	-	-	-	-	-	-	-	-	-	-
Iodofenphos	-	ug/l	None	-	-	-	-	-	-	<0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ionic Balance (Anions/Cations)	-	%	None	-	-	-	-	-	-	-4.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ioxynil	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iprodione	-	ug/l	None	-	-	-	-	-	-	<0.0130	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Irgarol 1051	-	ug/l	None	-	-	-	-	-	-	<0.0050	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron Dissolved	200	ug/l as Fe	DWS 2010	-	-	-	-	-	-	5900	-	-	5.9	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-
Iron Total	200	ug/l as Fe	DWS 2010	-	-	-	-	-	-	6200	-	-	6.3	-	6.9	-	-	-	-	-	-	-	-	-	-	-	-
Isodrin	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0030	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isophorone	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isopropylbenzene (Cumene)	-	ug/l	None	19	11	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isoproturon (Diip1,3Dithiolan-2-Ylidenemalonate)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0030	<0.0030	<0.2000	-	<0.0080	<0.0080	-	-	-	-	-	-	-	-	-	-	-	-
Lambda Cyhalothrin	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	<5.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead Dissolved	10	ug/l	WS Regs 20	-	-	6	<1	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead Total	10	ug/l	WS Regs 20	6.0	3.0	-	-	25.0	<4	<5	<5	<5	-	< 5	<5	<4	<4	5	3.63	3.68	<4	<4	<4	<4	<4	<4	<4
Linuron	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.0050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lithium Dissolved	-	ug/l as Li	None	-	-	-	-	-	-	<0.6	-	-	<0.0006	-	<0.0006	-	-	-	-	-	-	-	-	-	-	-	-
Lithium Total	-	ug/l as Li	None	-	-	-	-	-	-	1	-	-	<0.0006	-	<0.0006	-	-	-	-	-	-	-	-	-	-	-	-
Magnesium Dissolved	50	mg/l as Mg	EEC MAC	-	-	9	16	-	-	20	-	-	20	-	18	-	-	-	-	-	-	-	-	-	-	-	-
Magnesium Total	50	mg/l as Mg	EEC MAC	20	9	-	-	13	32	21	23	18	-	19	19	22	41	30	-	-	18	58	24	17	76	50	26
Malathion	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese Dissolved	50	ug/l as Mn	DWS 2010	-	-	-	-	-	-	110	-	-	0.1	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-
Manganese Total	50	ug/l as Mn	DWS 2010	-	-	-	-	-	-	110	-	-	0.1	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210 m	210m	210m	210m	210m	210m	210m	255 m	455 m	474 m	507 m	538 m	717 m	778 m	960 m	970 m	970 m	995 m	1007 m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
MCPA {2-methyl-4-chlorophenoxyacetic acid }	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00900	<0.00900	<0.00900	-	<0.00900	<0.00900	-	-	-	-	-	-	-	-	-	-	-	-
MCPB	10	ug/l	WHO 2004	-	-	-	-	-	-	<0.01100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mecoprop { }	0.1	ug/l	DWS 2010	-	-	-	-	-	-	8.38000	0.30800	0.96400	-	0.88400	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury Total	1	ug/l Hg	WS Regs 20	0.1	0.1	-	-	1	<0.05	<0.002	0.012	0.012	-	< 0.002	0.013	<0.05	<0.05	<0.05	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Metalaxyl	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metazachlor	-	ug/l	None	-	-	-	-	-	-	<0.01	<0	<0	-	< 0	<0.00800	-	-	-	-	-	-	-	-	-	-	-	-
Methabenzthiazuron	-	ug/l	None	-	-	-	-	-	-	<0.00300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methane	-	ug/l	None	-	-	-	-	-	-	<10	-	-	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methiocarb	-	ug/l	None	-	-	-	-	-	-	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methomyl	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metoxuron	-	ug/l	None	-	-	-	-	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metsulfuron - Methyl	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mevinphos	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Molybdenum Total	0	ug/l	GW Regs 98	-	-	-	-	-	-	<5	-	-	<5	-	<5	-	-	-	-	-	-	-	-	-	-	-	-
Monolinuron	-	ug/l	None	-	-	-	-	-	-	<0.00600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monuron	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTBE {Methyl Tert-Butyl Ether}	-	ug/l	None	10	10	<50	<50	10	<1	<0.13	-	-	-	-	-	<1	<1	<1	<10	<10	3	<1	<1	<1	<1	<1	<1
Multi Residual Scan	-	ug/l	None	-	-	-		-	-	-	-	-	-	<0.10000	-	-	-	-	-	-	-	-	-	-	-	-	-
n - Butylbenzene	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	1.2	ug/l	WFD D 10	106	3460	29400	17300	106	<0.01	0.15	-	-	0.07	-	0.08	<0.01	<0.01	<0.01	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Napropamide	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Neburon	-	ug/l	None	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel Total	20	ug/l as Ni	DWS 2010	10	7	-	-	179	17	7	9	6	-	5	5	31	<10	<10	2.62	11.8	<10	<10	10	<10	<10	<10	<10
Nitrate - N	11.3	mg/l as N	WS Regs 20	0.2	0.2	0.2	<0.2	0.2	<0.1	<0.043	<0.043	<0.043	-	< 0.068	<0.068	<0.1	<0.1	<0.1	<0.0677	<0.0677	<0.1	<0.1	<0.1	<0.1	2.9	<0.1	<0.1
Nitrite - N	0.03	mg/l as N	WS Regs 20	-	-	-	-	-	-	<0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrobenzene	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrogen Total Oxidised	11.3	mg/l as N	WS Regs 20	-	-	-	-	-	-	<0.05	-	-	15.1	-	<0.081	-	-	-	-	-	-	-	-	-	-	-	-
N-nitrosodi-n-propylamine	-	ug/l	None	5.0	5.0	<7	<6	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orthophosphate	-	mg/l as P	None	-	-	-	-	-	-	<0.18	-	-	0.41	-	<0.18	-	-	-	-	-	-	-	-	-	-	-	-
Oxamyl	-	ug/l	None	-	-	-	-	-	-	0.00600	-	-	0.01300	-	-	-	-	-	-	-	-	-	-	-	-	-	-
o-Xylene	-	ug/l	None	41.0	75.0	174	174	5.0	-	-	-	-	-	-	-	-	-	-	<10	<10	-	-	-	-	-	-	-
PAH 16 Total	0.1	ug/l	DWS 2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	1.55	-	-	-	-	-	-	-
PAHs Total	0.1	ug/l	DWS 2010	-	-	-	-	-	-	5.6	-	-	0.12	-	6.01	-	-	-	-	-	-	-	-	-	-	-	-
Parathion (Parathion-ethyl)	1	ug/l	SW Regs 96	-	-	-	-	-	-	<0.00900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210 m	210m	210m	210m	210m	210m	210m	255 m	455 m	474 m	507 m	538 m	717 m	778 m	960 m	970 m	970 m	995 m	1007 m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
Parathion (Parathion-methyl)	1	ug/l	SW Regs 96	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB Congener 028	0.1	ug/l	DWS 2010	0.05	0.05	<0.05	<0.05	0.05	-	<0.01	-	-	-	-	-	-	-	-	-	<0.015	-	-	-	-	-	-
PCB Congener 052	0.1	ug/l	DWS 2010	0.05	0.05	<0.05	<0.05	0.05	-	<0.01	-	-	-	-	-	-	-	-	-	<0.015	-	-	-	-	-	-
PCB Congener 101	0.1	ug/l	DWS 2010	-	-	<0.05	<0.05	-	-	<0.01	-	-	-	-	-	-	-	-	-	<0.015	-	-	-	-	-	-
PCB Congener 105	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB Congener 118	0.1	ug/l	DWS 2010	0.05	0.05	<0.05	<0.05	0.05	-	<0.01	-	-	-	-	-	-	-	-	-	<0.015	-	-	-	-	-	-
PCB Congener 138	0.1	ug/l	DWS 2010	0.05	0.05	<0.05	<0.05	0.05	-	<0.01	-	-	-	-	-	-	-	-	-	<0.015	-	-	-	-	-	-
PCB Congener 153	0.1	ug/l	DWS 2010	0.05	0.05	<0.05	<0.05	0.05	-	<0.01	-	-	-	-	-	-	-	-	-	<0.015	-	-	-	-	-	-
PCB Congener 156	0.1	ug/l	DWS 2010	-	-	-		-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB Congener 180	0.1	ug/l	DWS 2010	0.05	0.05	<0.05	<0.05	0.05	-	<0.01	-	-	-	-	-	-	-	-	-	<0.015	-	-	-	-	-	-
PCB Total of 7 Congener (Aqueous)	0.1	ug/l	DWS 2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.015	-	-	-	-	-	-	-
Pendimethalin	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pentachlorophenol	9	ug/l	WHO 2004	50.0	50.0	<65	<59	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Permethrin (Cis + Trans)	0.01	ug/l	WFD D 10	-	-	-	-	-	-	-	<0.10000	<0.10000	-	-	<0.10000	-	-	-	-	-	-	-	-	-	-	-	-
pH	10	pH units	DWS 2010	7.7	8.4	7.7	7.2	9.1	6.7	6.88	-	-	-	-	-	7.1	6.9	7.2	8.27	7.93	7.6	7.8	8.4	8.1	7.2	7.6	7.5
Phenanthrene	-	ug/l	None	47.9	47.9	17800	7980	5.58	0.01	<0.01	-	-	<0.01	-	<0.01	<0.01	0.02	<0.01	<0.022	0.0338	<0.01	0.01	0.01	0.02	<0.01	0.02	<0.01
Phenol	0.5	ug/l	EEC MAC	59.1	48.5	48.3	45.0	6.4	<0.1	<1	-	-	-	-	-	<0.1	<0.1	<0.1	<2.0	<2.0	<1	<0.1	<0.4	<0.4	<0.1	<0.1	<0.1
Phenol (Pentachlorophenol (PCP))	-	ug/l	None	-	-	-	-	-	-	<0.00900	<0.00900	<0.00900	-	<0.00900	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenols Total For SWAD (7 Compounds)	-	ug/l	None	-	-	-	-	-	-	-	18.0	33.0	-	10.0	-	-	-	-	-	-	-	-	-	-	-	-	-
Pichloram	-	ug/l	None	-	-	-	-	-	-	<0.00900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pirimephos (Pirimephos-methyl)	-	ug/l	None	-	-	-	-	-	-	<0.00300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pirimicarb	1	ug/l	FW List II	-	-	-	-	-	-	<0.00300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
p-Isopropyltoluene	-	ug/l	None	5	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polynuclear Aromatic Hydrocarbons (Total)	0.1	ug/l	DWS 2010	2371.206	854.027	29378.2	20738.9	159.166	<0.2	-	-	-	-	-	-	<0.2	<0.2	<0.2	-	-	0.05	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Potassium Dissolved	-	mg/l as K	None	-	-	-	-	-	-	5.6	-	-	5.7	-	5.5	-	-	-	-	-	-	-	-	-	-	-	-
Potassium Total	-	mg/l as K	None	-	-	-	-	-	-	5.6	6.7	5.5	-	5.9	5.7	-	-	-	-	-	-	-	-	-	-	-	-
Preparation (Purge And Trap)	-	Text	None	-	-	-	-	-	-	-	-	-	-	-	Prepared	-	-	-	-	-	-	-	-	-	-	-	-
Prochloraz	4	ug/l	FW List II	-	-	-	-	-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Promethryn	-	ug/l	None	-	-	-	-	-	-	<0.00300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Propachlor	-	ug/l	None	-	-	-	-	-	-	<0.00800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Propazine	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00400	<0.00400	<0.08000	-	<0.00500	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-
Propetamphos	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00500	<0.00500	<0.00500	-	<0.00500	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-
Propoxur	-	ug/l	None	-	-	-	-	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210m	210m	210m	210m	210m	210m	210m	255m	455m	474m	507m	538m	717m	778m	960m	970m	970m	995m	1007m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
Propylbenzene	-	ug/l	None	0.05	0.05	<100	<100	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Propyzamide	-	ug/l	None	-	-	-	-	-	-	<0.00600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	-	ug/l	None	21.9	2.16	3570	1650	1.04	<0.01	<0.01	-	-	<0.01	-	<0.01	<0.01	<0.01	0.02	<0.0015	0.0675	0.07	0.05	<0.01	<0.01	0.04	<0.01	<0.01
Qualitative Scan (Volatiles By GCMS) NP	-	Text	None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salmonella	0	ct/100ml	WFD 2010	0	0	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
sec-Butylbenzene	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium	10	ug/l as Se	DWS 2010	6	6	4	2	23	<3	<0.4	-	-	<0.4	-	0.7	<3	<3	<3	<1	10.8	<3	<3	<3	<3	<3	<3	<3
Silicate Reactive Dissolved - As SiO2	-	mg/l	None	-	-	-	-	-	-	13	-	-	14	-	13	-	-	-	-	-	-	-	-	-	-	-	-
Silver Total	0	ug/l	GW Regs 98	-	-	-	-	-	-	<0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simazine	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00900	<0.00900	<0.08000	-	<0.00400	<0.00400	-	-	-	-	-	-	-	-	-	-	-	-
Sisumxylene	-	ug/l	None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	-	-	-	-	-	-	-
Sodium Dissolved	200	mg/l as Na	DWS 2010	-	-	196	155	-	-	170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium Total	200	mg/l as Na	DWS 2010	379	393	-	-	207	160	170	180	160	-	170	190	190	140	97	-	-	130	400	520	86	590	480	360
Strontium Dissolved	-	ug/l as Sr	None	-	-	-	-	-	-	1900	-	-	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Strontium Total	-	ug/l as Sr	None	-	-	-	-	-	-	1900	-	-	1.8	-	1.4	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphate	250	mg/l as SO4	DWS 2010	143	323	118	23	162	75	94.9	96.9	88.2	-	88.3	87.4	9.3	220	110	106	220	230	280	190	71	160	170	240
Sulphide	-	ug/l	None	1,570.0	50.0	2030	3780	50.0	<10	<30.0	-	-	38.0	-	38.0	<10	<10	<10	-	-	280	<10	<250	<250	<250	<10	<10
Sum of BTEX	-	ug/l	None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	-	-	-	-	-	-	-
Tecnazene	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Terbutryn	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00300	<0.00300	<0.08000	-	<0.00500	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-
tert - Butylbenzene	0.1	ug/l	DWS 2010	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tertiary Amyl Methyl Ether (TAME)	-	ug/l	None	-	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetrachloroethane	10	ug/l	DWS 2010	-	-	-	-	-	-	<0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetrachloroethene (Per/Tetrachloroethylene)	10	ug/l	DWS 2010	5	5	<500	<500	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetrachloroethylene	-	ug/l	None	-	-	-	-	-	-	<0.09	<0.09	<0.09	-	< 0.09	<0.09	-	-	-	-	-	-	-	-	-	-	-	-
Tetrachlorothioanisole	-	ug/l	None	-	-	-	-	-	-	<0.00500	-	-	<0.00500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium Total	0	ug/l as Tl	GW Regs 98	-	-	-	-	-	-	<0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	-	mg/l	None	0.2	0.2	<0.2	<0.2	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin Total	0	ug/l as Sn	GW Regs 98	-	-	-	-	-	-	5	-	-	<5	-	<5	-	-	-	-	-	-	-	-	-	-	-	-
Titanium	0	ug/l as Ti	GW Regs 98	-	-	-	-	-	-	64	-	-	0.063	-	0.05	-	-	-	-	-	-	-	-	-	-	-	-
Toluene (Methylbenzene)	50	ug/l	WFD 2010	6.0	22.0	<25	35	5.0	<1	0.68	-	-	0.13	-	<0.55	<1	<1	<1	<10	<10	<1	<1	<1	<1	<1	<1	<1
Total Aliphatic TPH	-	ug/l	None	-	-	-	-	-	18	-	-	-	-	-	-	17	11	<10	-	-	5	150	24	17	62	27	25
Total Aliphatics & Aromatics >C12-C44 (Aqueous)	-	ug/l	None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	-	-	-	-	-	-	-
Total Aliphatics >C12-C35 (Aqueous)	-	ug/l	None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	-	-	-	-	-	-	-
Total Aliphatics C5-C12	-	ug/l	None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	-	-	-	-	-	-	-

Source of data*				SI	SI	SI	SI	SI	SI	TT	TT	TT	TT	TT	TT	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI
Name				SA6455A	SA6453A	SA6450	SR4118	SA6451	SR1048	SR1048	SR1048	SR1048	SR1048	SR1048	PR1048	SR1047	SR1049	SR1046	PR1027	SR1028	SR1045	SR1050	PR1043	SR1042	SR1042	SR1040	SR1041
Hydrogeological unit**				RTD	TSF	RTD	RTD	TSF	LCK	CK	CK	CK	CK	CK	LCK	SCK	SCK	LCK	LCK	CK	LCK	SCK	-	LCK	RTD	LCK	LCK
Distance from shaft	EQS Criteria			25m	30m	45m	45m	65m	210m	210m	210m	210m	210m	210m	210m	255m	455m	474m	507m	538m	717m	778m	960m	970m	970m	995m	1007m
Chemical	Value	Units	Source	30/3/12	30/3/12	21/3/12	21/3/12	30/3/12	2009	27/9/11	16/11/11	20/1/12	21/3/12	4/5/12	16/8/12	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
Total Aromatic TPH	-	ug/l	None	-	-	-	-	-	45	-	-	-	-	-	-	55	12	11	-	-	14	32	60	42	38	20	26
Total Aromatics >EC12-EC35 (Aqueous)	-	ug/l	None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	-	-	-	-	-	-	-
Total Aromatics C6-C12	1	ug/l	DWS 2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<10	-	-	-	-	-	-	-
Total Chemical Oxygen Demand	-	mg/l	None	-	-	-	-	-	26	-	-	-	-	-	-	180	<10	<10	-	-	420	16	<10	<10	24	13	<10
Total GRO	-	mg/l	None	1	0.9	2.6	2.1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Monohydric Phenols (W)	-	ug/l	None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<15.0	<15.0	-	-	-	-	-	-	-
Total Organic Carbon	-	mg/l	None	6.7	5.9	140	27	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triazophos	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.00800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethene (Trichloroethylene)	10	ug/l	DWS 2010	5	5	<500	<500	5	-	<0.07	<0.07	<0.07	-	< 0.07	<0.07	-	-	-	-	-	-	-	-	-	-	-	-
Trichlorofluoromethane	-	ug/l	None	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichlorophenoxyacetic Acid (2,4,5)	-	ug/l	None	-	-	-	-	-	-	<0.01500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triclopyr	-	ug/l	None	-	-	-	-	-	-	<0.01500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trietazine	-	ug/l	None	-	-	-	-	-	-	<0.00600	<0.00600	<0.04000	-	<0.00800	<0.00800	-	-	-	-	-	-	-	-	-	-	-	-
Trifluralin	0.1	ug/l	DWS 2010	-	-	-	-	-	-	<0.01000	<0.01000	<0.01000	-	<0.01000	-	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylphenols	-	mg/l	None	0.1219	0.1544	0.1060	0.0339	0.0005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	1	FTU	WS Regs 20	-	-	-	-	-	-	-	34.6	56.8	-	46.3	51	-	-	-	-	-	-	-	-	-	-	-	-
Uranium	0	ug/l as U	GW Regs 98	-	-	-	-	-	-	<0.1	-	-	<0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	0	ug/l as V	GW Regs 98	-	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vinyl Chloride	0.5	ug/l	DWS 2010	1	1	<100	<100	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylene (Meta & Para){1,3+1,4-Dimethylbenzene}	30	ug/l	WFD 2010	92.0	150.0	423	426	5.0	<1	0.26	0.43	0.54	<0.180	0.57	<0.09	<1	<1	<1	<10	<10	<1	<1	<1	<1	<1	<1	<1
Xylene (ortho)	30	ug/l	SW Regs 98	-	-	-	-	-	-	0.14	-	-	<0.09	-	<0.09	-	-	-	-	-	-	-	-	-	-	-	-
Zinc Dissolved	50	ug/l as Zn	DWS 2010	-	-	35	<2	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc Total	50	ug/l as Zn	DWS 2010	17	21	-	-	558	38	<5	<5	5	-	< 5	<5	20	17	7	14.9	19.1	<1	34	4	2	1	30	5

Notes:

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

* Origin of data: SI – Groundwater quality data collected during site investigation works by Thames Tunnel project (2009-2011), TT – Groundwater quality data collected during ongoing monitoring works by Thames Tunnel project (2009-2012)
** Hydrogeological unit: LCK – Lewes Nodular Chalk, CK – Chalk, SCK – Seaford Chalk, RTD – River Terrace Deposits, ALV - Alluvium

K.8 Groundwater status

K.8.1 The EC Water Framework Directive (WFD) requires the status of groundwater management units (groundwater bodies) within each river basin to be determined as ”good” or ”poor” by 2015. For groundwater there are two separate classifications for groundwater bodies; chemical status and quantitative status. The WFD aims to achieve good status by 2015, or, where this is not possible and subject to the criteria set out in the Directive, the WFD aims to achieve good status by 2021 or 2027.

K.8.2 The Thames River Basin Management Plan (RBMP)[14] shows that the Superficial Deposits (River Terrace Deposits and Alluvium), Lambeth Group, Thanet Sands and Chalk Formation in the area of the Earl Pumping Station site are designated as the Greenwich Chalk and Tertiaries groundwater body.

K.8.3 The baseline assessment for groundwater status classification for the Greenwich Chalk and Tertiaries shows poor quantitative status with respect to impact on surface waters and saline intrusions, good quantitative status with respect to groundwater dependent terrestrial ecosystems and resource balance for 2009. The baseline assessment also shows poor chemical status with respect to saline intrusions and drinking water protected area status and good chemical status with respect to general chemical assessment, groundwater dependent terrestrial ecosystems and impact on surface water chemical/ ecological status.

K.8.4 The predicted quantitative and chemical quality for 2015 is poor 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)[14].

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

a. The control of pollution to groundwater that may arise from any development which takes place on land.

b. prevent input of nitrates to groundwater body.

c. prevent inputs to and mitigate potential mobilisation of copper, other metals and hazardous substances in groundwater.

d. prevent and mitigate potential inflow of river water to groundwater due to dewatering/ abstraction by implementing working methods to protect surface and groundwater from impacts, including changes to flow, by producing site-specific water management plans and by monitoring where required.

e. prevent direct discharges of pollutants to groundwater.

K.9 Data sources

K.9.1 A list of data used for the Earl Pumping Station assessment is given in Vol 22 Table K.9.

Vol 22 Table K.9 Groundwater - desk based baseline data sources

Source	Data	Date received	Notes
BGS	British Geological Survey (BGS) 1:50,000 scale digital geological data	February 2009	
EA	Licensed groundwater abstraction boreholes, their ownership and purpose	December 2010,February 2011 and March 2012	Licensed abstraction rates, aquifer, and status (active or dormant)
LB's*	Unlicensed groundwater abstraction boreholes and their details	June 2009	Contacted 14 local authorities 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, May 2012 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	
EA	Regional Groundwater Levels in Chalk from 2000 to 2011	December 2011	
EA	London Basin Aquifer Conceptual Model (60121R1, June 2010)	December 2010 and April 2011	
EA	London Basin Groundwater Model	December 2011 and April 2012	Hydraulic properties (23/11/11) & layer thickness information

Source	Data	Date received	Notes
			(April 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 environmental monitoring draft strategy	Draft strategy February 2012	
Thames Tideway Tunnel project	Land quality data	February 2011	
Individual licence holders	Letters sent out to 30 licence holders	December 2011 (last updated 15th October 2012)	

** LBs – London Boroughs*

References

[1] British Geological Survey (BGS). British geology onshore digital maps 1:50 000 scale. February 2009.

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.22**

Volume 22: Earl Pumping Station appendices

Appendix L: Water resources - surface water

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 22 Earl Pumping Station appendices

Appendix L: Water resources – surface water

List of contents

Page number

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Appendix L: Water resources – surface water

L.1 Introduction

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

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Thames Water Utilities Limited

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Appendix M: Water resources - flood risk

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Thames Tideway Tunnel

Environmental Statement

Volume 22 Earl Pumping Station appendices

Appendix M: Water resources – flood risk

List of contents

Page number

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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 Earl Pumping Station is provided below.

Local policy

Strategic Flood Risk Assessment

M.1.4 The Earl Pumping Station site lies within the London Borough (LB) of Lewisham. The LB of Lewisham produced a Level 1 Strategic Flood Risk Assessment (SFRA) (Jacobs, 2008)[2]. This outlines the main flood sources to the Borough.

M.1.5 The SFRA confirms that the Thames Tidal Defence network (the River Thames flood defences and the Thames Barrier) reduces the annual probability of flooding from the Thames to less than 0.1%. The risk of flooding is a residual risk associated with a breach in the defences

M.1.6 The SFRA advocates the use of flood resilience and resistant measures.

M.1.7 According to the SFRA:

a. The site is underlain by Reading and Thanet Sands bedrock, which in turn is overlain by Alluvium drift geology.

b. It is within the Flood Warning Area of the Tidal Thames from the Limehouse Basin to Blackfriars Bridge Tidal, and Environment Agency (EA) Flood Zone 3.

c. The site is located within an area which has had between 1 and 10 historical sewer flooding events.

d. In terms of emergency planning during the construction phase, rest and reception centres have been identified 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 LB of Lewisham, 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.

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 Thames Estuary 2100 (TE2100)Plan (EA, 20012)[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 outlines that the local sources of flood risk at this location as including:

a. tidal from the River Thames and

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

M.1.13 Defences from these sources include:

a. the Thames Barrier and secondary tidal defences along the Thames frontage (both making up the Thames Tidal Defence)

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

c. flood forecasting and warning.

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. In the Plan there is also the vision to increase flood risk awareness within the area.

London Regional Flood Risk Appraisal

M.1.15 For the reach between Hammersmith Bridge and the Thames Barrier (City Reach) the London Regional Flood Risk Appraisal (RFRA) (GLA, 2009)[5] encourages small scale set back of development from the river walls where possible. The aim 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.1.16 There is particular concern surrounding confluences of tributaries into the River Thames and the interactions between tidal and fluvial flows in the future due to climate change.

[i] Area susceptible to surface water flooding.

M.1.17 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] Jacobs. *London Borough of Lewisham Level 1 Strategic Flood Risk Assessment*. (July 2008).

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

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Thames Tideway Tunnel
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Doc Ref: **6.2.22**

Volume 22: Earl Pumping Station appendices

Appendix N: Development schedule

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 22 Earl Pumping Station appendices

Appendix N: Development schedule

List of contents

Page number

List of tables

Page number

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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 22 Table N.1 of the resulting development projects, a description of what is proposed and assumptions on phasing. Longer term development projects may be included under both base case, with construction preceding that of the Thames Tideway Tunnel site, and cumulative with construction or operation occurring at the same time as a given Thames Tideway Tunnel site.

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Vol 22 Table N.1 Development schedule for Earl 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 & peak construction traffic year)	2023 (Year 1 of operation)		
Cannon Wharf, 35 Evelyn Street	Adjacent	DC/08/68523/X	London Business Centres	The demolition of existing buildings at Cannon Wharf Business Centre, 35 Evelyn Street SE8 and construction of buildings 3 to 8 storeys plus two buildings 20 and 23 storeys in height, comprising 6,588m2 commercial units (Use Classes B1, A1, A2, A3, A5 & D1) and 679 residential units with on-site energy centre, 401 car parking spaces, cycle parking and associated landscaping with accesses onto Evelyn Street, Rainsborough Avenue and Yeoman Street.	B	Blocks B1, B2, B3, B4, C1, C2, C3, G, H, J and Business Centre complete & operational. Blocks A, B5, C4, D1, D2, D3, E, F and Family Accommodation under construction.	100% complete & operational	Application documents – Chapter 8 of Environmental Statement as well as Housing Implementation Strategy.	**2017:** Base case = Blocks B1, B2, B3, B4, C1, C2, C3, G, H, J and Business Centre. Cumulative = Blocks A, B5, C4, D1, D2, D3, E, F and Family Accommodation **2023:** Base case = all blocks No cumulative
Yeoman Street Note: not Mayoral referral development but included due proximity to site (potential new receptors).	10m east	DC/11/77408/X	CGMS Consulting	Construction of a five storey building incorporating balconies on the site of 7-17 Yeoman Street SE8 to provide 8 one-bedroom, 20 two-bedroom and 5 three bedroom apartments together with 33 bicycle spaces and roof top communal gardens	B	Under construction	100% complete & operational	Information provided by LB Lewisham. Likely to be under construction until 2017/2018.	**2017:** Cumulative **2023:** Base case
Marine Wharf West, Plough Way	100m east	DC/10/73437/X	Trademark Group	The construction of new buildings between 1 and 8 storeys in height at Marine Wharf West (land formerly occupied by Jet Stationary), Plough Way SE16 to accommodate 4,126 square metres of commercial floorspace (Use Classes A1/A2/A3/B1/B1c), 532 residential units (including 78 units provided as an "Extra Care" facility), car parking, pedestrian and vehicular access, landscaping, new public open space along the route of the former Grand Surrey Canal, and other associated works.	B	Under construction	100% complete & operational	Information provided by LB Lewisham. Likely to be under construction until 2017/2018.	**2017:** Cumulative **2023:** Base case
Tavern Quay, Rope Street	150m northeast	11/AP/1079, DC/11/77189/FT	Mr Burger Edwards	Renewal of planning permission 08-AP-0337 dated 10th September 2008 for the construction of a nine storey building (with top two floors set back) for mixed use purposes comprising business use on the ground and first floors, a restaurant on the ground floor and 71 residential units on the upper floors with associated access, servicing, car parking and landscaping.	B	100% complete & operational	100% complete & operational	Meetings with LB Southwark & professional judgement.	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 & peak construction traffic year)	2023 (Year 1 of operation)		
Oxestalls Road	Approx 400m southeast	DC/09/ 73189	City & Provincial Properties PLC	The comprehensive redevelopment of land bounded by Oxestalls Road, Grove Street, Dragoon Road and Evelyn Street SE8, but excluding Scott House, 185 Grove Street (formerly known as Diploma Works). Outline planning application for the whole site comprising: The demolition of existing buildings on the site, excluding former Public House on Grove Street. The phased redevelopment of the site to provide a maximum of 1,029,670m2 (gross external floor area) comprising up to 905 residential units (853,218m²) and 17,645m2 non-residential floorspace comprising A1 Shops, A2 Financial & Professional Services, A3 Restaurants & Cafés, A4 Drinking Establishments, A5 Hot Food Takeaways, B1 Businesses, D1 Non-Residential Institutions and D2 Assembly & Leisure uses. Erection of buildings ranging in height from 4 to 18 storeys. An energy centre. Open space. New vehicular access into the site and parking (up to 1,127 cycle and 370 vehicle spaces) and associated works. Detailed planning application for Phases 1 & 2 only (covering the southern ? of the site) Redevelopment of land fronting Evelyn Street, Dragoon Road and Grove Street for 591 residential units and 9,424 m2 of non residential floorspace (comprising A1 Shops, A2 Financial & Professional Services, A3 Restaurants & Cafés, A4 Drinking Establishments, A5 Hot Food Takeaways, B1 Businesses, D1 Non-Residential Institutions and D2 Assembly & Leisure uses) in buildings ranging from 4 to 18 storeys in height. An energy centre. Car and cycle parking. New access into the site and associated highway infrastructure. Public realm works, landscaping and amenity / open space including water feature.	B	Under construction	100% complete & operational	Environmental Statement. It is expected that construction of the development would take approximately eight years, beginning in 2010 and being completed by 2018.	**2017:** Cumulative **2023:** Base case
Surrey Quays Leisure Site	Approx 500m northwest	09/AP/ 1999	Frogmore	Application made under the provisions of the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 seeking Outline permission for demolition of all existing buildings and erection of buildings ranging from 2 to 10 storeys (36.3m AOD) comprising 11,105sqm leisure floorspace (including cinema) (Class D2), 2,695sqm retail floorspace (Class A1-A3), 49,276sqm of private and affordable residential accommodation (Class C3), 495 car parking spaces (142 for residential and 350 for leisure uses and 3 for commercial uses) and associated works including public and private open space, as well as detailed design for 123 rooms (4,250sqm) of student housing (Sui Generis use), 2,500sqm commercial floorspace (Class B1), 86 residential units (included in the 49,276sqm referenced above) (Class C3) and the external appearance of any elevation facing Harmsworth Quays Printworks.	B	100% complete & operational	100% complete & operational	Assumptions based on available information. It is assumed that this development would be complete by Site Year 1 of construction.	Base case (all years)
Quebec Way Industrial Estate	Approx 600m north	11/AP/ 2565	Woodland Views Ltd	Demolition of three existing warehouse buildings and construction of 7 blocks between 3 and 6 storeys high (max 21m AOD); containing 366 residential units (142x 1 bed, 113x 2 bed, 98x 3 bed and 13x 4 bed) and commercial	B	100% complete & operational	100% complete & operational	No information is available in the planning application documentation. On the basis that the application has been	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 & peak construction traffic year)	2023 (Year 1 of operation)		
				floorspace for Class A1 (shops) / A3 (restaurant/cafes) / D1 (non-residential institutions / D2 (assembly and leisure)uses; with basement car parking, motorcycle and cycle storage, ancillary storage spaces and a new route through the site into Russia Dock Woodlands. New vehicle and pedestrian accesses to be created from Quebec Way.				permitted and needs to commence within three years, it has been assumed that it will be built by Site Year 1 of construction.	
Convoys Wharf	Approx 800m southeast	DC/02/52533	Convoys Investment S.A R.L and News International	Revised outline application for the comprehensive redevelopment of Convoys Wharf to provide a mixed-use development of up to 445,200m² comprising: up to 337,980m² (3,514 units) residential (Classes C2 & C3) up to 19,100m² employment space including up 2,200m² for 3 potential energy centres (Classes B1, live/work units & B8) wharf with associated vessel moorings (Class B2 & sui generis) (32,200m²) up to 6,400m² retail (Classes A1 & A2) up to 4,520m² restaurants/cafes and drinking establishments (Classes A3 & A4) up to 15,000m² community/non residential institutions and assembly and leisure (Class D1) up to 30,000m² hotel (Class C1) up to 2,700m² leisure (Class D2) a river bus facility 2,318 car parking spaces together with vehicular access from Grove Street and amended access arrangements from New King Street.	C	Phases 1 & 2 under construction Phase 3 not yet under construction	100% complete and operational	Information sourced from Convoys Wharf website: http://www.convoyswharf.com/appdocuments.html Phase 1 - The core area and adjoining residential blocks to east and south including works to the existing jetty and new water taxi jetty. Construction: 2013-2017 Phase 2 - The core area and adjoining residential blocks to north and west, the School, the Wharf and new jetty (Parcel F) and hotel. Construction:2014-2019 Phase 3 - The Wharf-related and employment area, together with the remaining residential blocks. Construction: 2017- 2022	**2017:** Cumulative = Phases 1 & 2 **2023:** Base case (all phases)
Canada Water Surrey Quays Road - Site C	Approx 850m northwest	09-AP-1783	Sellar, application by Conrad Phoenix	Redevelopment of existing retail warehouses and erection of six buildings varying in height from four to ten storeys, comprising 430 residential units, a 9,104 sq.m retail store, 1,287 sq.m of other retail/restaurant space, 644 sq.m of office space, 528 sq.m of community space and a basement car park for 340 cars.	B	100% complete & operational	100% complete & operational	Application documents and developer website. It is assumed that the whole of site C would be complete by Site Year 1 of construction.	Base case (all years)
Canada Water, Surrey Quays Road – Site A	Approx 900m northwest	09/AP/1870	Barratt Homes and BL Canada Quays Limited	Erection of a series of buildings comprising a 26 storey tower, with ground floor mezzanine (maximum height 92.95m AOD), and 9 individual buildings ranging from 4 to 8 storeys in height to provide 668 residential units, 958sqm of retail (Class A1, A2 and A3), and 268sqm of community use (Class D1), creation of a new open space and construction of new roads, pedestrian and cycle routes and new access to the highway, together with associated works including the provision of public cycle facility, basement car parking for 166 cars and cycle parking, servicing, landscaping and plant areas.	A	100% complete & operational	100% complete & operational	Application documents and developer website. Currently under construction, elements of the development are now complete. It is assumed that the whole of site A would 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 & peak construction traffic year)	2023 (Year 1 of operation)		
Mulberry Business Park	Approx 900m northwest	07-AP-2806	Mulberry Park Investments (SE) Ltd	Demolition of existing buildings and the erection of a series of buildings up to 8 storeys comprising 256 residential units, 5105m² of Class B1 (Office) floorspace, basement car park with access to Canada Street, and landscaping works.	B	100% complete & operational	100% complete & operational	No information is available in the planning application documentation. On the basis that the application has been permitted and needs to commence within three years, it has been assumed that it will be built by Site Year 1o of construction.	Base case (all years)
Surrey Canal Triangle	Approx 900m southwest (closest part of dev)	DC/11/76357	Renewal New Bermondsey Two Ltd	Revisions to planning application for the comprehensive phased mixed-use development of the site for up to 240,000 m² of development. "Comprehensive, phased, mixed use development of the site, for up to 240,000sqm (GEA) of development, as set out in the revised Development Specification dated 1July 2011, and as amended 2 September 2011. The development comprises: Class A1/A2 (Shops and Financial and Professional Services) up to 3,000 sq m; Class A3/A4 (Cafes/Restaurants and Drinking Establishments) up to 3,000 sq m; Class A5 (Hot Food Takeaways) up to 300 sq m; Class B1 (Business) between 10,000 sq m 15,000 sq m; Class C1 (Hotels) up to 10,000 sq m; Class C3 (Dwelling Houses) between 150,000 sq m 190,000 sq m (up to 2,400 homes of different sizes and types); Class D1 (Non-Residential Institutions) between 400 sq m 10,000 sq m; Class D2 (Leisure and Assembly) between 4,260 sq m 15,800 sq m (excluding the Stadium which remains but including a replacement ground person's store of 140 sq m). involving the demolition of all existing buildings on the site with the exception of the Millwall FC Stadium (which is to be retained and its facade upgraded and / or reclad), Plot Excelsior 2 - Guild House (which is to be retained and extended), and Plot Excelsior 5 - Rollins House (which is to be retained, but not altered or extended as part of this planning application); the demolition and replacement of the existing Millwall FC ground person's store of approximately 140 sq m; redevelopment to provide a series of new buildings (including roof top and basement plant); re-profiling of site levels; alterations to Surrey Canal Road and the re-alignment of Bolina Road; new streets and other means of access and circulation, including pedestrian/cycle paths carriageways and servicing areas; areas for parking for emergency services vehicles and outside broadcast units; external areas of hard and soft landscaping and publicly accessible open space; car and coach parking areas and accesses to them; cycle storage; and, supporting infrastructure works and facilities including sub-stations, energy centre/s District Heating Network (DHN) connections to and between each plot, the proposed energy centre and the adjoining South East London Combined Heat and Power (SELCHP) plant (to the extent to which they lie within the Planning Application Boundary) and an ENVAC waste storage and handling system (including DHN	B	Phase 1A & 1B complete Phase 2 under construction Other phases not yet under construction	Phase 1A, 1B, ,2, 3 & 4 complete Phase 5 under construction Phase 5A not yet under construction	Masterplan delivery strategy, section 8. The site would broadly be developed from north to south through phasing: Phase 1A – Excelsior 1-5 – start construction in late 2012, completed by mid 2015 Phase 1B – Orion – start construction late 2012, completed by early 2015 Phase 2 – Timber Wharf 1 and 2 – start construction mid 2015, completed in 2018 Phase 3 – Stockholm 1 & 2 – start construction early 2018 and completed by mid 2020 Phase 4 – Senegal Way 1 & 2 plus Stadium (Avenue, 1 and 2) – start construction mid 2020, completed late 2021 Phase 5 – Bolina North 1 & 2, and Bolina West – start construction late 2020, completed by late 2024 Phase 5A –Bolina East - start construction late 2024, completed by early 2026	**2017:** Base case = Phases 1A & 1B Cumulative = Phase 2 **2023:** Base case = Phases 1A, 1B, 2, 3, 4 Cumulative = Phase 5

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 & peak construction traffic year)	2023 (Year 1 of operation)		
				and ENVAC connections to plots south of Surrey Canal Road under the carriageway of Surrey Canal Road, as altered)."					

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

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