Thames Tideway Tunnel
Thames Water Utilities Limited

Development Consent Order

Application Reference Number: WWO10001

Documents for Certification
September 2014

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

Lindsay Speed

Sarah Fairbrother

September 2014

Thames Tideway Tunnel

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.25**

Volume 25: Abbey Mills Pumping Station appendices

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

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Appendix A: Introduction

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Volume 25 Abbey Mills Pumping Station appendices

Appendix A: Introduction

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Appendix A: Introduction

A.1 Summary

A.1.1 This document presents the appendices that accompany the *Environmental Statement* Volume 25 Abbey Mills Pumping Station site assessment.

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

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

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

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

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Appendix B: Air quality and odour

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Appendix B: Air quality and odour

B.1 Model verification

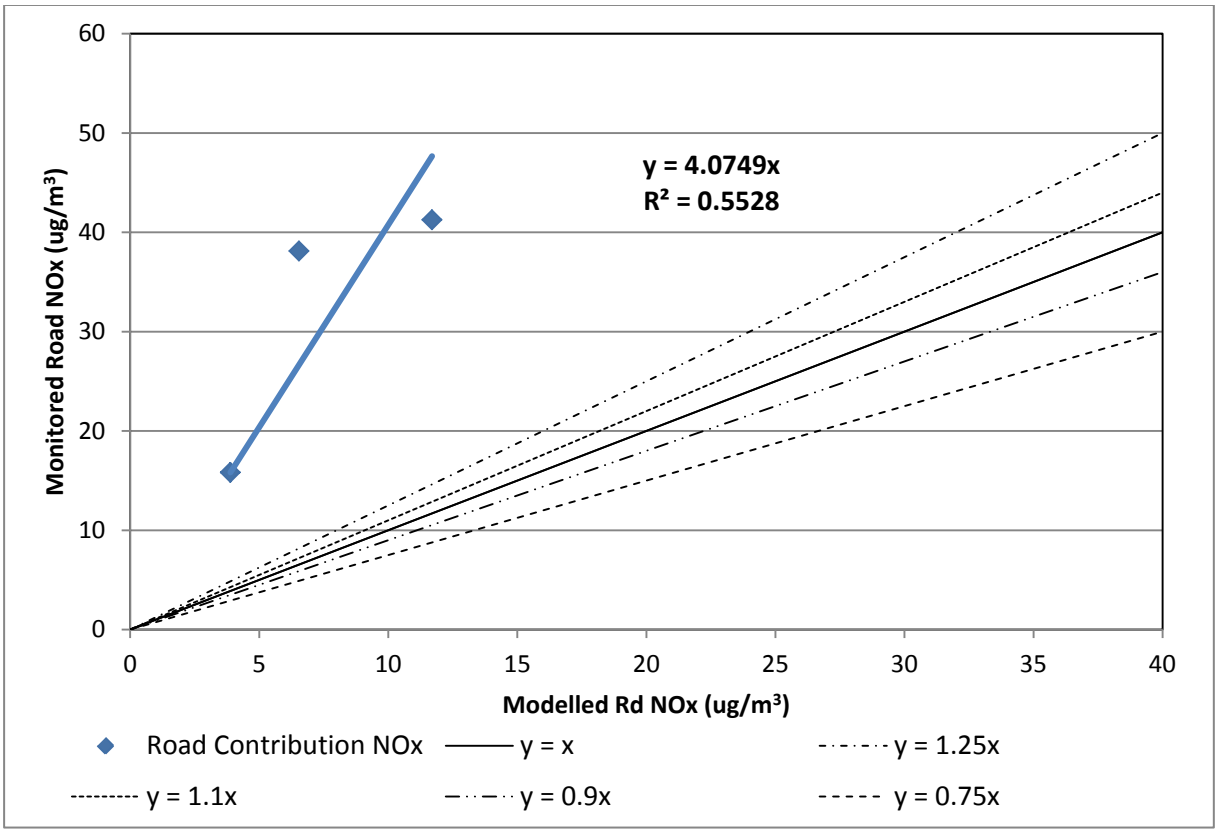
B.1.1 Modelled NO_2 concentrations have been plotted against monitored concentrations at the three diffusion tube sites (AMPM1 – AMPM3) shown in Vol 25 Figure 4.4.1 (see separate volume of figures). Sites AMPM4 and AMPM5 could not be used as there was insufficient traffic data for roads next to these sites.

B.1.2 This showed that the modelled results underestimated NO_2 concentrations by between 11% and 23%. 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.

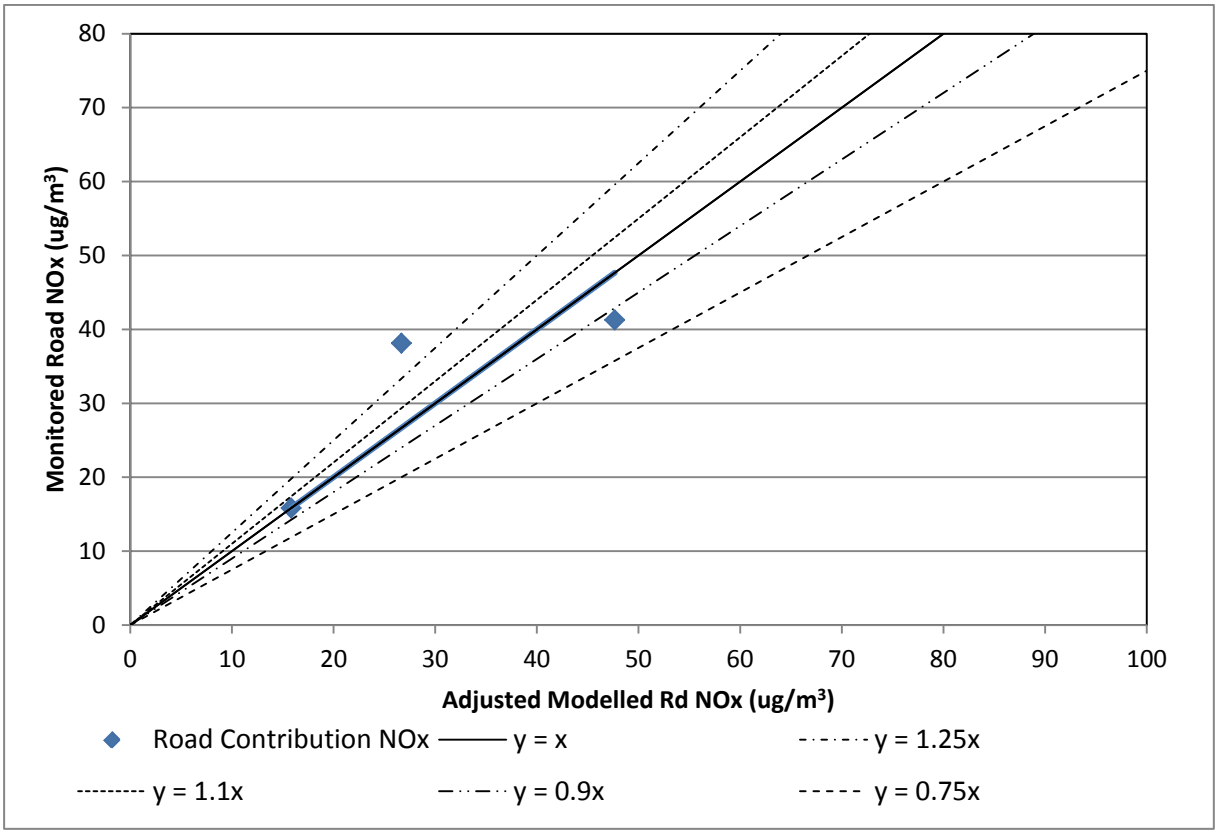
B.1.3 To derive the adjustment factor, modelled road NO_X concentrations were plotted against calculated monitored road NO_X concentrations - see Vol 25 Plate B.1 below. An adjustment factor of 4.07 was calculated to adjust modelled roadside NO_X concentrations, in accordance with LAQM.TG(09)[1] and was subsequently applied – see Vol 25 Plate B.1. A PM_{10} adjustment factor was similarly developed using monitoring data from the LB Newham site in Cam Road (NM2). A factor of 3.55 was applied to the results.

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

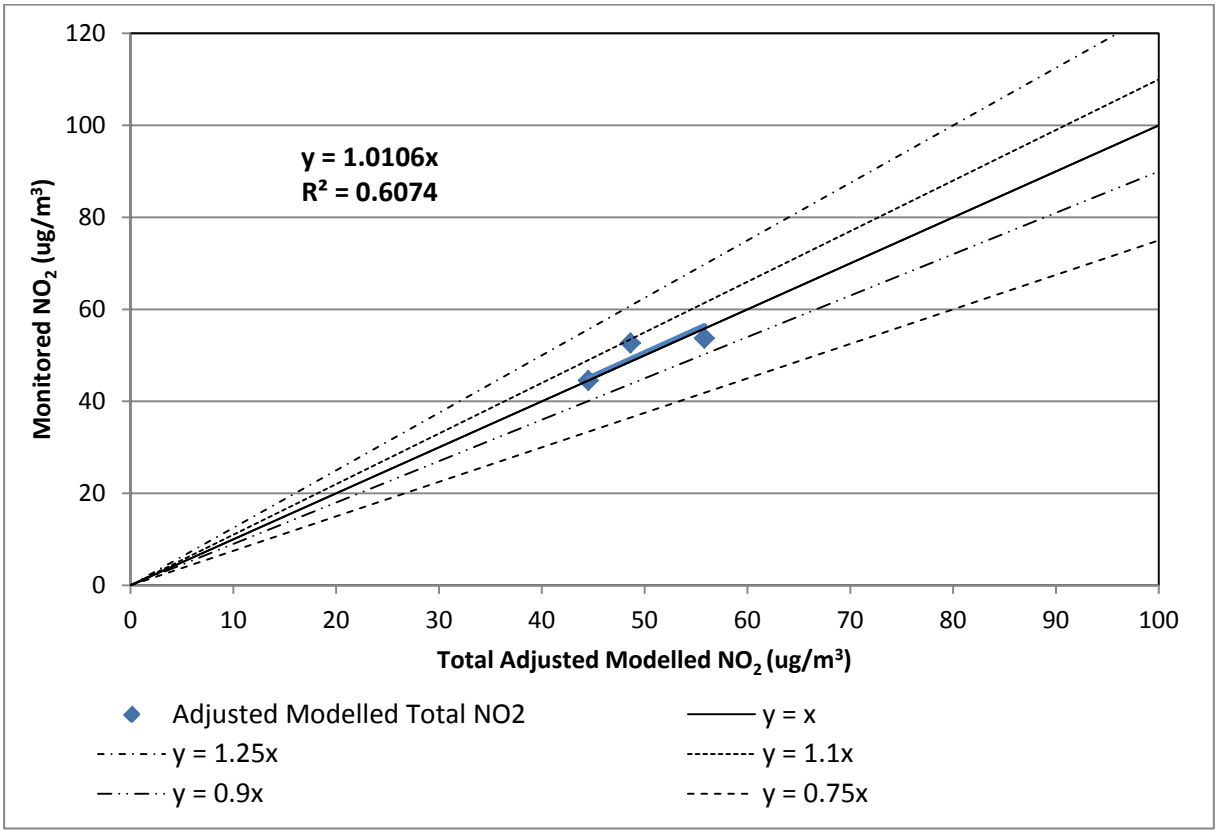
Vol 25 Plate B.1 Air quality – monitored road NO_X vs. modelled road NO_X



Vol 25 Plate B.2 Air quality – monitored road NO_X vs. adjusted modelled road NO_X



Vol 25 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 Abbey Mills Pumping Station site are shown in Vol 25 Table B.1.

Vol 25 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)
TfL Model	A11 High Street west of Abbey Lane	42565	6.9	30	16.8	12.2	47773	50	47833	7.0
ATC** 'direct'	Abbey Lane	1005	11.4	30	22.0	12.2	1128	50	1178	15.1
TfL Model	A11 High Street east of Abbey Lane	41412	6.9	30	16.8	12.2	46478	0	46489	6.9

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

B.3 Construction plant emission factors

B.3.1 For the purpose of the assessment, the following listed equipment in Vol 25 Table B.2 has been modelled for the peak construction year at Abbey Mills Pumping Station site.

Vol 25 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	8.6×10^{-08}	5.4×10^{-09}
	Ground level behind hoarding	Generator - 200kVA	1	100	160	2.7×10^{-07}	1.7×10^{-08}
	Ground level behind hoarding	JCB with hydraulic breaker	1	50	67	5.6×10^{-08}	3.5×10^{-09}
	Ground level behind hoarding	Cutting equipment (diamond saw)	1	10	2.3	2.0×10^{-09}	4.2×10^{-09}
	Ground level behind hoarding	Telescopic handler / FLT**	1	30	60	3.0×10^{-08}	1.9×10^{-09}
	Ground level behind hoarding	Hiab*** lorry/crane	1	5	56	4.7×10^{-09}	2.9×10^{-10}
	Ground level behind hoarding	Well drilling Rig	1	50	403	3.4×10^{-07}	2.1×10^{-08}
Diaphragm wall construction	Ground level behind hoarding	Diaphragm wall rig (grab)	2	90	250	7.5×10^{-07}	4.7×10^{-08}
	Ground level behind hoarding	Diaphragm wall rig (hydrofraise)	2	90	250	7.5×10^{-07}	4.7×10^{-08}

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	Concrete deliveries (discharging)	1	20	223	7.4×10^{-08}	4.6×10^{-09}
	Ground level behind hoarding	Concrete pump	1	20	223	7.4×10^{-08}	4.6×10^{-09}
	Ground level behind hoarding	Compressor 400cfm	1	50	104	8.6×10^{-08}	5.4×10^{-09}
	Ground level behind hoarding	Dumper	1	50	81	6.7×10^{-08}	4.2×10^{-09}
	Ground level behind hoarding	150t crawler crane	2	50	240	4.0×10^{-07}	2.5×10^{-08}
Shaft excavation	Ground level behind hoarding	Long reach excavator	2	80	178	4.7×10^{-07}	3.0×10^{-08}
	Ground level behind hoarding	20t excavator with breaker	2	50	73	1.2×10^{-07}	7.6×10^{-09}
	Ground level behind hoarding	25t excavator	1	80	125	1.7×10^{-07}	1.0×10^{-08}
	Ground level behind hoarding	Dumper	1	50	81	6.7×10^{-08}	4.2×10^{-09}
	Ground level behind hoarding	80t crawler crane	1	50	240	2.0×10^{-07}	1.2×10^{-08}
	Ground level behind hoarding	150t crawler crane	1	50	240	2.0×10^{-07}	1.2×10^{-08}

Note: For the purposes of this assessment, the above listed equipment has been modelled for the peak construction year. The data assumes a 10 hour working day. This schedule provides an illustration of typical plant that could be used in the construction of the Thames Tideway Tunnel at this site. The appointed Contractor must comply with section 6 of the CoCP but may vary the method and plant to be used. This schedule

*therefore represents the most reasonable assumption for the assessment that can be made at this stage. * cfm – cubic feet per minute. ** FLT – fork lift truck. ***Hiab – loader crane.*

References

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

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Appendix C: Ecology - aquatic

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Appendix C: Ecology – aquatic

C.1 Introduction

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

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Appendix D: Ecology - terrestrial

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Appendix D: Ecology – terrestrial

D.1 Notable species survey report

Introduction

D.1.29 A Phase 1 Habitat Survey was carried out on 7 December 2010 at the Abbey Mills Pumping Station site (see Vol 25 Figure 6.4.2 in separate volume of figures). Based on this, surveys for the following species have been undertaken:

a. otter *(Lutra lutra)* and water vole *(Arvicola amphibius)*

b. bats

c. breeding birds

d. wintering birds

e. black redstart *(Phoenicurus ochruros)*

f. reptiles

g. invasive plants.

D.1.30 The purpose of the surveys is to determine the presence or likely absence of these species at and around the site.

D.1.31 This report presents the survey findings. The survey area for each species is described with reference to the habitat types identified during the Phase 1 Habitat Survey as having potential for notable species (paras. D.1.33 to D.1.51). The results from the surveys are then presented (paras. D.1.52 to D.1.73). The final section provides an interpretation of the results (paras. to D.1.74 to D.1.94). Figures referred to in this report are contained within Vol 25 Abbey Mills Pumping Station Figures.

D.1.32 Information on legislation, policy and methodology can be found in Vol 2 of the *Environmental Statement*. Information on site context can be found in Section 3 of this volume.

Survey area

Otter and water vole

D.1.33 Water voles are associated with vegetated river banks where there is a range of habitat structure and food plants such as common reed *(Phragmites australis)*. They occupy burrows in the river bank where they shelter and breed. Otters move along watercourses and eat fish and other aquatic animals. They shelter and breed in holts, which can be a hole in the base of a tree or can comprise holes in banks. They also make use of tall bankside vegetation as resting places.

D.1.34 The survey area, as shown in Vol 25 Figure 6.4.3 (see separate volume of figures) includes a stretch of both the Abbey Creek and the Channelsea River, both of which lie in the immediate vicinity of Abbey Mills Pumping Station and the proposed development site. The watercourse and associated bank vegetation adjacent to the southwest of the site were

considered to provide a potential corridor for the movement of otter (if present) as well as providing possible areas for otter to rest. The bank vegetation was also considered to have the potential to support foraging and burrowing water vole.

D.1.35 An otter and water vole survey was not undertaken along the Prescott Channel, to the west of the site, as it was assessed as offering unsuitable habitat, due to its canalised nature and lack of bankside vegetation.

Bats

D.1.36 Bats are associated with a diverse range of habitats, including woodland, scrub, riparian habitats and buildings. They roost in trees and buildings where suitable features are present, and they commute along linear features such as hedgerows, watercourses and tree lines, and forage around vegetation such as scrub, hedgerows, grassland, trees and river corridors.

D.1.37 A two stage bat survey was carried out. The first survey was a remote recording (bat triggering) survey using remote Anabat™ recording devices. Based on the habitat types identified during the Phase 1 habitat survey and their potential to support foraging, commuting or roosting bats, three locations were chosen for the installation of the remote recording devices (shown on Vol 25 Figure 6.4.4, see separate volume of figures).

D.1.38 Location 1 is on the western boundary of the site in the vicinity of Three Mills Lock. The recording device was attached to the boundary fence. This location was selected to record potential bat activity associated with foraging and commuting along the adjacent Prescott Channel and to record the movement of bats entering and leaving the site along this boundary.

D.1.39 Location 2 is to east of the site along the Channelsea Path. The recording device was attached to a mature tree. This location was selected to gain an understanding of bat activity associated with foraging and commuting along the tree and scrub line adjacent to the Channelsea Path and along the Channelsea River and Abbey Creek.

D.1.40 Location 3 is to the east of the site where the remote recording device was attached to a building that was identified during the Phase 1 Habitat Survey as having potential for roosting bats.

D.1.41 The bat activity recorded during the remote recording surveys triggered the need for an additional dawn survey (see Volume 2 Environmental assessment methodology for bat triggering criteria). Therefore, a second stage of bat surveying was undertaken, comprising one dawn survey visit by two ecologists to assess the usage of the site and immediate surrounds by bats.

D.1.42 No habitat suitable for foraging or roosting was identified on site during the Phase 1 Habitat Survey. However, the survey area included the site in order to record the passage of bats through the area. Habitats adjacent and in close proximity to the site were also surveyed as bats using these habitats have the potential to be disturbed by lighting and noise during construction. The adjacent Channelsea River, Abbey Creek and the

Prescott Channel, and the tree and scrub line along the Channelsea Path were surveyed as these habitats have potential as bat foraging and commuting resources. The survey area for the bat activity (dawn) surveys, is shown in Vol 25 Figure 6.4.4 (see separate volume of figures).

Breeding birds

D.1.43 Breeding birds forage and nest within a range of habitat including grassland, scrub, trees and marginal aquatic habitats. Birds can also nest on and within buildings. The survey area, as shown in Vol 25 Figure 6.4.5 (see separate volume of figures) covers the entirety of the existing Abbey Mills Pumping Station compound, which includes the proposed development site and habitats immediately adjacent. The survey focussed on the following habitats within the Abbey Mills Pumping Station compound that were considered to provide potential nesting and foraging opportunities for breeding birds and consequently could be affected by construction:

a. the hedgerow adjacent to the proposed site access road to the north of the Abbey Mills Pumping Station compound

b. marginal vegetation the broad-leaved trees and scrub immediately adjacent to the site to the south along Channelsea Path

c. marginal vegetation on the banks of the Channelsea River and Abbey Creek to the south of the site

d. trees, scrub and marginal vegetation on Channelsea Island to the south of the site

e. trees and scrub on the opposite bank of the Prescott Channel

f. buildings within the Abbey Mills Pumping Station site.

Wintering birds

D.1.44 Wintering birds are mainly associated with aquatic habitats such as intertidal mudflats and marshes, marginal vegetation and wetlands, which they use for resting and foraging. Some wintering bird species are also associated with terrestrial habitats such as scrub and grassland, which they use for roosting at high tide or foraging. The survey area, as shown in Vol 25 Figure 6.4.6 (see separate volume of figures), includes the proposed development site and habitats in close proximity to the site that have potential for wintering birds as follows:

a. The open water within the Prescott Channel to the west of the development site, which has potential for wintering birds to be resting on the water surface. There is no marginal vegetation along the channel and no mudflats are exposed at low tide. Therefore, the Prescott Channel is sub-optimal for foraging wintering birds.

b. The Channelsea River and Abbey Creek, to the south and east of the proposed development site, which has potential for wintering birds to rest and forage on the intertidal mudflat habitat, marginal reed fringe vegetation and along the open water within the river channel.

c. Trees and scrub along the Channelsea Path adjacent to the south of the site and the grassland to the east of the site, that have potential for foraging and resting wintering birds.

Black redstart

D.1.45 Black redstart nest on and within buildings and structures (mostly those that are derelict), and forage on sparsely-vegetated open areas. The survey area is shown in Vol 25 Figure 6.4.7 (see separate volume of figures). There was a record of black redstart within 500m of the site in the desk study data (Geographic Information for Greater London (GiGL)). There are currently no potential foraging areas on or immediately adjacent to the proposed development site. However, the site was included in the survey area to record any movements of black redstart through or in close proximity to the site. The survey area included the buildings within the Abbey Mills Pumping Station compound, the building on the Channelsea Island to the west of the site and buildings along and adjacent to the west of the Prescott Channel.

Reptiles

D.1.46 Reptiles are associated with a variety of habitats including open woodland, abandoned and derelict land, large gardens, heathland, grassland, scrub and riparian habitats. Reptiles are usually found where there is a mosaic of these habitats that provide a range of conditions that provide shelter, foraging areas and areas for basking. They also require sheltered locations for hibernating in winter, such as piles of wood or stone.

D.1.47 The survey area, as shown in Vol 25 Figure 6.4.8 (see separate volume of figures), comprises connecting habitat to the site along the Channelsea Path to the south of the site. The survey covered the length of the Channelsea Path adjacent to the Abbey Mills Pumping Station compound. Reptiles are mobile and tend to move around within an area of suitable habitat. Therefore, if reptiles were observed at the northern end of this section of the Channelsea Path then it can be inferred that reptiles would likely be present immediately adjacent to the site to the south. As the proposed development site comprises hardstanding, this area is considered to be sub-optimal for reptiles. Habitats to the north of the proposed development site, such as the allotments, were not surveyed due to the lack of suitable connecting habitat between these areas and the site.

Invertebrates

D.1.48 An invertebrate survey was scheduled to be undertaken following the Phase 1 Habitat Survey, as the sparsely vegetated habitat and scattered trees and scrub on site were considered to have potential for notable invertebrate species. However, the site was cleared of vegetation after the Phase 1 Habitat Survey. No habitats with potential to support notable invertebrate species were then present on or immediately adjacent to the proposed development site. Therefore, no invertebrate surveys have been undertaken at this site.

Botanical surveys

D.1.49 A botanical survey was scheduled to be undertaken following the Phase 1 Habitat Survey, as the sparsely vegetated habitat on site was considered to have potential for notable botanical species. However, the site was cleared of vegetation after the Phase 1 Habitat Survey was undertaken. No habitats with potential to support notable species were then present on or immediately adjacent to the proposed development site. Therefore, a botanical survey has not been undertaken.

Invasive plants

D.1.50 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.1.51 The invasive plants survey area, as shown on Vol 25 Figure 6.4.9 (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 (eg Japanese knotweed (*Fallopia japonica*)).

Results

D.1.52 In this section, the results of the desk study, notable species surveys and the invasive plant survey are presented. The results are then interpreted in paras. D.1.74 and D.1.94.

Desk study

D.1.53 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 25 Table D.1.

Vol 25 Table D.1 Terrestrial ecology – species recorded within 500m of the site between 2001 - 2011

Common name	Species name (Latin)	Record count
Mammals		
Pipistrelle sp.	*Pipistrellus sp.*	1
Birds		
Black redstart	*Phoenicurus ochruros*	1
Brambling	*Fringilla montifringilla*	2
Caspian gull	*Larus cachinnans*	2
Common kingfisher	*Alcedo atthis*	4

Common name	Species name (Latin)	Record count
Common linnet	*Carduelis cannabina*	6
Common redpoll	*Carduelis flammea*	1
Common starling	*Sturnus vulgaris*	2
Eurasian curlew	*Numenius arquata*	1
Eurasian tree sparrow	*Passer montanus*	1
Fieldfare	*Turdus pilaris*	5
Green sandpiper	*Tringa ochropus*	9
House sparrow	*Passer domesticus*	2
Northern lapwing	*Vanellus vanellus*	3
Peregrine falcon	*Falco peregrinus*	2
Redwing	*Turdus iliacus*	5
Reed bunting	*Emberiza schoeniclus*	2
Sand martin	*Riparia riparia*	2
Sky lark	*Alauda arvensis*	2
Song thrush	*Turdus philomelos*	3
Yellow-legged gull	*Larus michahellis subsp. michahellis*	1
Plants		
Cornflower	*Centaurea cyanus*	4
Black poplar	*Populus nigra subsp. Betulifolia*	2

Water vole and otter survey

D.1.54 An otter *(Lutra lutra)* and water vole *(Arvicola terrestris)* survey was undertaken on 19 September 2011 by experienced ecologists, in suitable weather conditions (10-14°C, light breeze, dry on the day of survey with a period of dry weather preceding the survey visit). No observations were made of otters or water voles during the survey. No field signs, such as otter spraint, water vole droppings and footprints of either species, which would be indicative of presence of these species, were recorded.

Bat surveys

Bat triggering (remote recording) surveys

D.1.55 The bat triggering (remote recording) surveys were undertaken between 13 and 15 May 2011 in suitable weather conditions (Vol 25 Table D.2).

D.1.56 Two species of bat were recorded: common pipistrelle *(Pipistrellus pipistrellus)* and soprano pipistrelle *(Pipistrellus pygmaeus).* At location one, the maximum count of common pipistrelle bat passes recorded in any

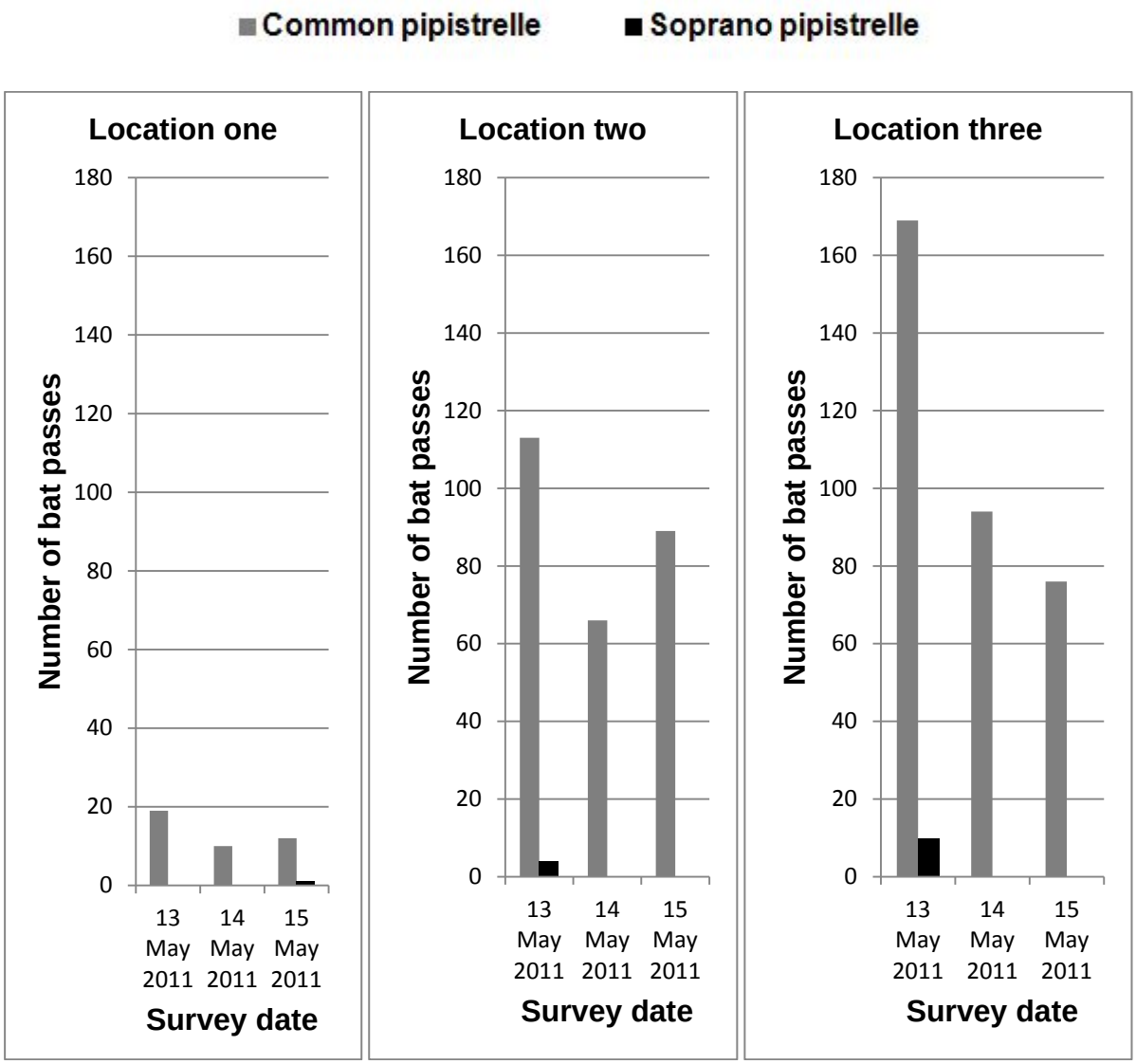
one night is 19, recorded on 13 May 2011. Higher counts of common pipistrelle were recorded at locations two and three, with maximum counts of 113 and 169 respectively, both recorded on the 13 May 2011. There was some variation between the survey nights, with higher counts at each location on the 13 May 2011 than during the other two survey nights.

D.1.57 Low counts of soprano pipistrelle were recorded at all three locations (between one and ten bat passes, see Vol 25 Plate D.1). This species was recorded on only one survey night at each location: 15 May 2011 at location one; and 13 May 2011 at locations two and three.

Vol 25 Table D.2 Terrestrial ecology – bat survey weather conditions

Survey visit	Weather conditions
13 May 2011	10-15°C, gentle breeze, dry, 10% cloud cover
14 May 2011	12-14°C, gentle breeze, dry, 10% cloud cover
15 May 2011	12°C, gentle breeze, dry, 20% cloud cover

Vol 25 Plate D.1 Terrestrial ecology – bat passes recorded during remote recording surveys at three locations at Abbey Mills Pumping Station



Bat activity (dawn) surveys

D.1.58 As there were high numbers of common pipistrelle recorded during the remote recording survey, this triggered the need for a bat activity (dawn) survey to be undertaken (based on bat triggering criteria in Vol 2 Section 6). The bat activity survey was undertaken on 17 June 2011 in suitable weather conditions (light breeze, dry, no cloud cover, 16°C). The bat activity survey results are shown on Vol 25 Figure 6.4.4 (see separate volume of figures).

D.1.59 No bat activity was recorded on the proposed development site during the bat activity survey. However, common pipistrelle bats were recorded within the wider Abbey Mills Pumping Station compound. Common pipistrelle bats were recorded foraging around vegetation in close proximity to the pumping station building to the east of the proposed development site. Six of the nine bat passes recorded were within the hour prior to dawn (bats usually return to their roost sites during this period). A common pipistrelle was recorded flying towards the Abbey Mills

Pumping Station compound from the Channelsea River to the south during this time period. Close to dawn, eight common pipistrelle bats were recorded commuting from west to east along the northern boundary of the survey area.

D.1.60 No soprano pipistrelle bats were recorded during the bat activity survey.

Breeding bird survey

D.1.61 Three survey visits were undertaken (24 May, 17 June and 23 June 2011) in suitable weather conditions (Vol 25 Table D.3) by an experienced ornithologist (bird specialist). The results of breeding bird survey are shown on Vol 25 Figure 6.4.5 (see separate volume of figures) and in Vol 25 Table D.4.

Vol 25 Table D.3 Terrestrial ecology – breeding bird survey weather conditions

Survey visit	Weather conditions
24 May 2011	16°C, calm, 10% cloud cover, dry
17 June 2011	14°C, light southeasterly breeze, 100% cloud cover, dry
24 June 2011	12°C, light westerly breeze, 10% cloud cover, dry

D.1.62 No active nests were recorded on site. Sand martin *(Riparia riparia)*, which is an Amber List[i] species included in the Birds of Conservation Concern 3 (RSPB, 2009[1]), was observed flying around sand and rubble piles that were present on site during the survey. These sand and rubble piles are no longer present on site. Sand martin was not recorded nesting on or in close proximity to the site.

D.1.63 A total of 27 breeding bird species and 61 breeding territories (active nests and their surrounding territory) were recorded within the survey area. No active nests were observed on site. Species of conservation importance were recorded as follows:

a. The marginal vegetation along the Channelsea River provided breeding habitat for a pair of mallards *(Anas platyrhynchos)*.

b. The Greenway Bridge over the Channelsea River provided a nest site for a pair of grey wagtails *(Motacilla cinerea)*.

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

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

c. The scrub along the Channelsea Path supported two pairs of dunnocks *(Prunella modularis)*, one pair of whitethroat *(Sylvia communis)* and one pair of linnet (*Carduelis cannabina)*. A third pair of dunnock nested in the introduced shrub to the north-west of the proposed development site.

d. Kestrel *(Falco tinnunculus)* was observed between the Channelsea River and the old pumping station buildings, foraging over an area of grassland habitat. This species was not nesting within the survey area.

Vol 25 Table D.4 Terrestrial ecology – breeding bird territories recorded within the survey area

Species name	Latin name	Conservation designation[ii]	Estimated number of breeding territories
Mallard	*Anas platyrhynchos*	Amber List	1
Moorhen	*Gallinula chloropus*	Green List	1
Coot	*Fulica atra*	Green List	1
Feral pigeon	*Columba livia*	Green List	4
Wood pigeon	*Columba palumbus*	Green List	7
Collared dove	*Streptopelia decaocto*	Green List	1
Grey wagtail	*Motacilla cinerea*	Amber List	1
Pied wagtail	*Motacilla alba*	Green List	1
Wren	*Troglodytes troglodytes*	Green List	6
Dunnock	*Prunella modularis*	Amber List UK BAP Priority List	3
Robin	*Erithacus rubecula*	Green List	2

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

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

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

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

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

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

Species name	Latin name	Conservation designation[ii]	Estimated number of breeding territories
Blackbird	*Turdus merula*	Green List	6
Blackcap	*Sylvia atricapilla*	Green List	6
Whitethroat	*Sylvia communis*	Amber List	1
Sedge warbler	*Acrocephalus schoenobaenus*	Green List	1
Reed warbler	*Acrocephalus scirpaceus*	Green List	2
Chiffchaff	*Phylloscopus collybita*	Green List	1
Great tit	*Parus major*	Green List	2
Blue tit	*Parus caeruleus*	Green List	2
Magpie	*Pica pica*	Green List	1
Jackdaw	*Corvus monedula*	Green List	1
Carrion crow	*Corvus corone*	Green List	1
Chaffinch	*Fringilla coelebs*	Green List	3
Greenfinch	*Carduelis chloris*	Green List	4
Goldfinch	*Carduelis carduelis*	Green List	1
Linnet	*Carduelis cannabina*	Red List UK BAP Priority List	1

Wintering bird survey

D.1.64 A total of six survey visits were undertaken at monthly intervals between December 2010 and March 2011, and during October and November 2011 by an experienced ornithologist (bird specialist). The survey visits were undertaken in suitable weather conditions (Vol 25 Table D.5). The main foraging and resting areas for wintering birds are indicated on Vol 25 Figure 6.4.6 (see separate volume of figures). The numbers of individuals of each species recorded in each month are provided in Vol 25 Table D.6.

Vol 25 Table D.5 Terrestrial ecology – wintering bird survey weather conditions

Survey visit	Weather conditions
22 December 2010	14°C, light northeasterly wind, 100% cloud cover, dry
27 January 2011	3°C, light easterly wind, 100% cloud cover, dry
25 February 2011	10°C, calm, 25% cloud cover, dry

Survey visit	Weather conditions
17 March 2011	11°C, calm, 90% cloud cover, dry
21 October 2011	12°C, light southwesterly wind, 25% cloud cover, dry
17 November 2011	14°C, light southwesterly wind, 25% cloud cover, dry

Waterbirds

D.1.65 A total of 19 waterbird[iii] species were recorded in the intertidal watercourses (the Channelsea River and Abbey Creek), which lie adjacent to the south of the proposed development site. No wintering birds were observed within the Prescott Channel to the west of the site.

D.1.66 The following species were observed in close proximity to the site:

a. Gadwall *(Anas strepera)*, teal *(Anas crecca)*, mallard, snipe *(Gallinago gallinago)* and green sandpiper *(Tringa ochropus)* were recorded foraging on exposed mud and along the water's edge as the tide receded in the Channelsea River.

b. Pochard *(Aythya farina)*, tufted duck *(Aythya fuligula)*, black-headed gull *(Chroicocephalus ridibundus)*, common gull *(Larus canus*), lesser black-backed gull *(Larus fuscus)* and herring gull *(Larus argentatus)* were recorded resting on open water within the Channelsea River, before low tide.

c. A common kingfisher *(Alcedo atthis)* was recorded flying along the Channelsea River as the tide receded, foraging for fish in the shallow water.

d. The marginal reed fringe vegetation adjacent to the Channelsea River is used as a place of shelter by snipe and water rail *(Rallus aquaticus)*.

D.1.67 Teal, an Amber List species, was recorded on each survey visit foraging and resting on the intertidal mudflats, and sheltering in the marginal reed fringes along Channelsea River. Teal was recorded in particularly high numbers during the December 2010 survey visit, with a count of 152 individuals.

Other bird species

D.1.68 Two pied wagtails *(Motacilla alba yarrellii)* and a wren were recorded at the site. The trees and scrub adjacent to the site to the south support wood pigeon, wren, robin *(Erithacus rubecula)*, thrushes and finches during the winter. A single male kestrel was recorded hunting over grassland to the east of the proposed development site, and a meadow pipit *(Anthus pratensis)* was also recorded foraging in this area.

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

Vol 25 Table D.6 Terrestrial ecology – species and numbers of wintering waterbirds recorded during monthly wintering bird surveys

Species name	Latin name	Conservation designation	Monthly wintering waterbird counts					
			22 Dec. 2010	27 Jan. 2011	25 Feb. 2011	17 March 2011	21 Oct. 2011	17 Nov. 2011
Little grebe	*Tachybaptus ruficollis*	Green List	2	-	-	-	-	-
Cormorant	*Phalacrocorax carbo*	Green List	2	2	1	2	-	1
Grey heron	*Ardea cinerea*	Green List	1	-	-	-	-	1
Mute swan	*Cygnus olor*	Green List	2	-	-	1	-	-
Gadwall	*Anas strepera*	Amber List	-	28	-	-	-	-
Teal	*Anas crecca*	Amber List	152	48	4	14	5	52
Mallard	*Anas platyrhynchos*	Amber List	28	16	6	16	12	18
Pochard	*Aythya ferina*	Amber List	2	-	-	-	-	-
Tufted duck	*Aythya fuligula*	Amber List	8	-	-	-	-	-
Water rail	*Rallus aquaticus*	No conservation designation. However, water rail is a nationally scarce species with a British population of between 450 and 900 pairs (Baker *et al*, 2006[2]). It is considered likely that continental birds visit Britain during the winter.	1	-	-	-	-	-
Moorhen	*Gallinula chloropus*	Green List	4	1	-	4	1	1

Species name	Latin name	Conservation designation	Monthly wintering waterbird counts					
			22 Dec. 2010	27 Jan. 2011	25 Feb. 2011	17 March 2011	21 Oct. 2011	17 Nov. 2011
Coot	*Fulica atra*	Green List	-	-	2	6	-	-
Snipe	*Gallinago gallinago*	Amber List	10	1	3	-	-	-
Green sandpiper	*Tringa ochropus*	Amber List	-	1		-	-	-
Black-headed gull	*Chroicocephalus ridibundus*	Amber List	62	78	2	21	9	8
Common gull	*Larus canus*	Amber List	2	-	-	-	-	-
Lesser black-backed gull	*Larus fuscus*	Amber List	-	2	-	2	2	-
Herring gull	*Larus argentatus*	Red List UK BAP Priority List	2	-	-	3	3	-
Common kingfisher	*Alcedo atthis*	Amber List	1					

Black redstart survey

D.1.69 Five black redstart survey visits were undertaken between 24 May 2011 and 14 July 2011 by an experienced ornithologist in suitable weather conditions (Vol 25 Table D.7). The two July visits are outside of the optimum survey period for black redstart. However, surveys can be undertaken during July as breeding usually continues into this month (Brown and Grice 2005[3]). The other three visits were undertaken during the peak breeding period for black redstart in May and June. Therefore, if black redstart were breeding on or near the site, then this would have been recorded with the survey effort undertaken. Consequently, two survey visits in July are not considered to limit the results of the survey.

D.1.70 No black redstarts were recorded during the surveys.

Vol 25 Table D.7 Terrestrial ecology – black redstart survey weather conditions

Date	Weather conditions
24 May 2011	13°C, Calm, 10% cloud cover, dry
17 June 2011	10°C Calm, 10% cloud cover, dry
23 June 2011	12°C, Light southwesterly breeze, 50% cloud cover, dry
1 July 2011	14°C, Light southwesterly breeze, 0% cloud cover, dry
14 July 2011	13°C, Light westerly breeze, 100% cloud cover, dry

Reptile survey

D.1.71 A total of 10 reptile survey visits were conducted by experienced ecologists at an appropriate time of year and during suitable weather conditions (Vol 25 Table D.8). No reptiles were recorded during the reptile survey.

Vol 25 Table D.8 Terrestrial ecology – reptile survey weather conditions

Date	Weather conditions
20 May 2011	Weather not relevant. Equipment setup (mat placement)
17 June 2011	13°C, calm, 25% cloud cover, dry
21 June 2011	22°C, light breeze, 25% cloud cover, dry
24 June 2011	12°C, light breeze, 25% cloud cover, dry
1 July 2011	14°C, light breeze, 75% cloud cover, dry
14 July 2011	13°C, light breeze, 65% cloud cover, dry
6 September 2011	17°C, light breeze, 60% cloud cover, dry
20 September 2011	15-17°C, light breeze, 40% cloud cover, dry

Date	Weather conditions
21 September 2011	17°C, light breeze, 50% cloud cover, dry
23 September 2011	17-20°C, moderate breeze, 65% cloud cover, dry
27 September 2011	15°C, moderate breeze, 100% cloud cover, dry

Invasive plants survey

D.1.72 An invasive plant survey was undertaken on 16 August 2011 by an experienced ecologist. The results of the survey are shown on Vol 25 Figure 6.4.9 (see separate volume of figures).

D.1.73 A large stand of Japanese knotweed *(Fallopia japonica)* (c. 10m by 40m) was recorded in the north of the proposed development site at Ordnance Survey grid reference TQ 38559 83117. The Japanese knotweed was undergoing a programme of treatment, with much of the visible growth appearing to be dead.

Interpretation

Otter and water vole

D.1.74 No evidence of otter or water vole was found on or in close proximity to the site. The suitability of this habitat is likely to be reduced by the presence of the invasive plant species Himalayan balsam *(Impatiens glandulifera)*, which dominates the bank vegetation. Himalayan balsam often out-competes other plant species and prevents them from colonising, resulting in a bare open understorey beneath the stands of Himalayan balsam, which is also more vulnerable to erosion. Connectivity between the surveyed stretch of the watercourse and other nearby watercourses that support otter and water vole was considered to be poor. This may reduce the likelihood of otter and water vole presence in this section of the watercourse.

Bats

D.1.75 The proposed development site is not considered to be important for bats given the absence of bat activity associated with the site. However, bats may occasionally pass through the site whilst they commute between foraging areas and roosts.

D.1.76 The watercourses, trees, scrub and grassland adjacent to the development site to the south and west are likely to provide occasional foraging resources for common and soprano pipistrelle bats, as indicated by the results of the remote recording surveys and the single record of foraging in this area during the bat activity survey.

D.1.77 The majority of bat activity recorded was associated with buildings and vegetation to the east of the proposed development site during the bat surveys. High numbers of common pipistrelle bat passes were recorded during the remote recording surveys in this area (remote recording device

locations one and two). Foraging activity was also recorded in this area during the bat activity survey.

D.1.78 Common pipistrelle bats were observed close to dawn commuting along the northeast boundary of the survey area (to the northeast of the proposed development site). It is likely that there is a common pipistrelle roost either within pumping station buildings on site, or other buildings and structures near to the site. Bats from this roost are likely to forage around areas of trees, scrub and grassland within the survey area.

D.1.79 It is estimated that approximately 50 bats use the Abbey Mills Pumping Station compound area for foraging and commuting.

D.1.80 Small numbers of soprano pipistrelle bats were recorded during the remote recording surveys. However, soprano pipistrelle was not recorded during dawn activity surveys. This is indicative of a small number of individuals occasionally using the site for foraging and/or commuting. It is considered unlikely that a soprano pipistrelle roost is present nearby due to the lack of activity recorded close to dawn.

D.1.81 There was some variation in the number of bats recorded on the nights of the remote recording surveys. This is likely to be due to local variations in weather conditions during the days preceding the survey and the survey nights. This may have resulted in slight differences in the availability of some invertebrates as a foraging resource.

Breeding birds

D.1.82 The proposed development site does not support breeding birds. The majority of the site comprises hardstanding or made ground that has recently been disturbed by the Lee Tunnel works at the site. The absence of vegetation reduces the potential opportunities for birds to nest on site.

D.1.83 Of the 27 bird species which occupied breeding territories within the survey area, none are afforded the higher level of legal protection as provided by Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). However, five species that are breeding within the survey area are of nature conservation importance and are included in the Birds of Conservation Concern Red or Amber List and/or UK BAP Priority Species: mallard (one breeding territory), grey wagtail (one breeding territory), dunnock (three breeding territories), whitethroat (one breeding territory) and linnet (one breeding territory).

D.1.84 Breeding birds recorded within the survey area (off-site) were mainly associated with the line of trees and scrub to the south of the proposed development site along the Channelsea Path, and trees and scrub scattered throughout the Abbey Mills Pumping Station compound, with some species such as feral pigeon recorded nesting on buildings within the survey area. The intertidal mudflats also provided breeding habitat for mallard and the Greenway Bridge over Channelsea River provided opportunities for nesting grey wagtails.

Wintering birds

Waterbirds

D.1.85 Of the 19 waterbird species that were recorded within the survey area, 11 are of nature conservation importance and are included in the Birds of Conservation Concern Red or Amber List and/or are UK BAP Priority Species: gadwall, teal, mallard, pochard, tufted duck, snipe, green sandpiper, black-headed gull, common gull, lesser black-backed gull and herring gull.

D.1.86 The majority of species were recorded in small numbers foraging and resting on the exposed intertidal mudflats within Channelsea River and Abbey Creek and around the Channelsea Island. The marginal vegetation on the north east bank of the Channelsea River and around the Channelsea Island provided shelter for some species, such as snipe and mallard.

D.1.87 Teal (Amber list) was recorded in high numbers foraging and resting on the intertidal mudflat, and sheltering within the marginal reed fringe along the river. The availability of shelter and large areas of intertidal mudflat for foraging is likely to be the main reason for their abundance at this location.

D.1.88 No waterbirds were observed along the Prescott Channel. This watercourse is canalised and therefore lacks marginal vegetation, which would provide shelter for wintering birds. Mudflats do not become exposed along the Prescott Channel, therefore the foraging resource along the Prescott Channel is limited. The combination of these sub-optimal habitat conditions, make the Prescott Channel less attractive to wintering waterbirds than the connecting Channelsea River and Abbey Creek.

Other bird species

D.1.89 Only one species, pied wagtail, was recorded on site. This species was likely to be resting in this area, as the foraging resource is limited due to the presence of hard standing and made ground.

D.1.90 Small numbers of common bird species, such as wood pigeon, wren, robin *Erithacus rubecula*, thrushes and finches were recorded within trees and scrub along the Channelsea Path adjacent to the south of the site. This habitat provides shelter for these birds, as well as providing a small invertebrate foraging resource. These common birds are likely to visit occasionally during winter on their way between habitat areas of higher quality.

D.1.91 A kestrel and meadow pipit were observed foraging over the grassland, adjacent to the east of the site. Kestrel feeds on small mammals such as mice, and the grassland area may support these species. Meadow pipit feeds on worms and insects, which are also likely to be present in the soil in this area.

Black redstart

D.1.92 The absence of black redstart observations indicates that this species does not currently use the site and the immediate surrounds for either

foraging or breeding. The proposed development site lacks the presence of any ephemeral short perennial vegetation that is favoured by black redstart for foraging. However, the buildings in close proximity to the site to the east and the buildings on the Channelsea Island are potentially suitable for nesting black redstart. While there are many opportunities for black redstart to nest and forage in London, not all these locations are occupied by this species. This is mainly due to the rarity of black redstart in the UK and in London (Holling and Rare Breeding Birds Panel)[4].

Reptiles

D.1.93 Although some of the habitat appeared suitable for reptiles along the Channelsea Path to the south of the site, no reptiles were recorded during the reptile survey. The habitat is limited in extent and isolated from other potentially suitable reptile habitat in the area. Therefore, it is likely that reptiles are locally absent. It is considered unlikely that reptiles would colonise this area in future whilst there is the lack of habitat connectivity.

Invasive plants

D.1.94 The invasive plant species Japanese knotweed was recorded on site in the north of 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.

References

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

[2] Baker, H., Stroud, D.A., Aebischer, N.J., Cranswick, P.A., Gregory, R.D., McSorley, C.A., Noble, D.G. & Rehfisch, M.M. *Population estimates of birds in Great Britain and the United Kingdom*. *British Birds* (2006), 99, 25-44.

[3] Brown, A., Grice, P. *Birds in England*. T & A D Poyser Ltd (2005).

[4] Holling and Rare Breeding Birds Panel. *Rare breeding birds in the United Kingdom in 2008*. Mark Holling and the Rare Breeding Birds Panel (2008).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.25**

Volume 25: Abbey Mills Pumping Station appendices

Appendix E: Historic environment

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

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Environmental Statement

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Appendix E: Historic environment

E.1 Gazetteer of known heritage assets

E.1.1 Details of known heritage assets within the assessment area are provided in Vol 25 Table E.1 below, with their location shown on the historic environment features map (Vol 25 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 25 Table E.1 Historic environment – gazetteer of known heritage assets within the site and assessment area

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
1A	Lea Tunnel Thames Water, Abbey Mills Pumping Station. Geoarchaeological assessment of geotechnical data by Museum of London Archaeology (MOLA) in 2009. The assessment identified an area of low lying migrating channel deposits along the line of the Abbey Creek with high levels of natural gravel deposits in the north (in the region of the main pumping station buildings) and lower lying gravels to the south. The results allowed the sub-surface topography and alluvial deposits to be modelled. MOLA monitored five geoarchaeological boreholes along the line of the proposed culvert and shaft, in order to evaluate the survival and archaeological potential of the alluvial deposits identified in the deposit model. The two boreholes in the northern segment of the culvert were not drilled as an underground tank was located in this area. The boreholes along the southern section of the proposed culvert found evidence for a former landsurface developed in overbank flood deposits overlying floodplain gravel and sealed by post-medieval soils. An episode of wetter (sedge fen) conditions, prior to post-medieval soil development, might be associated with the excavation of a man-made channel in the post medieval period, which appears to have run across the line of the culvert. It eventually silted up, becoming a boggy hollow.	ABM11
1B	Line of Bazalgette's Lower Level Sewer.	---
2	Northern outfall sewer bridge over Channelsea River. Grade II listed.	1392549

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
3	Engine house at West Ham Pumping Station. Grade II listed. On the Heritage at Risk register.	1357997
4	The site of a post-medieval bridge over the Prescott Channel. Recorded on the Greater London Historic environment Record (GLHER).	MLO73095062812
5	Post-medieval bridge over the Channelsea River. In 1539 the western entrance to Stratford Langthorne Abbey was documented as through the 'kilnhouse' gate. Recorded on the GLHER.	MLO73101062818 MLO40079
6	In 1539 a bake house of Stratford Langthorne Abbey was documented, adjoining the abbey mill and the kilnhouse. Recorded on the GLHER.	MLO34624 MLO54878
7	The location of a guest hall ('le Gestenhall') to the south of a house leased in 1537 to Peter Vannes, Dean of Salisbury. The house lay within the former precinct of Stratford Langthorne Abbey, alongside the road leading from the precinct to the abbey mills. Demolished in the 1840s and last used as a home for Lascars (Asian seamen who served on European ships). Recorded on the GLHER.	MLO40705
8	Stratford Langthorne Abbey (part of area within precincts), Baker's Row, West Ham: nationally designated Scheduled Monument. Documentary evidence indicates that the abbey of St Mary Stratford Langthorne was founded in 1135 by William de Montfichet as a Savigniac house, becoming Cistercian in 1147: the abbey precinct was situated beside the Channelsea River. The majority of the buildings were demolished at the Dissolution in 1538 and a late 18th century owner of the site auctioned and sold much of the surviving masonry, although part of the main gateway survived into the 19th century. The site is now mostly covered by railway lines and industrial buildings. In 1845 railway excavations revealed a brick and stone built drain running east-west. This drain was not observed in later excavations and probably lies under or to the immediate north of Baker's Row.	LO148 1003775 MLO10229
9	In 1539 Lady De Vere leased houses and gardens to the north and south of the west end of Stratford Langthorne Abbey church. These buildings do not appear in any later documents relating to the site. Recorded on the GLHER.	MLO40085
10	Archaeological excavation in 1973–4 by Passmore Edwards Museum (PEM) on the north side of Baker's Row located the line of the moat of the abbey of Stratford Langthorne. The	MLO31524 MLO40086

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	line of the stone boundary-wall, beside the moat, had four building phases. An early 13th century chalk and flint two-roomed house, perhaps the gate-keeper's house, was found inside the medieval wall line: the house was much altered throughout the medieval period with walls and doorways rebuilt. An area was subsequently designated as a Scheduled Monument (HEA 8). In 1983, PEM carried out further excavations on the north side of Abbey Road, west of the North Woolwich Railway, revealing part of the abbey church, cemetery, and a limekiln. An archaeological evaluation of a large area to the north of Abbey Road and east of the Channelsea (Stratford Market Depot) was carried out by Oxford Archaeology Unit (OAU) between 1991 and 1993. Surviving walls, containing some green sandstone, were recorded. The walls were thought to form part of the abbey buildings due to the quality of the workmanship and their location. At least nine inhumations were recorded in the area of the northeast cemetery. A compacted chalk surface overlaid by rubble was not securely dated, but was thought to be possibly medieval. To the east of this area, excavation and watching brief by NMS was carried out on the route of the Jubilee Line extension in 1994. This revealed the east end of the Abbey church, associated structures and part of the cemetery, including 80 human burials.	MLO40088 MLO54160 MLO54305 BR73 SL83 HW-OP91 HW-RW94 LT94 DD94
11	Three stone coffins were dug up near Grange Farm in the 1830s. By 1895 all were in the vault of a non-conformist chapel containing the bodies of three members of the Mabbs family, one-time occupants of the farm. Recorded on the GLHER. The GLHER records that removal of the foundations of Stratford Langthorne Abbey on Thomas Holbrook's land in the late 18th century revealed a small onyx seal with the impression of a griffin (or pegasus) carved into it. The seal was set into a silver fitting and an inscription incised into the silver. The inscription read "nuncio vobis gaudium et salvetum". 13th century arch, probably part of the cloisters of Stratford Langthorne Abbey, built into the wall of an outbuilding at the Adam and Eve public house. First mentioned in 1732, when the outbuilding was a dove house. Demolished between 1863 and 1888. Recorded on the GLHER.	MLO56523 MLO241780 61161 MLO40090
12	Abbey Road Bridge, West Ham. An archaeological excavation by NMS in 1994 in advance of a gas pipeline. The	HW-GP94

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	area, c. 5m square, contained four burials and foundations overlying an earlier ditch. The foundations were part of the medieval Stratford Langthorne Abbey, and consisting of pillar bases within the nave and a chapel wall, belong to an as yet undated phase.	
13	In 1539 the Abbey slaughterhouse was documented as near the barn of the lodge and probably in the abbey grange (farm). Recorded on the GLHER.	MLO40082
14	Olympic Development: BH9 Abbey Lane Pedestrian Bridge, Abbey Lane, E15. Standing structure recording by Museum of London Archaeology Service (MoLAS, now MOLA) and Pre Construct Archaeology (PCA). This bridge carried the Northern Outfall Sewer across Abbey Lane, and allowed pedestrian access along the Greenway footpath that runs along the top of the sewer. The sewer and its associated structures relate to Bazalgette's London sewerage system, constructed by the Metropolitan Board of Works between 1859 and 1875, with later repairs and rebuilding. The bridge featured yellow brick abutments with millstone grit copings, and appeared to have been partially rebuilt in the mid-late 20th century; the cast iron riveted plates which contain the sewerage pipes were replaced in the 1950s.	OL-04507
15	Olympic Development: BH23 Brick wall opposite 116–118 Abbey Lane, Stratford, E15. Standing structure recording by MoLAS and PCA. The wall was classically styled, constructed from yellow stock bricks and blue engineering bricks, and related to the former West Ham gasworks site. The wall was constructed during the 1890s, and formed part of the boundary wall which originally surrounded the entire gas works site. By the late 1990s most of the boundary wall's eastern extent had been demolished by the construction of Rick Roberts Way, creating its current length.	OL-04807
16	116– 130 Abbey Lane. Grade II listed. On the Heritage at Risk register	1080983
17	A slab with brass studs in it for affixing inlays in the forms of a cross and two figures under canopies was still visible in the kitchen of the Adam And Eve public house in 1863. Recorded on the GLHER. The GLHER also records the location of 'Le pore infirmary', possibly the site of an infirmary provided by the abbey for the lay poor.	MLO40708
18	Baker's Row, Stratford. An evaluation was carried out by	SFY07

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	MoLAS in 2007 followed by a community excavation in 2008 to assess the level, nature and condition of structures on the site and to expose remains in advance of conservation for display. These excavations revealed parts of the east end of a medieval building belonging to the abbey which was previously exposed during excavations in 1973–4. The building lay close to the site of the abbey gatehouse and originally may have served as a guest house. By the Dissolution it had become `the tenement of the janitor of the great gate'. It was mainly built of flint and mortar with chalk foundations. A stone wall, possibly of medieval date, had been built against the south face of the building. Cess pits and one brick wall apparently represented the northern extension of the medieval building after the Dissolution. No external ground surfaces contemporary with the medieval building were identified, and may have been removed in the 1970's excavations.	AYF08 MLO40092 MLO54837
19	Beck Lane (Stratford Market Depot), West Ham. Medieval pits were found through excavations by the OAU in 1991 and 1992. A sparse amount of residual Neolithic flint was found. To the north of the later abbey precinct, a late-Bronze Age to middle-to-late Iron Age and Roman site was discovered, including a horse burial and other animals close to two crouched human burials, suggesting a possible ritual or religious element. A dense area of features (pits, postholes, hut-gullies, ditches) cut into the clay subsoil covered an area of at least 0.6ha (1.5 acres) on the east bank of the Channelsea River, and would seem to indicate a multi-phase settlement. Residual finds also attest to earlier use of the site from the Mesolithic period onwards. Sparse residual middle and late Saxon pottery and 14th to 15th century pottery was recovered from the pit fills. The pits cut through earlier grave cuts. Brick-lined channels and floors were associated with J. Tucker's Abbey Print Works. The works were involved in printing calico up until the early 18th century, after which they were used for printing silk. The channels may have been used either for washing the silk or, for conducting water to a washing tank. Traces of later 19th century and early 20th century factory buildings were also recorded.	HW-0P91
20	19th century gasholder. Grade II listed.	1080994
21	19th century gasholder. Grade II listed.	1190906
22	19th century gasholder. Grade II listed.	1293590
23	19th century gasholder. Grade II listed.	1080995

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
24	Unspecified works prior to 1912 revealed an iron spear head. It is thought to date from the early medieval period. Recorded on the GLHER.	MLO254206 1760
25	The site of the Three Mills dating to the post-medieval period. Recorded on the GLHER.	MLO635600 62193 MLO635620 62194 MLO635630 62195
26	The historic core of the Abbey Mills Pumping Station complex, Abbey Lane E15, recorded on the GLHER. Built 1865–8 as part of Bazalgette's drainage scheme. For individual elements see below.	MLO90648
27	B Station at Abbey Mills Pumping Station. Grade II listed. On the Heritage at Risk register.	1357994
28	C Station, with associated valve house, Abbey Mills Pumping Station. Grade II listed. On the Heritage at Risk register.	1392550
29	Stores building at Abbey Mills to the west of the Pumping Station. Grade II listed. On the Heritage at Risk register.	1080980
30	Abbey Mills Pumping Station. An archaeological excavation by NMS in 1995. The post-mediaeval deposits were uniformly of 19th and 20th century date. A linear feature at the west end of the site corresponded to Low Level Sewer No. 2, linked to the 1868 pumping station (Station 'A'), and a ceramic pipe running roughly north-south was an overflow pipe, also of later 19th century date. The latter followed the course of an earlier open sewer, the Mill Meads Common Sewer between Stratford and the Channelsea River. A small quantity of residual 17th and 18th century ceramic material was recovered from the 19th century layers. This included Speckled Ware, Post-Mediaeval Redware and Bow Porcelain.	HW-AM95
31	Abbey Mills Pumping Station. Grade II* listed. On the Heritage at Risk register.	1190476
32	The bases of a pair of former chimney stacks at Abbey Mills to the northwest and southeast of the pumping station. Grade II listed. On the Heritage at Risk register.	1357995

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
33	Offices (former Superintendents' House) at Abbey Mills. Grade II listed. On the Heritage at Risk register.	1080981
34	Gates and gatepiers at the entrance to Abbey Mills Pumping Station. Grade II listed. Gate lodge at Abbey Mills. Grade II listed. On the Heritage at Risk register.	1080982 1080982
35	Transmission towers: standing structure recording by MoLAS and PCA in 2007. Overhead transmission lines were first erected in the Lower Lea Valley in 1953, as part of a 132kV line transmitting electricity from Brimsdown power station to Brunswick Wharf. Two new overhead transmission lines were installed in 1971; a 275 kV line and a 132kV diversion for local electricity supply, which both ran from West Ham power station to Hackney substation. Some of the transmission towers may have been reused in 1971, as they share the same footprint as many erected in 1953, however these early towers have all been renewed. The Three Mills Conservation Area Character Appraisal highlighted the transmission towers as having a negative visual impact on their surroundings; that removal would be of significant visual benefit, and that they do not merit any statutory protection. A comprehensive written and photographic record was made of the transmission towers, substations, associated equipment and their setting in the landscape.	OL-04607 MLO99080
36	Clock Mill. Grade II listed.	1191269
37	A paved roadway extending from the west side of House Mill to the wall and gate on the east side of Clock Mill. Grade II listed. Also the site of offices opposite Clock Mill. Grade II listed.	1080972 1080971
38	Tide Mill (known as the House Mill). Grade I listed.	1080970
39	The Bridport Site, Three Mills, Three Mill Lane, Bromley-by-Bow, E3. An archaeological watching brief and evaluation by PCA in 2003. Alluvial deposits were recorded, one of which contained a single sherd of pottery dating to the 15th or early 16th century. Further alluvial layers from the 18th and 19th centuries were covered with made ground from the 19th/20th centuries. The site had been disturbed by the insertion of a sewer, the construction of the river wall and some fuel storage	TMI03

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	tanks.	
40	The site of a medieval water mill. Recorded on the GLHER.	080995
41	The chance find of Roman coin. Recorded on the GLHER.	080806
42	Olympic Development: BH11, Pedestrian viaduct of sewer. Standing structure recording by MOLAS and PCA in 2007. The pedestrian viaduct, which is part of the Northern Outfall Sewer and associated Greenway footpath, spanning Bridge Road, was photographically recorded.	OL-04707
43	19th century gasholder. Grade II listed.	1190911
44	19th century No. 1 gasholder. Grade II listed.	1080996
45	19th century gasholder. Grade II listed.	1080993
46	Bromley-by-Bow gasworks was owned by the Imperial Gas and Coke Co. Production ceased in 1972. There is a group of seven gasholders (originally 8) which were erected in 1872. The engineers were Clark and Kirkham. The gasworks were linked to the dock at Bow Creek and there were rail connections to the Great Eastern Railway and the London Tilbury and Southend Railway. Recorded on the GLHER.	MLO23336 221584
47	The site of a post-medieval drain. Recorded on the GLHER.	060173
48	Olympic Development: Marshgate Lane Lock, Stratford, E15. Standing structure recording by MoLAS and PCA in 2007. Marshgate Lane Lock is located between the City Mill and Waterworks. The lock and surrounding banks date from a period of construction following the passing of the River Lea (Flood Relief) Act in 1930 and are constructed variously in plain concrete or in concrete over steel coffering.	OL-07407
49	War Memorial, Twelvetrees Crescent. Grade II listed. Statue of Sir Corbet Woodhall. Grade II listed.	1392547 1392548
50	Twelvetrees Crescent Bridge. Grade II listed.	1268439
51	Stratford Edge, 80–92 High Street, Stratford, E15. An archaeological evaluation by MOLA in 2010. Original drift geology was not reached, although the silt of the former Waterworks River channel (backfilled in the 1930s) was found at c. 103.2m ATD (above Tunnel Datum; the equivalent of 3.2m Ordnance Datum) in the west. Two probably 19th or early 20th century revetments were found at the former south bank of the river: a masonry-faced concrete and rubble revetment in the west and a timber revetment near the centre of the site. To south of the former channel, 18th or 19th century landfill was found as deep as c. 102.1m ATD in the	HSV10

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	east and c. 102.9m ATD in the west. The masonry-faced revetment was topped by mass concrete of uncertain function, possibly a foundation of late 19th or early 20th century date, and a concrete surface of early to mid-20th century date was found just to the south at c. 104.9m ATD. Stone and brick floors or paved areas and a remnant brick wall probably dating to the latter half of the 19th century were found at c. 104.0m ATD in the east together with a concrete surface at c. 104.2m ATD. The remains in the east are industrial in character, probably related to the stone industry (there was a 'stone yard' depicted on an 1867 Ordnance Survey (OS) map.	
52	Olympic Development: PDZ12, WP 1, Olympic Paralympic and Legacy Transformations Planning. An archaeological evaluation and excavation by MoLAS and PCA in 2007. Gravels of late Pleistocene - early Holocene date were recorded, overlain by prehistoric and historic alluvial sequences containing evidence for human activity. The sequence broadly suggested a site that lay at the eastern margins of a prehistoric river course: gravels were exposed of late Pleistocene to early Holocene date, overlain by a sequence of alluvial deposits that represented several phases of channel activity from the Neolithic to Iron Age. These alluvial deposits, interbedded sands, clays and gravels accumulated on channel bars within shifting stream channels. A gravel horizon within the sand bars produced flint debitage and a number of un-abraded sherds of Neolithic pottery, an assemblage of animal remains, including horse, and a possible wooden stake structure. The sand bar deposits were truncated by a channel containing a possible dislodged or disaggregated wooden structure comprising the remnants of at least four roundwood timbers. The remains are undated as yet but are not thought to predate the Iron Age. A sequence of organic clays and peats overlay the active channel deposits; these are likely to represent a channel marginal backwater environment that gradually silted up. In the upper part of the alluvium an early medieval channel, consistent with the possible site of a mill works, was identified. Substantial gravel dumps were laid down to consolidate the ground above the alluvium prior to construction. This was characterised by a range of wells, cesspits, brick walls and drains of 17th century date. A number of walls recorded in section at the northern end of the site were clearly Victorian and are likely to relate to the former Christ Church.	OL-08707
53	Lockkeeper's Cottage on Blaker Road. Locally listed. Three bays, two storey cottage. Stuccoed walls, hipped roof	---

HEA Ref no.	Description	Site code/ GLHER ref/ List Entry Number
	with modern tiling. Door frame with architrave and corbelled entablature.	
54	The Still, 3 Mills Distillery. Locally listed. Classical building built in London stock brick, with a hipped slate roof.	---
55	Blackwall Tunnel Northern Approach. Site of a watermill that was Four Mills St 'Foure Milstrett' in 1551. Named from the four mills along the Lea. The Cartulary of Holy Trinity, Aldgate refers to a mill in Bromley in 1227.	MLO3936 080972
56	Twelvetrees Crescent. The site of the 17th century Bromley by Bow Palace, known as the Old Palace and also as Queen Anne's Palace, built of brick with a plain front and flanking pyramidal towers. The rooms had stucco ceilings, Jacobean panelling, William and Mary carvings and marble floors: one of the rooms is preserved in the Victoria and Albert Museum. The building was divided into two merchants' houses in 1750 and demolished in 1893 to make way for a London County Council Board School. Its demolition was the inspiration for the *Survey of London* project.	MLO236300 81036
57	Set of tidal locks over the River Lea.	MLO729960 84434
58	Line of Bazalgette's Northern Outfall Sewer.	---
59	Line of Bazalgette's Northern High Level Sewer.	---

E.2 Site location, topography and geology

Site location

E.2.1 The site is bounded by the main Abbey Mills Pumping Station complex to the north and northeast, Abbey Creek to the east, the Channelsea River to the south and Prescott Channel to the west. The site lies 2.3km to the north of the River Thames within an area characterised by the numerous natural and artificial channels which form part of the River Lea (or Lee) system.

Topography

E.2.2 The site is located on the alluvial floodplain, the top of which is naturally flat, and any variations in level ground will be artificial.

E.2.3 Ground level within the site is fairly flat, with some slight variation. The northern part of the site lies at 105.7m ATD (above Tunnel Datum) and rises to 106.1m ATD in the centre of the site. Ground level in the south is

at 105.2m ATD. The eastern edge of the site lies at 105.3m ATD and the western edge lies at 105.8m ATD.

E.2.4 In the centre of the site are two large artificially raised areas. The top of the northern mound lies at 108.5m ATD while the southern mound lies at 108.2m ATD.

Geology

E.2.5 The site is situated in an area of alluvium overlying sand and gravel deposits associated with the River Lea and its network of channels (British Geological Survey digital data). The Lea is a major tributary of the Thames with the confluence of the two rivers some 2.3 km downstream to the south of the site.

E.2.6 The site is situated approximately in the centre of the floodplain: outcrops of Kempton Park and Taplow terrace gravels, which form the valley sides, are located 300m to the east and 400m to the west of the site respectively. The floodplain of the Lea is at its narrowest in the Mill Meads area (where Abbey Mills is situated), but widens immediately south and to a lesser extent upstream. It is also in this location, immediately downstream of Mill Meads, that a step (or 'knickpoint') occurs in the downstream gradient of the Lea and its floodplain, which might have influenced the river's characteristics and led to the location of so many mills and their associated streams in this area. The characteristics and thickness of the alluvial floodplain deposits differ upstream and downstream of this 'step' in the valley floor. The sequence at Abbey Mills and upstream is shallower and variable. In contrast, immediately downstream, the alluvium is considerably thicker with a ubiquitous layer of Middle Holocene peat sandwiched between alluvial / estuarine clay, a sequence that more closely resembles that of the Middle Thames.

E.2.7 Past geotechnical investigations are widely distributed across the site, and these provide borehole logs that are modern and detailed. A selection of these were utilised in a previous geoarchaeological assessment (**HEA 1A**) undertaken by MOLA and it is from this assessment, which encompassed a larger area than the current site, that information has been taken for this section of the report. The borehole data were used to create illustrative transects (cross-sections) through the sub-surface deposit sequence and to model the underlying gravel surface (Vol 25 Plate E.9). As shown on Vol 25 Plate E.10 and Vol 25 Plate E.11, the assessment identified Landscape Zones (LZs) broadly characterising elements of the ancient topography and environment:

a. LZ1 – lower lying gravel topography, where evidence for active river channels is lacking, and the overlying alluvial clay is relatively thick and representative of a wetland environment;

b. LZ2 – relatively high floodplain gravels, overlain by relatively thin alluvial clay;

c. LZ3 – a low-lying area of migrating stream channels and associated marginal environments.

E.2.8 The alluvium was deposited from c. 10,000BC to the present, with the underlying gravel associated with Devensian (Ice Age) river environments and deposited around 14,000 years ago. The gravel surface slopes down from west to east from a maximum of 100.3m ATD in the west to 98.0m ATD beyond the southeastern boundary of the site, close to the Channelsea River, where the gravels have been removed by river scour. The gravels also slope southwards towards the Thames from the centre of the site where their surface lies relatively flat at 100.0m ATD (Vol 25 Plate E.9, Vol 25 Plate E.10 and Vol 25 Plate E.11).

E.2.9 The alluvium (largely silty clays and peats) as noted in the boreholes varies in thickness between 0.0m and 4.0m. The variation is due to truncation, disturbance and redeposition of the deposits by dredging and other activities along the river channels. Past archaeological investigations indicate that the top of the natural alluvium (the pre-industrial landsurface) lies at 102.0m ATD in the general area. However, the top of the alluvium has been noted as high as 104.0m ATD on the site (Vol 25 Plate E.10 and Vol 25 Plate E.11), suggesting that here it has been redeposited and dumped on top of the natural landsurface.

E.2.10 The thickness of made ground overlying the alluvium also varies by up to 5m across the site, and is generally thicker in the southern half of the site. The surface of the made ground varies from around 105.0m to 106.0m ATD and slopes down in an easterly direction toward the Channelsea River to 104.0m ATD. A large area of truncation, 50m (north to south) by 100m (east to west) has been recorded just beyond the northern boundary of the site, 80m southwest of Abbey Mills Pumping Station (Vol 25 Plate E.9).

E.2.11 Following the deposition of the gravel deposits during the last Ice Age, the river stabilised, flow waned and the gravel surface became the Early Holocene (Early Mesolithic) landsurface, forming the buried topography (Vol 25 Plate E.9), Subsequently, relative sea level began to rise, causing inundation and waterlogging of previously dry landsurfaces as drainage became impeded and the Lea was backed-up by the rising Thames. This led to the accumulation of peat in marginal areas along the river and silty clays as accretionary soil deposits across the higher ground in times of river floods. As the ground became increasingly waterlogged, peat and wetland environments would have encroached further across the higher ground.

E.2.12 The 2009 deposit modelling (Vol 25 Plate E.9) indicates that the central and northern part of the site lies on higher ground and this is likely to have remained as a dry landsurface, part of a larger island within the floodplain, until later in prehistory. In contrast, the lower lying topography in the southern part of the site is likely to have been wetland from an earlier period. As yet no dating is available to suggest when the transition from dry ground to wetland took place.

E.3 Past archaeological investigations within the assessment area

E.3.1 A number of archaeological investigations have taken place within the assessment area: one, a geoarchaeological assessment of geotechnical boreholes by MOLA in 2009 (**HEA 1A**), extended into the site. This identified an area of low-lying migrating channel deposits along the line of the Abbey Creek with high levels of natural gravel deposits in the north and lower lying gravels to the south.

E.3.2 Archaeological investigations carried out in the assessment area around the site, which have revealed evidence of activity from the prehistoric period onwards, although predominantly post-medieval. The closest to the site is an excavation at the Abbey Mills Pumping Station, 80m to the east of the site (**HEA 30**), in 1994. This revealed post-medieval features and finds associated with the pumping station.

E.3.3 Extensive excavations at Stratford Market Depot (**HEA 19**), 350m to the northeast of the site, revealed a multi-phase settlement with prehistoric finds and features and Roman remains, and occasional Saxon and later medieval pottery in pits which cut through earlier graves. Post-medieval industrial remains were also recorded. Investigations undertaken 300m to the north of the site (**HEA 52**) as part of the Olympics development revealed evidence of prehistoric activity beneath substantial Victorian dumping.

E.3.4 In the 1970s and 1990s, excavations at the site of the medieval Stratford Langthorne Abbey (**HEA 8**), c. 570m to the northeast of the site, have recorded structural remains of the abbey buildings and associated features, including the abbey church, gate house, boundary wall and moat, and cemetery (**HEA 10**, **12** and **18**).

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

E.4 Archaeological and historical background of the site

E.4.1 The following section presents a detailed chronological and historical background for the site. It should be read along with the research framework presented in Appendix C to Vol 2 Appendix E2, which sets the overall Thames Tideway Tunnel project, and the individual site-specific assessments, within a broader historic environment context (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 Following the end of the Ice Age the Lea valley would have included a mosaic of environments: streams, marshland, pools, springs and dry ground, which would have provided a valuable resource for hunting,

fishing and communication. Mesolithic activity (10,000–4000 BC) is likely to have targeted stream margins and the wetland / dryland interface. A few residual Mesolithic flints were found during excavations at the Stratford Market Depot, 350m to the northeast of the site (**HEA 19**). It is likely that the entire site was a dry landsurface in the Mesolithic period. Given the position of the site, above a knickpoint in the river, which separated the shallower floodplain of the Lea with the deeper wetlands at the confluence with the Thames *(Corcoran et al., 2011)*[1], the site would have provided an attractive base for floodplain exploitation.

E.4.3 During the Neolithic period (4000–2000 BC) farming developed, communal monuments began to be constructed and temporary openings were cleared in the densely forested landscape for cultivation. Rising sea levels may not have impacted on the lower Lea in this period, but ponding-back of the river channels as drainage became impeded would have caused extensive wetlands to develop across former dry ground by the Bronze Age, with higher areas forming isolated islands within the expanding wetland. There would have been arable cultivation on the nearby river terraces and higher gravel islands in the floodplain and animals may have been pastured on the wetter floodplain soils. The varied natural resources of the floodplain continued to be exploited. In order to exploit natural floodplain resources, Bronze Age (2000–600 BC) populations constructed trackways, platforms and other timber structures that facilitated access across waterlogged areas. These structures are often found within the peat deposits and at the interface of the peat and silty clay, where they are well preserved: they also apparently provided a focus for ritual activities, such as the deposition of metal, stone and wooden artefacts in water. The archaeological evaluation which formed part of the Olympic Development in 2007 (**HEA 52**), 300m to the north of the site, found prehistoric flint debitage (waste flakes from flint tool manufacture), Neolithic pottery, animal remains and a possible wooden stake structure, sealed beneath substantial dumps of late 19th century and later made ground.

E.4.4 During the later Bronze Age and Iron Age (600 BC–AD 43) the increasingly wet environment of the Lea Valley led to the construction of dwellings set on piles driven into marginal wetland, known from further upstream. Small assemblages of artefacts dating to this period have also been recovered during the archaeological fieldwork in the northern part of the assessment area, where higher floodplain topography existed throughout the prehistoric period. The excavations at Stratford Market Depot, 350m to the northeast of the site (**HEA 19**), recorded ditches probably forming part of a field system dating from the late Bronze Age or early Iron Age, and in use until the Roman period, with a possible peak of activity in the middle to late Iron Age. A dense area of features including pits, postholes, hut-gullies and ditches on the east bank of the Channelsea River indicated a multi-phase settlement. Additionally a wooden structure was recorded during archaeological investigation (**HEA 52**), 300m to the north of the site. The structure is possibly Iron Age or later. Although similar features might exist in the north of the site, where the buried topography is higher, it is likely that the southern part of the site lay at a

slightly lower elevation and was a wetland area, or at least subject to more regular overbank flooding.

E.4.5 In summary, the area of the site would have been attractive for prehistoric settlement. In the Mesolithic period it may have provided a dry base from which to exploit the lower-lying wetlands of the Thames/Lea confluence area. In later prehistory the higher ground of the northern part of the site may have been occupied, forming a base for exploitation of the wetlands and possibly the construction of timber trackways or platforms. If such activity took place any remains would be buried within and at the base of the alluvium.

Roman period (AD 43–410)

E.4.6 The Roman town of Londinium was founded around AD 50, 6km to the southwest of the site. A major road to East Anglia via Camulodunum (Colchester) left Londinium at Aldgate, crossing the River Lea at Old Ford, c. 1.5km to the northwest of the site. In addition to roads, the development of Londinium as a trading port would also have meant an increase in river traffic along the Thames and its tributaries, including the Lea.

E.4.7 A small settlement may have developed at the crossing of the Lea at Old Ford, 1.5km northwest of the site (Margary, 1967)[2], but evidence of Roman occupation has also been found during archaeological excavations at Stratford Market Depot, 350m to the northeast of the site (**HEA 19**). Here possible early Roman features were sealed by a layer of ploughsoil, which was in turn cut by late Roman postholes and two slots, possibly for a timber building.

E.4.8 It is not known to what degree Roman activity or settlement may have extended along the fringes of the river, which would have remained a valuable resource for food and pasture, exploited by any farmsteads located on the dry gravels to the east. The GLHER records the chance find of a Roman coin (**HEA 41**), 470m to the west of the site. Sea and river levels continued to rise towards the end of and after the Roman period, and even formerly dry islands may have become inhospitable for occupation which is likely to have moved to the nearby gravel terraces. Evidence of occupation is therefore unlikely to be present within the site.

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

E.4.9 The River Lea is mentioned in the Anglo-Saxon Chronicle entry for the year AD 894, when Alfred is reputed to have trapped the Danes there by cutting a series of channels, lowering the water level and grounding their ships. The many tidal channels of the Lea may, however, have originated as mill streams, which are documented from the 11th century onwards (Victoria County History, 1973)[3].

E.4.10 The site lay within the ancient Saxon manor of Hamme, first mentioned in AD 958 when King Edgar granted land to Ealdorman Athelstan of East Anglia. The ‘Hamme’ name refers to an area of low-lying pasture, and much of the land lay in marshland below the level of ordinary spring tides (Victoria County History, 1973)[4]. The main settlement probably grew up in

the vicinity of the later medieval village of West Ham, 875m to the northeast of the site (Victoria County History, 1973)[5]. The 12th-century parish church of All Saints was probably built on the site of an earlier church (Victoria County History, 1973)[6], and would have formed the focus of the settlement.

E.4.11 A few residual sherds of Early (AD 410–700) to Middle Saxon (AD 700–850) pottery were found during excavations at Stratford Market Depot, 350m northeast of the site (**HEA 19**). A Saxon-type spearhead was found in a later ditch on this site, and another has been recorded as a chance find in Canning Road, 370m to the east of the site (**HEA 24**). Alluvial deposits of an early medieval date were recorded during an archaeological investigation (**HEA 52**), as part of the Olympic Development in 2007, 300m to the north of the site. These deposits are thought to be consistent with a mill working site.

E.4.12 By the end of the period, a number of mills existed along the Lea and its tributaries. Domesday Book (AD 1086) records nine mills in Hamme before the Conquest (AD 1066), probably including one c 390m north of the site at Wiggen, later known as Honeredes or the Abbey Mill, and one in the area later known as Three Mills (**HEA 25**), c. 270m southwest of the site (Domesday, 2002)[7]. These mills were tidal: the tide dammed back the flow of the Lea down its several channels and impounded a large body of water upstream of the mills. At the peak of the tide, the water was allowed to flow back at a controlled rate to operate the mill wheels (The House Mill website, 2012)[8]. It is thought that they must have been employed mainly in grinding flour for the bakers of Stratford. Later documentary sources refer to fulling mills in the area (Victoria County History, 1973)[9].

E.4.13 Throughout this period the site lay at some distance from the known settlements, and on the floodplain of the Lea valley. Water levels continued to rise and the river channels may also have shifted across the valley floor. The site was probably located within marshland used for rough grazing.

Later medieval period (AD 1066–1485)

E.4.14 According to Domesday Book (AD 1086), the manor (estate) of Hamme was held by Aethelstan before the Conquest (AD 1066), and afterwards was given by King William to be held jointly by Robert Gernon and Ranulph Peverel (Domesday, 2002)[10]. By the 12th century it had been divided into a number of smaller estates. The primary settlement of the manor remained in the vicinity of the parish church, on the eastern side of the Lea valley, 875m to the northeast of the site.

E.4.15 In AD 1135, William de Montfitchet, successor to half of the manor, granted his lordship to his newly-founded abbey of St Mary Stratford Langthorne, which was built c. 500m to the northeast of the site **(HEA 8**). Initially of the Order of Savigny, in 1147 the abbey was incorporated into the Cistercian Order. Severe flooding in the late 14th century possibly resulted in the temporary abandonment of the abbey. It was restored under the patronage of Richard ll (AD 1377–99), and included a cloister to the south of the church, a mill, bakehouse and kiln. Archaeological

investigations at Bakers Row, c. 680m to the northeast of the site (**HEA 10**), recorded a moat which defined the east side of the abbey precinct. This may have been constructed to improve drainage, as it was regularly re-cut during the medieval period. Other parts of the abbey complex have been recorded in a number of archaeological investigations in the northeastern part of the assessment area (**HEA 12** and **HEA 18**). The GLHER also records the location of chance finds of objects probably associated with the abbey. A crystal relic, a small onyx seal, and a medieval silver ring were all found near Bakers Row, 550m to the northeast of the site, as the abbey foundations were being removed in the 18th and 19th centuries (**HEA 11**).

E.4.16 To the south and west of the site the rivers continued to provide a source of water and power for milling and other manufacturing processes. It is likely that widespread marshland drainage and reclamation began in the later medieval period. This initially took the form of drainage channels and embankments that served as river walls around parcels of land. The purpose would have been primarily economic, to provide good-quality grazing for livestock and fertile land for crops (Rippon, 2000)[11], (Thirsk, 2000)[12]. During this period, the site probably lay within reclaimed marshland, possibly held by the abbey of Stratford Langthorne, and used for grazing or cultivation.

Post-medieval period (AD 1485–present)

E.4.17 Stratford Langthorne Abbey, c. 500m to the northeast of the site (**HEA 8**), was formally surrendered to the Crown in 1538, during the Dissolution, and its abbot and community of fourteen monks were granted pensions. In 1539, the abbey passed to Sir Peter Meautis or Mewtas (Victoria County History, 1973)[13]; the majority of the buildings were demolished, although a few parts were converted to private domestic use and survived until the 18th or 19th centuries.

E.4.18 Rocque's map of 1746 (Vol 25 Plate E.1) shows general topographic detail, main settlements and roads. The map shows the site within a reclaimed part of Stratford Marsh, probably used for pasture. To the east of the site is a channel (now known as the Channelsea) which forms part of the Lea. The Lea remained a significant source of power for mills and the location of The Three Mills, 280m west/southwest of the site (**HEA 25**), is shown on Rocque's map. Within the Three Mills site the Grade I listed House Mill (**HEA 38**) was built in 1776. Settlement developed along the main road (now the High Street) 600m to the northwest of the site. Some buildings are also shown on the old abbey site on the eastern bank of the Channelsea 370m to the northeast of the site.

E.4.19 Chapman and André's map of 1777 (Vol 25 Plate E.2) shows no buildings in the vicinity of the site, but a river wall flood defence is shown running along the southeastern edge of the site along the bank of the Channelsea.

E.4.20 In the 19th century a number of industries developed in the Lea valley, and the Brunswick Dock was constructed in the early 19th century at the mouth of the Lea c. 2km to the south of the site, but much of the rural character of the area remained until the latter part of the century. The

Eastern Counties and Thames Junction Railway opened in 1846 between Stratford in the north and Canning Town in the south, passing c 500m east of the site, and the London, Tilbury and Southend Railway opened in 1854, running 180m to the southeast of the site, on the southern bank of the Channelsea.

E.4.21 The mid-19th century saw a series of public health crises in London, arising from the problems of waste disposal in the metropolis, which had grown rapidly in size and population in the preceding decades. Schemes were devised for main sewers on three levels to drain into the Thames, at Beckton on the north side of the river and Erith on the south. The initial construction of the system took place in the late 1850s and early 1860s, and was overseen by Joseph Bazalgette, Chief Engineer for the Metropolitan Board of Works (Weinreb B and Hibbert, 1995)[14]. Bazalgette's works form a project-wide theme, which is discussed in more detail in the route overview, Volume 1. The Northern Outfall Sewer (**HEA 58**) passes c. 140m to the northeast of the site, with the Northern Low Level Sewer (**HEA 1B)** passing through the northern part of the site below ground. The Northern High Level Sewer (**HEA 59**) crosses the southwestern edge of the assessment area, c. 670m southwest of the site. In 2007, parts of the sewer and associated structures were the subject of a standing structure survey in advance of redevelopment (**HEA 14**).

E.4.22 The Ordnance Survey 1st edition 25" mile map of 1862–95 (Vol 25 Plate E.3) shows the site within Stratford Marsh and Abbey Meads, within open reclaimed former marshland crossed by drainage ditches. A river flood defence embankment is shown along the southern edge of the side. The map shows the Northern Outfall Sewer to the northeast of the site, the London, Tilbury and Southend Railway to the southeast of the site, and the Three Mills industrial complex to the southwest. There is no change within the site on the Ordnance Survey 2nd edition 25" mile map of 1896–8 (Vol 25 Plate E.4).

E.4.23 As part of Bazalgette's system, pumps assisted the flow of waste at strategic points. The richly decorated Abbey Mills Pumping Station (**HEA 26**) was built in 1865–8, 160m to the northeast of the site. The Ordnance Survey 2nd edition 25" mile map of 1896–8 (Vol 25 Plate E.4) shows the main Pumping Station (**HEA 31**) to the northeast of the site, along with several other associated buildings (some of which are still extant). These include the B Station (**HEA 27**), a store building (**HEA 29**), a pair of chimney bases (**HEA 32**), the former Superintendent's House (now offices) (**HEA 33**) and the gates and gate lodge (**HEA 34**). By this time, industry dominated much of the area, particularly noxious processes which required good supplies of water. The 1896–8 map (Vol 25 Plate E.4) shows Gas Works to the south of the site (**HEA 46**), a number of Chemical Works to the east and a distillery operating at the Three Mills complex to the southwest of the site.

E.4.24 The Ordnance Survey 3rd edition 25" mile map of 1909–20 (Vol 25 Plate E.5) shows that the central part of the site comprised allotment gardens, crossed by additional drainage channels. Other than this there is no change within the site.

E.4.25 The Ordnance Survey 1:10,000 scale map of 1954–96 (Vol 25 Plate E.6) shows the Prescott Channel constructed along the southwestern edge of the site. It was built in c 1930–35 as part of the flood relief scheme for the Lea Navigation. The drainage ditches shown on earlier maps within the site are not shown. Ground reduction appears to have taken place along the northeastern edge of the site. Later maps show no change within the site.

The current site

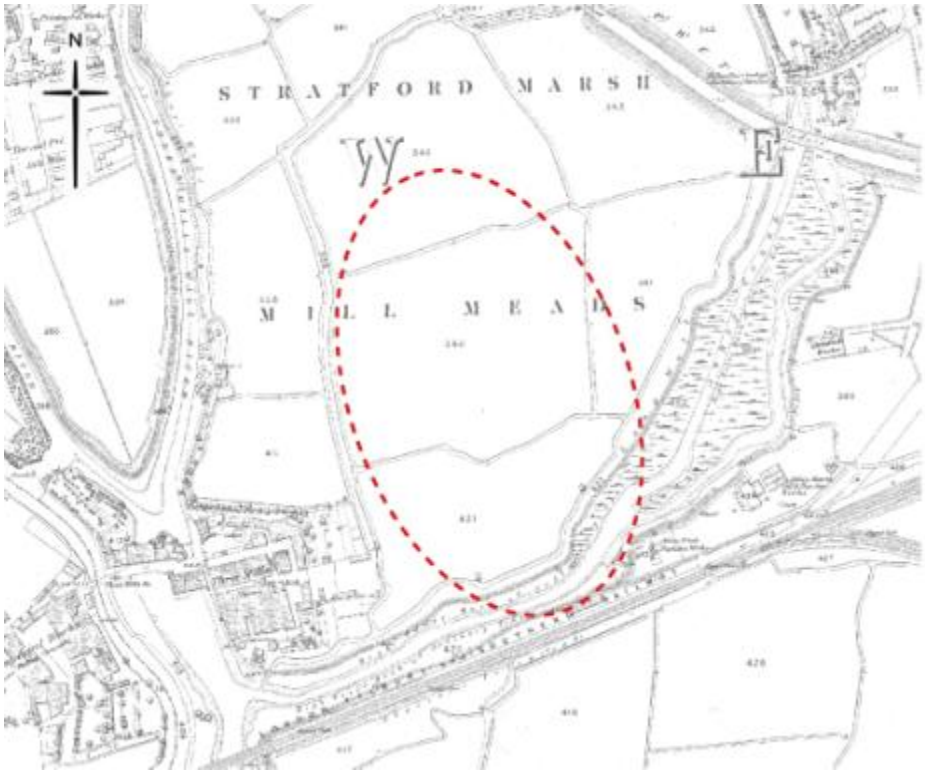
E.4.26 The southern half of the site is a construction/works site for the Lee Tunnel project. It was not possible to access this area for the site walkover survey. A topographic survey indicates the presence of two large mounds of excavated material in the southern area of the site. The northern part of the site comprises hardstanding for a car park and storage area.

E.5 Plates

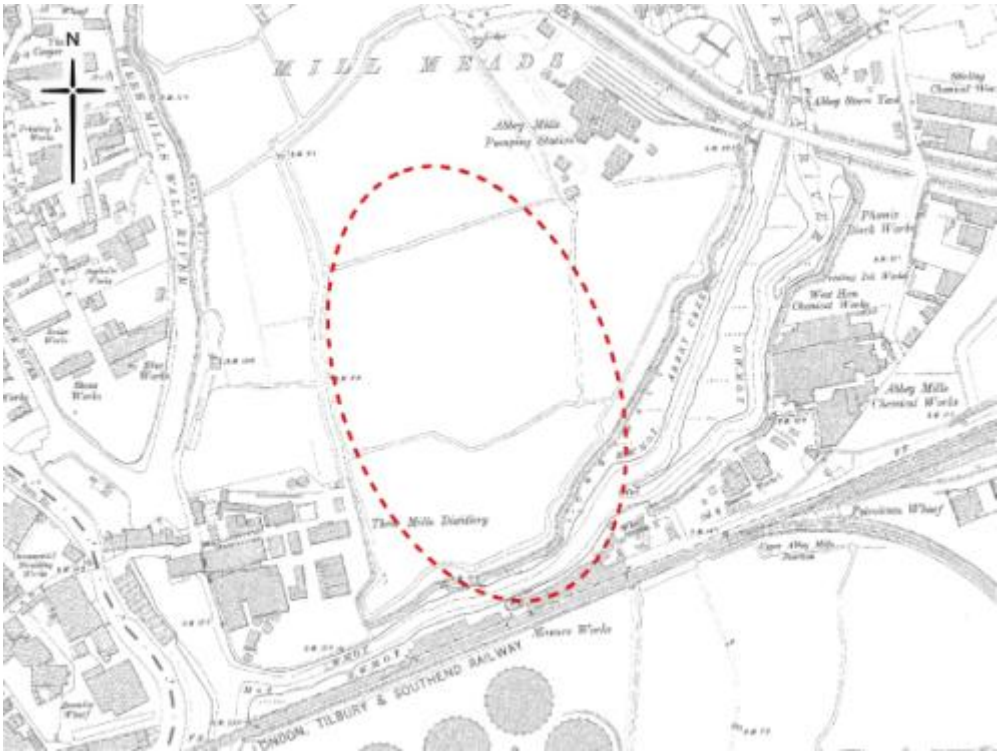
Vol 25 Plate E.1 Historic environment – Rocque's map of 1746

Vol 25 Plate E.2 Historic environment – Chapman and Andre's map of 1777

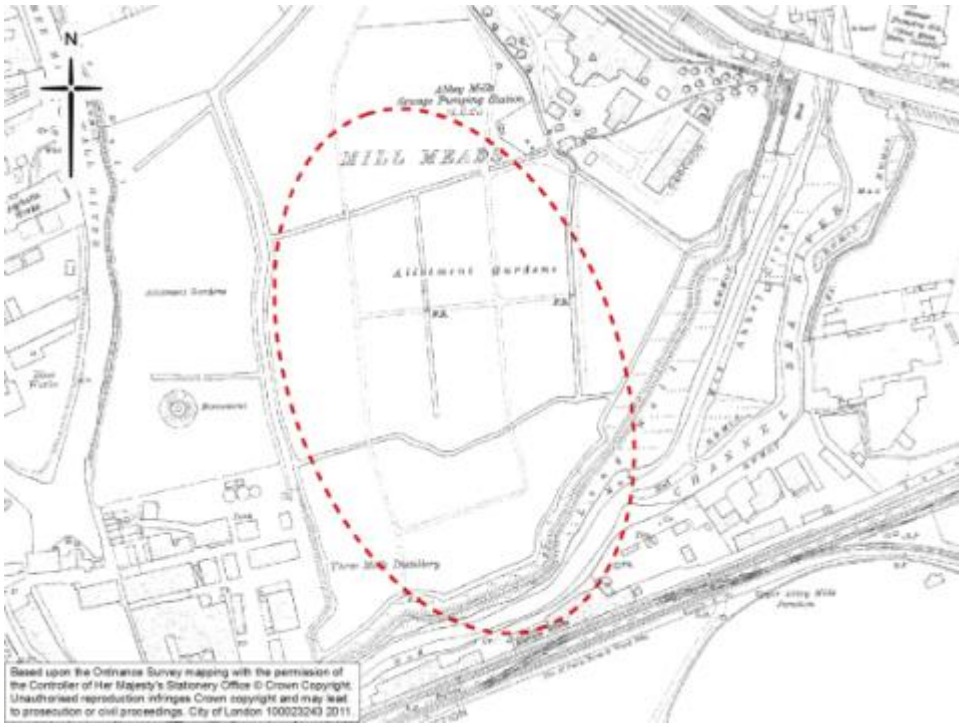
Vol 25 Plate E.3 Historic environment – Ordnance Survey 1st edition 25" scale map of 1868-95 (not to scale)



Vol 25 Plate E.4 Historic environment – Ordnance Survey 2nd edition 25” scale map of 1896-8 (not to scale)



Vol 25 Plate E.5 Historic environment – Ordnance Survey 3rd edition 25” scale map of 1909–1920 (not to scale)

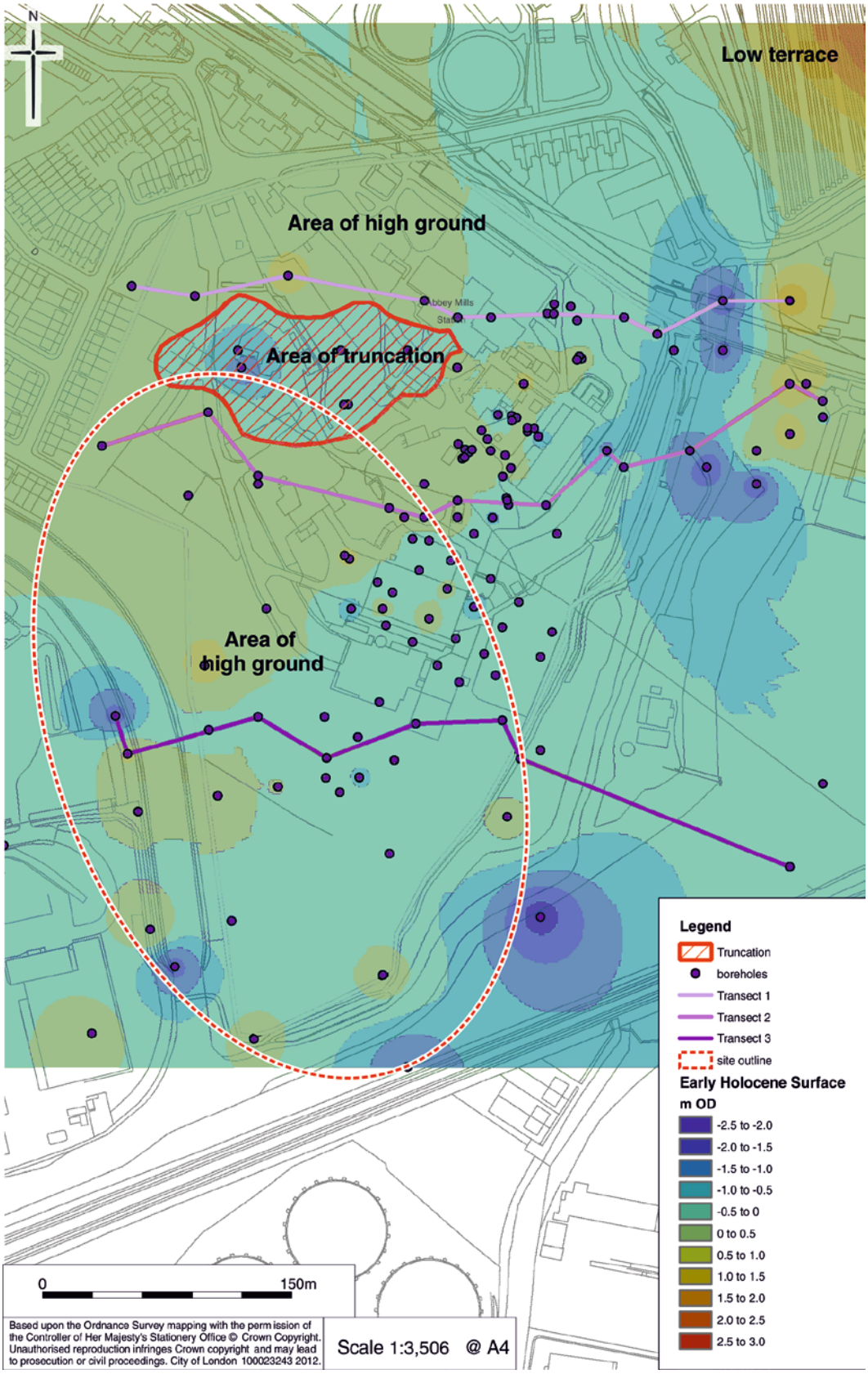


Vol 25 Plate E.6 Historic environment – Ordnance Survey 1:10,000 scale map of 1954–96 (not to scale)

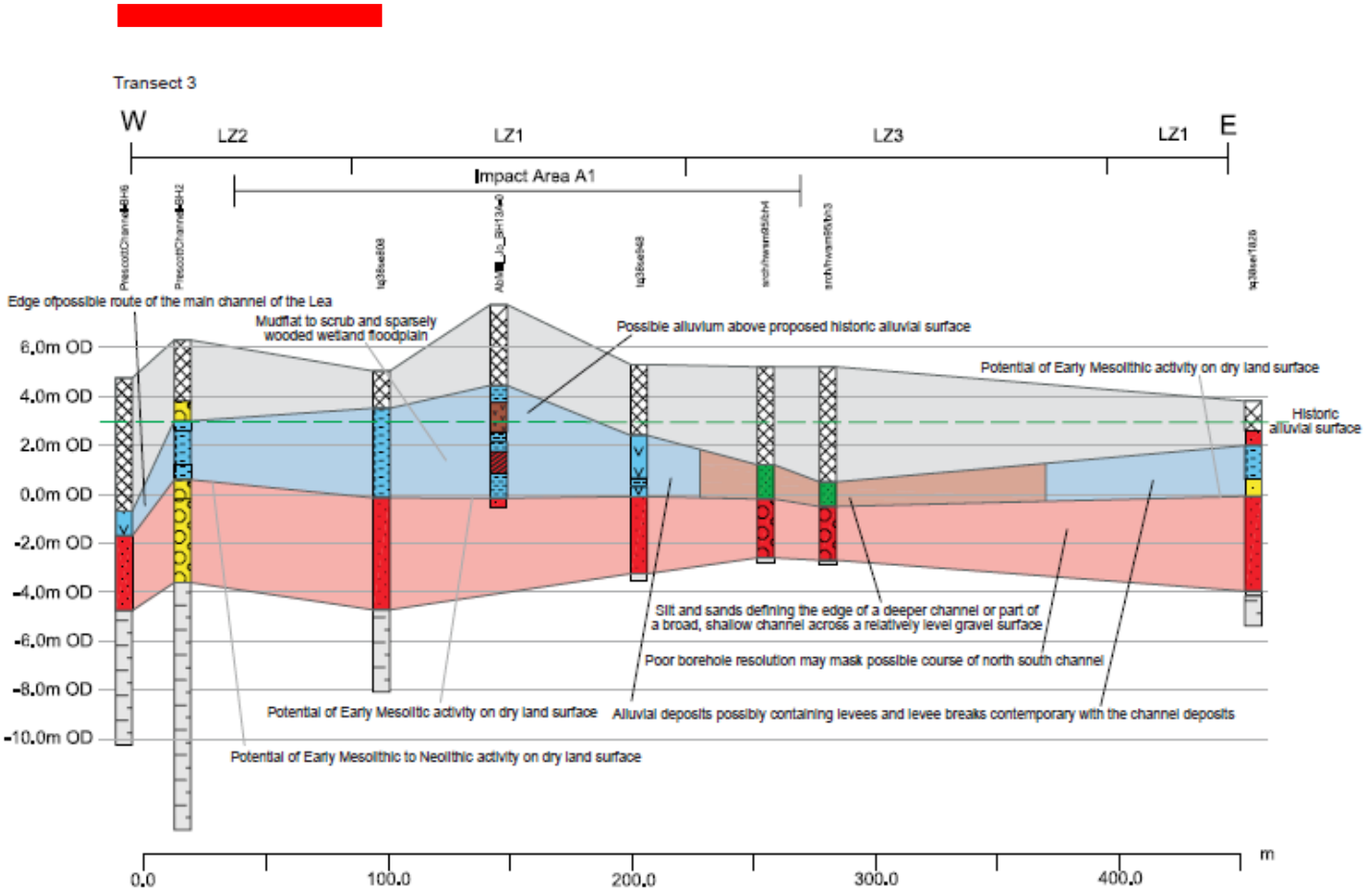
Vol 25 Plate E.7 Historic environment – The Grade II* Listed Abbey Mills Pumping Station (station A) outside the site to the northeast, looking north; standard lens

Vol 25 Plate E.8 Historic environment – The site from the southwest, aerial view c. 2005

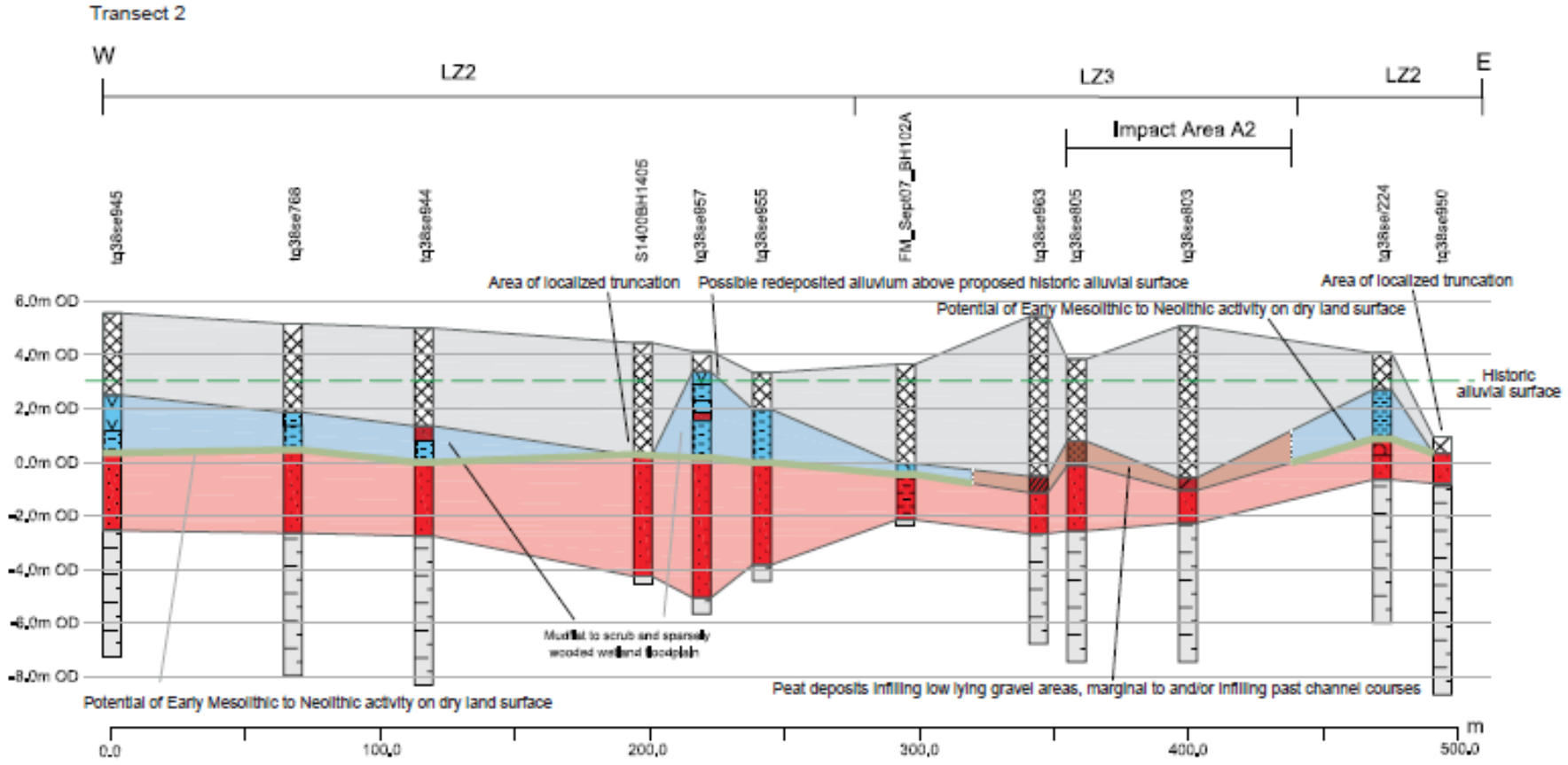
Vol 25 Plate E.9 Historic environment – Distribution of previous geotechnical boreholes on and around the site and buried topography reconstructed from their logs, as produced for the 2009 geoarchaeological investigation (HEA1A)



Vol 25 Plate E.10 Historic environment – West to east transect crossing the central part of the site, as produced in the deposit model for the 2009 geoarchaeological investigation (HEA1A). The red bar shows the extent of the Thames Tideway Tunnel project site. A key is given in Plate E.12 and the line of the transect (Transect 3) is shown on Plate E.9

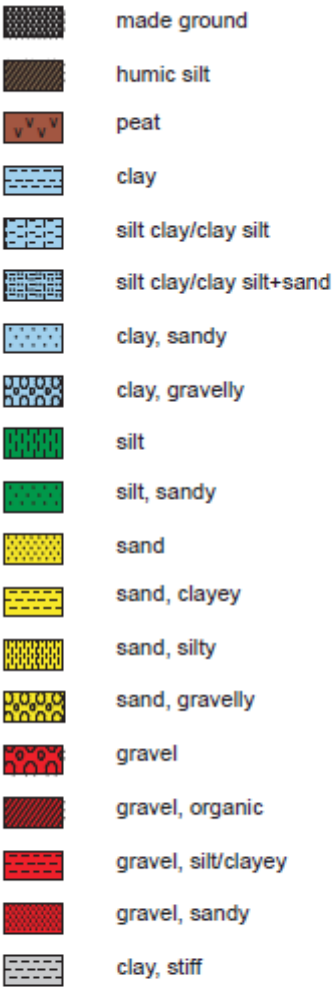


Vol 25 Plate E.11 Historic environment – West to east transect across the northern part of the site, as produced in the deposit model for the 2009 geoarchaeological investigation (HEA 1A). The red bar shows the extent of the Thames Tideway Tunnel project site. A key is given in Plate E.12 and the line of the transect (Transect 2) is shown on Plate E.9

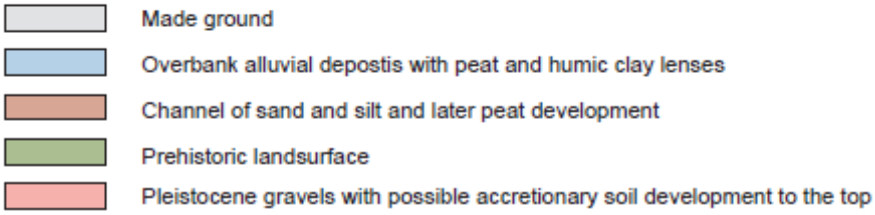


Vol 25 Plate E.12 Historic environment – key to Plate E.10 and E.11

Lithology index



Stratigraphy Index



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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.25**

Volume 25: Abbey Mills 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 25 Appendices: Abbey Mills Pumping Station site assessment

Appendix F: Land quality

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Appendix F: Land quality

F.1 Baseline report

F.1.1 Baseline data is sourced from:

a. walkover survey

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

c. stakeholder consultation

d. the results from a preliminary intrusive ground investigation undertaken by the Thames Tunnel project as well as other historical ground investigation information.

Site walkover

F.1.2 An initial site walkover survey was undertaken on 25th May 2011.

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

F.1.4 No obvious potential on-site contaminative sources were identified during the walkover survey, although some of the excavated material present was noted to contain fragments of tarmac and ash, which can represent a source of heavy metals and polyaromatic hydrocarbon (PAH) contamination.

F.1.5 A further site visit was subsequently undertaken in January 2012. This visit identified that site clearance has taken place as part of the Lee Tunnel project; a perimeter fence has been constructed around the Thames Water site; and groundworks have been carried out, including levelling of the area for the Lee Tunnel shaft, removal of stockpiled soil and hard surfacing.

F.1.6 It is understood that stands of Japanese Knotweed have been identified at the site by previous surveys, although these were not recorded as part of the land quality walkover survey.

F.1.7 Detailed site walkover notes are provided in Vol 25 Table F.1 below.

Vol 25 Table F.1 Land quality – site walkover report

Item (Site ref: PNM3X, Abbey Mills Pumping Station	Details	
Date of walkover	25th May 2011 and 25th January 2012.	
Site location and access	Abbey Mills Pumping Station, Gay Road, Abbey Lane, London Borough of Newham.	
Size and	Record elevation in relation	Initially the central part of the site

Item (Site ref: PNM3X, Abbey Mills Pumping Station		Details
topography of site and surroundings	to surroundings, any hummocks, breaks of slope etc.	was found to be covered with stockpiles of Made Ground soils. The site has now been levelled as part of Lee Tunnel project.
Neighbouring site use (in particular note any potentially contaminative activities or sensitive receptors)	North	Abbey Mills Sewage Pumping Station. Abbey Lane Gas Depot is located northeast and located northwest of the site are residential properties situated off of Gay Road, Bisson Road and Riverside Road. Allotments located on the sites northern boundary.
	South	Channelsea River and Prescott Channel and situated across the channel are gasworks located on Twelvetrees Crescent.
	East	Abbey Mills Sewage Pumping Station and Abbey Creek.
	West	Channelsea River and Prescott Channel, across the channel is the Three Mills Green and an industrial estate and commercial properties. Allotments are located on the sites western boundary. River Lee is located to the west of the site.
Site buildings	Record extent, size, type and usage. Any boiler rooms, electrical switchgear?	The work site comprises a largely unused plot of land (part of the Lee Valley Park) that is free from significant structures within the southern and western portion of the Abbey Mills site.
Surfacing	Record type and condition	Unsurfaced
Vegetation	Any evidence of distress, unusual growth or invasive species such as Japanese Knotweed?	None during site walkover, although the boundary with the Channelsea River is heavily vegetated and marked by low sheet piling which has failed in a number of places. NB Japanese Knotweed was recorded during other surveys

Item (Site ref: PNM3X, Abbey Mills Pumping Station		Details
		both on and within 10m of the proposed development site boundary in the north of the site noted (see below).
Services	Evidence of buried services?	None observed
Fuels or chemicals on site	Types/ quantities?	None observed during site walkover. Thames Water operational records confirmed storage of 120000 litres of fuel oil within the wider operational land (away from limits of land to be acquired and used).
	Tanks (above ground or below ground)	See above
	Containment systems (eg, bund, drainage interceptors). Record condition and standing liquids	None observed
	Refill points located inside bunds or on impermeable surfaces etc?	None observed
Vehicle servicing or refuelling onsite	Record locations, tanks and inspection pits etc.	None observed
Waste generated/stored onsite	Adequate storage and security? Fly tipping?	Worksite contains mounds of excavated material
Surface water	Record on-site or nearby standing water	Site is located at the confluence of the Channelsea River and the Prescott Channel in Stratford. River Lee and Abbey Creek also border the site.
Site drainage	Is the site drained, if so to where? Evidence of flooding?	None observed
Evidence of previous site investigations	Eg trial pits, borehole covers.	None observed

Item (Site ref: PNM3X, Abbey Mills Pumping Station		Details
Evidence of land contamination	Evidence of discoloured ground, seepage of liquids, strong odours?	No obvious potential contaminative sources were identified during the survey.
Summary of potential contamination sources		Some of the excavated material was noted to contain fragments of tarmac and ash, which can represent a source of heavy metals and PAH contamination.
Any other comments	Eg access restrictions/ limitations	Extensive foreshore of the Channelsea River is exposed at low tide and is noted to be largely formed from mud (silt and clay). The Prescott Chanel has recently been upgraded and includes new locks and landscaping areas.

Review of historical contamination sources

F.1.8 Historical mapping (dated between 1860 and 1995) has been reviewed in order to identify potentially contaminating land-uses at the site and within the 250m assessment area.

F.1.9 Vol 25 Table F.2 tabulates the potentially contaminating land-uses, inferred dates of operation and typical contaminants associated with the land-uses in question. Potential contaminants are sourced from CLR8: *Potential contaminants for the assessment of land (*Defra and EA, 2002*)*[1] and former Department of the Environment industry profiles (Department of the Environment, 2011)[2].

F.1.10 All dates are approximate, where no other information is available the dates relate to when the items first appeared and disappeared from the mapping rather than actual dates of construction, operation or demolition.

F.1.11 Items listed in the table are also shown on Vol 25 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 25 Appendix E.

Vol 25 Table F.2 Land quality – potentially contaminating land-uses

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[1,2]

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[1,2]
On-site			
1	Sewage pumping station	c1860s-present	Heavy metals, arsenic, free cyanide, nitrates, ammonium, phosphates, sulphates, sulphides, asbestos, oil/fuel hydrocarbons, chlorinated aliphatic hydrocarbons, chlorinated aromatic hydrocarbons, Polychlorinated Biphenyls (PCBs), pathogens
6	Three Mills Distillery (located at the edge of the sites southwest corner)	c1896-c1995	Volatile Organic Compounds (VOCs), total petroleum hydrocarbon, heavy metals, ethanol/methanol, ammonia, chlorinated alkalis, benzene, toluene, ethybenzene and xylenes
Off-site			
2	Chemical works (90m southeast)	c1869-c1951	Heavy metals, arsenic, boron, selenium, free cyanide, nitrates, sulphates, sulphides, asbestos, PAHs, phenols, acetones, aromatic hydrocarbons, PCBs, dioxins,

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[1,2]
			furans
3	Abbey Marsh Oil Works (140m east)	c1869-c1896	Monoaromatic hydrocarbons (BTEX), PAHs, n-alkanes (C5-C20), methyl tert-butyl ether (MTBE), lead
4	Abbey Creek Naphtha works (70m east)	c1869-c1882	Monoaromatic hydrocarbons (BTEX), PAHs, n-alkanes (C5-C20), MTBE, lead, tar, phenolic compounds, ammoniacal liquors, cyanide
5	Railway (55m south)	c1869-c1920	PAHs, heavy metals, phenols, sulphates, fuel oil, lubricating oil, greases, PCBs, solvents, asbestos, chlorinated aliphatic hydrocarbons, sulphates
7	Blue Works (215m west)	c1896-c1951	Heavy metals, arsenic, selenium, free cyanide, nitrates, sulphates, sulphides, asbestos, PAHs, phenols, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, organotin compounds
8	Asphalt works (230m west)	c1896-c1946	Heavy metals, arsenic, sulphides,

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[1,2]
			asbestos, acetone, oil/fuel hydrocarbons, PAHs, PCBs, tars, phenolic compounds, ammoniacal liquors, cyanide
9	Gas works (90m south)	c1896-present	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds. cyanides, ammonia, phenols, heavy metals and asbestos
10	Tanks (50m south)	c1916-c1948	Contents unknown
11	Metal works (40m northeast)	c1916-c1948	Heavy metals, arsenic, boron, free cyanide, nitrates, sulphates, sulphides, asbestos, aromatic hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
12	Printing works (75m northwest)	c1916-c1948	Dyes, paints, solvents, hydrocarbons
13	Engineering works (220m northwest)	c1948-c1965	Heavy metals, arsenic, boron, free cyanide, nitrates, sulphates, sulphides, asbestos, aromatic
14	Engineering works (215m west)	c1969-c1920	

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[1,2]
			hydrocarbons, PAHs, PCBs, chlorinated aliphatic hydrocarbons
15	Factory (200m west)	c1969-c1970	Use unknown
16	Distillery (215m west)	c1995-present	VOC, total petroleum hydrocarbons, heavy metals, ethanol/methanol, ammonia, chlorinated alkalis, benzene, toluene, ethylbenzene and xylenes
17	Gas works and associated tanks (130m northeast)	c1896	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds. cyanides, ammonia, phenols, heavy metals and asbestos
18	Garage (195m north)	c1970	Heavy metals, paints, asbestos, total petroleum hydrocarbons, aromatic hydrocarbons, chlorinated aliphatic hydrocarbons, solvents, de-greasers, cutting oils, mineral oil

Ref	Item	Inferred date of operation	Potentially contaminative substances associated with item[1,2]
19	Depot (155m southeast)	c1975-c1995	Oil/fuel hydrocarbons, aromatic hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, organolead compounds, heavy metals and asbestos
20	Pacific Wharf (48m south)	c1948-c1975	Heavy metals, arsenic, asbestos, phenols, oil/fuels, hydrocarbons, PAHs, PCBs, sulphide, sulphate, chlorinated aromatic hydrocarbons, chlorinated aliphatic hydrocarbons

On-site

F.1.12 In summary, the site was first developed as a sewage pumping station as part of Joseph Bazalgette's London sewerage upgrades in the 1860s and has been in continual use to the present day. The site previously contained chimneys and boiler houses as part of the former coal fired steam driven pump system which operated until the 1930s. The Three Mills Distillery was also situated on the very edge of the sites southwest corner between c1896-c1995, on land currently known as 'Three Mills Island'.

Off-site

F.1.13 Within the 250m assessment area, the historical mapping shows that the surrounding area has a long history of industrial usage including gas works, chemical works and various engineering operations.

Geology

F.1.14 Data from the Thames Tideway Tunnel project ground investigation indicates the anticipated geological succession, as summarised in Vol 25 Table F.3 below.

Vol 25 Table F.3 Land quality – anticipated site geology

Geological unit/ strata	Description	Approximate depth below ground level (m)
Made Ground	Largely comprises sandy gravely silt with local gravels of brick, concrete and flint.	0-0-4.0
Alluvium	Soft and firm sandy slightly gravel clay with occasional shell fragments	4.0-5.0
River Terrace Deposits	Medium dense to dense to dense sand and gravel (predominantly quartz sand and flint gravel).	5.0-8.5
London Clay	Locally silty and sandy clay	8.5-13.6
Harwich Formation	Sand and shelly sandstone	13.6-14.5
Lambeth Group (Upper Shelly Beds)	The Lower and Upper Mottled Beds are mottled or multicoloured, stiff or very stiff fissured clay, compact silt, and dense or very dense sand. The Upper Shelly Beds is mainly grey shelly clay, occasionally dominated by sand and shelly limestone. The Laminated Beds consists of thinly interbedded fine- to medium-grained sand, silt and clay. The Lower Shelly Beds is a dark grey to black clay with abundant shells. It may also be Shelly sand and thin limestone bands. The Upnor Formation comprises dense glauconitic sand with rounded black gravel.	14.5-16.5
Lambeth Group (Upper Mottled Beds)		16.5-17.5
Lambeth Group (Laminated Beds)		17.5-20.0
Lambeth Group (Lower Shelly Beds)		20.0-22.5
Lambeth Group (Lower Mottled Beds)		22.5-24.0
Lambeth Group (Upnor Formation)		24.0-31.0
Thanet Sand Formation	Generally dense glauconitic silty fine sand with occasional rounded flint gravel. The Bullhead beds at the base comprise rounded cobbles of flint, deposited unconformably on the eroded surface of the Chalk	31.0-43.5
Chalk Group	Weak fine grained limestone with	>43.5

Geological unit/ strata	Description	Approximate depth below ground level (m)
	nodular and tabular flints.	

Unexploded ordnance

F.1.15 During World Wars I and II, the London area was subject to extensive bombing and in some cases bombs failed to detonate on impact. During construction works, Unexploded Ordnance (UXOs) are sometimes encountered and require safe disposal.

F.1.16 A desk based assessment for UXO threat was undertaken as part of the Phase 1 contamination assessment for the Lee Tunnel EIA[3]. Records gathered during this process from Faber Maunsell and Zetica Ltd resulted in the area having a high risk threat from UXO at the Abbey Mills Pumping Station site.

F.1.17 A further desk study report (see Vol 25 Appendix F.2) as part of the phase 2 contamination assessment[4] identified a low to moderate threat from UXO.

Thames Tideway Tunnel ground investigation data

F.1.18 This section summarises the ground investigation undertaken by the Thames Tideway Tunnel project.

F.1.19 Boreholes were drilled on-site (borehole reference SR3001 and SR3002) and in the immediate vicinity of the Abbey Mills Pumping Station site. Vol 25 Figure F.1.2 (see separate volume of figures) identifies the location of the boreholes in relation to the site.

F.1.20 Vol 25 Figure F.1.2 also identifies a number of other boreholes excavated in vicinity of the site, these are not considered relevant, either due to their distance from the proposed shaft location or because certain boreholes were excavated purely for geotechnical purposes.

Soil contamination testing

F.1.21 Soil contamination testing was undertaken on one sample of alluvium retrieved from borehole SR3002 and eight samples retrieved from borehole SR3001 (samples comprised Made Ground, River Terrace Deposits, Laminated Beds and Thanet Sand Formation). The testing included a variety of common contaminants (including heavy metals and metalloids, PAHs, and TPH).

F.1.22 The results of the soil analyses from the ground investigation have been compared against human health screening values (for light industrial / commercial land use[5,6]). There were no contaminants above human health screening values in the samples tested.

F.1.23 See Volume 2 Environmental assessment methodology for full guidance on the benchmarks used.

Soil gas testing

F.1.24 Soil gas testing was undertaken in the boreholes at the Abbey Mills Pumping Station site on two occasions. At the time of monitoring the response zones of the standpipes were below the water table and such results have not been included.

Groundwater contamination data

F.1.25 The water quality assessment data for ground investigation boreholes SR3001 and SR3002 show elevated concentrations of contaminants, zinc and PAH's respectively.

F.1.26 Refer to Section 13 Water resources – groundwater of this volume for further information.

Sediment quality analysis

F.1.27 No sediment quality testing was undertaken at the Abbey Mills Pumping Station site.

Thames Water ground investigation data

F.1.28 Additional documents that can provide information on land quality at the site have also been reviewed as part of the baseline work for Abbey Mills, namely: Phase One Contaminated Land Assessment (Faber Maunsell, June 2007)[7] and a Phase Two Contaminated Land Assessment (Scott Wilson, May 2008)[8].

Faber Maunsell 2007

F.1.29 The Phase One contaminated land assessment was undertaken for the West Ham Flood Alleviation Scheme, part of which involved constructing a tunnel shaft (T1) on the Abbey Mills site in 2009.

F.1.30 Elevated levels of aromatic hydrocarbons in groundwater were found in the northeastern part of the site, primarily in the Harwich Formation and Lambeth Group, but also in the River Terrace Deposits and, to a lesser degree, in the Thanet Sands. Elevated concentrations were not encountered in the monitoring of the boreholes installed within the Chalk.

F.1.31 Elevated levels of VOCs, namely benzene, toluene and xylene, and PAHs were also found to be present within the groundwater in the Harwich formation but were not found within the Lambeth Group.

Scott Wilson 2008

F.1.32 The Scott Wilson work was undertaken for the Lee Tunnel scheme which included investigation for a shaft located to the east of the proposed Thames Tunnel main shaft.

F.1.33 The Phase Two Contaminated Land Assessment identified hydrocarbon odours within soil samples of Made Ground and Alluvium at Abbey Mills Pumping Station near the proposed site of the Lee Tunnel shaft. However, none of the chemical test results showed significant concentrations of hydrocarbons in comparison with light industrial/commercial soil screening values for used in the assessment of risk to human health.

F.1.34 The investigation did however note the following within the wider Lee Tunnel investigation at the Abbey Mills site:

a. Lead – elevated within the Made Ground in two boreholes to a maximum concentration of 2,580.5mg/kg

b. Copper (for phytotoxicity only): elevated within the Made Ground at one location (430mg/kg)

c. Zinc (for phytotoxicity only): elevated within the Made Ground at one location (755.5mg/kg)

d. Cyanide (Total): elevated within the Made Ground at two of eight locations to a maximum concentration of 68.7mg/kg

e. Coliforms – Present to 2,300 per gram within one sample of the Blackheath Beds at a depth of 19mbgl.

F.1.35 Overall the report recommended some remedial measures to deal with the elevated contaminants (in particular the lead and cyanide which pose a risk to human health).

F.1.36 The exact scope of remediation had yet to be agreed but in principal it was proposed to comprise some form of soil treatment (with agreed validation limits) and/or the placement of a cover system in soft landscaping areas (whereby contaminated soils are isolated by a layer of clean soils). Alternatively, in soft landscaping areas the removal of contaminated soils in their entirety was also considered. No remediation was proposed for soils where hardstanding and buildings are proposed.

Other environmental records

F.1.37 Details of environmental records (hazard and waste sites) in the vicinity of the site held by the Environment Agency (EA) and other bodies have been obtained from the Landmark Information Group and are presented in Vol 25 Table F.4. Pertinent records are discussed in further detail below.

F.1.38 The location of these records is shown on Vol 25 Figure F.1.3 (see separate volume of figures).

Vol 25 Table F.4 Land quality – hazard and waste sites

Item	On-site	Within 250m of site boundary
Active integrated pollution prevention and control	0	0
Control of major accident hazard sites	0	1
Historical landfill site	0	1
LA pollution prevention and control	0	1
Licensed waste management facility	0	0

Item	On-site	Within 250m of site boundary
Notification of installations handling hazardous substances	0	2
Past potential contaminated industrial uses	0	There are a number of areas classified as past potential contaminated industrial uses within 250m of the site.
Pollution incident to controlled water*	0	5
Registered waste transfer site	0	0
Registered waste treatment or disposal site	0	0

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

F.1.39 Inspection of the data has identified no on-site hazard and waste sites at Abbey Mills Pumping Station site.

F.1.40 Within 250m of the Abbey Mills Pumping Station site, inspection of the data has identified two notifications of an installation that involves hazardous substances. This is on the site of the gas holder station (former gas works) to the north of the proposed site. There is also one historical landfill site adjacent to the gas works.

F.1.41 There are a number of areas located within the 250m assessment area, identified as having past potential contaminated industrial uses.

F.1.42 From an analysis of the historical mapping data, the past industrial land-uses can be attributed to various industries as highlighted on Vol 25 Figure F.1.1 (see separate volume of figures).

F.1.43 These include former chemical works, gas works, asphalt works, various unspecified works, wharves and the sewage pumping station, contaminants typically associated with these types of industries are identified in Vol 25 Table F.2.

F.1.44 Five pollution incidents to controlled water within 250m of the Abbey Mills Pumping Station site are also identified. Details of licensed groundwater abstractions are detailed in the groundwater appendix (Vol 25 Appendix K). It is known through other work undertaken recently at Abbey Mills Pumping Station that both abstraction boreholes owned by the mosque have been backfilled but they retain the licence and may construct new abstraction boreholes in the future.

Thames water operational records

F.1.45 Thames Water records of contaminating substance storage at the Abbey Mills Pumping Station site within the last five years were reviewed.

F.1.46 Records identify bulk storage of 120,000 litres of fuel oil within the wider Abbey Mills Pumping Station operational land to the north.

F.1.47 No spillages of any potentially contaminating substances to ground were recorded.

Land quality data from local authority

F.1.48 The Contaminated Land officer from the London Borough (LB) of Newham was contacted in relation to the proposed development and although some information was provided, none was directly relevant to this project.

Summary of contamination sources

F.1.49 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. potentially elevated concentrations of metals and cyanide in the Made Ground

b. hydrocarbon, VOC, benzene toluene, ethylbenzene and xylene contamination of the groundwater in the Harwich Formation and Lambeth Group

c. potential UXO

d. Japanese Knotweed.

F.1.50 Off- site sources of contamination include historic and present industrial facilities (including gas works, naphtha works, chemical works electrical substations and printing works).

F.1.51 It should be noted that at the time of writing extensive redevelopment of much the Abbey Mills site is in progress as part of the Lee Tunnel works and as such much of the Made Ground can either be expected to have been removed or is now isolated beneath the construction area slab.

F.1.52 During the excavation of the Lee Tunnel Abbey Mills Connection Shaft, no notable contamination was encountered within the undisturbed soils that make up approximately 95% of the excavated materials. This observation supports the findings from investigations that soil contamination appears to be limited to shallow near surface Made Ground soils only. The Abbey Mills Connection Shaft comprises a 25m internal diameter shaft extending into the Chalk to approximately 68mbgl and is located approximately 25m to the east of the proposed Thames Tideway Tunnel shaft site.

F.2 Detailed Unexploded Ordnance (UXO) risk assessment

References

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

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

[3] Scott Wilson Ltd, Abbey Mills Pumping Station and Lee Tunnel, London: Desk Study: Phase 1 Contamination Assessment for Abbey Mills (2008)

[4] Scott Wilson Ltd, Abbey Mills Pumping Station and Lee Tunnel, London: Desk Study: Phase 2 Contamination Assessment for Abbey Mills (2008)

[5] Defra/EA, Soil Guideline values for industrial and light commercial land use, 2009.

[6] Land Quality Management/Chartered institute of Environmental Health, Generic Assessment Criteria for Human Health Risk Assessment, 2nd Edition, 2009.

[7] Faber Maunsell. Phase One Contaminated Land Assessment. June 2007

[8] Scott Wilson. Phase Two Contaminated Land Assessment. May 2008

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.25**

Volume 25: Abbey Mills Pumping Station appendices

Appendix G: Noise and vibration

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

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Environmental Statement

Volume 25 Abbey Mills Pumping Station appendices

Appendix G: Noise and vibration

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Appendix G: Noise and vibration

G.1 Baseline noise survey

Introduction

G.1.13 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.1.14 The nearest identified noise sensitive receptors to Abbey Mills Pumping Station are the residential dwellings on Riverside Road. In addition, there are house boats at Three Mills Wall to the west, two storey residential premises on Abbey Lane to the northeast and two storey residential premises on Crows Road to the south, beyond the Channelsea River and the railway line.

Survey methodology

G.1.15 The London Borough of Newham has been consulted regarding the noise assessment and monitoring locations, prior to completing the surveys.

G.1.16 A baseline noise survey was completed on 15th through 17th May 2011, which comprised short term attended measurements taken during the daytime, evening and night-time at one location, and also included continuous unattended monitoring.

G.1.17 The attended measurements were undertaken during the interpeak periods of 10:00-12:00, 14:00-16:00, 20:00-22:00 and 00:00-04:00 on a typical weekday, and 14:00-18:00 and 00:00-04:00 on a typical weekend day so that the baseline data is representative of the quieter periods where any disturbance from construction would be most noticeable. Continuous unattended monitoring was completed at two locations over the three day period.

G.1.18 Vol 25 Table G.1 describes the survey equipment that was used to collect the baseline data at the site.

Vol 25 Table G.1 Noise – survey equipment

Item	Type	Manufacturer	Serial number(s)	Laboratory calibration date*
Baseline survey: 15 – 17 May, 2011				
Hand-Held Analyzers	2250	Brüel & Kjær	2626231 2626232 2626233	20/01/2010 15/02/2010 15/02/2010
½ " Microphones	4189	Brüel & Kjær	2621209 2621211 2621212	20/01/2010 15/02/2010 15/02/2010

Item	Type	Manufacturer	Serial number(s)	Laboratory calibration date*
B&K Sound Calibrator	4231	Brüel & Kjær	2619374	21/02/2011

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

G.1.19 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.1.20 For the attended measurement, the sound level meter was 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.1.21 For the unattended measurements, the environmental cases used for the continuous data logging were locked to avoid any potential tampering. The microphones were tripod-mounted approximately 1.3m above ground level. Windshields with bird spikes were fitted over the microphones at all times during the survey period to minimise the effects of any wind induced noise, and also to prevent birds from perching on the equipment.

G.1.22 The prevailing weather conditions observed during the baseline survey are described in Vol 25 Table G.2.

Vol 25 Table G.2 Noise – weather conditions during baseline noise survey

Wind Speed (ms^{-1})	Wind Direction	Temperature (°C)	Precipitation	Description
Baseline Survey – 15 May 2011 (daytime, 14:00-18:00)				
Maximum: 1.8-4.1 Average: 0.6-1.1	W; NW	17-19	No	Cloudy, light breeze, dry
Baseline Survey – 16 May 2011 (night-time, 00:00-04:00)				
Maximum: 1.0-1.4 Average: 0.4-0.6	WSW	13	No	Cloudy and dry
Baseline Survey – 16 May 2011 (daytime, 10:00-12:00)				
Maximum: 2.1-3.1	W	17-18	Yes, light drizzle between	Overcast and breezy

Wind Speed (ms^{-1})	Wind Direction	Temperature (°C)	Precipitation	Description
Average: 0.9-1.6			10:09-10:10 and 11:00-11:01	
Baseline Survey – 16 May 2011 (daytime, 14:00-16:00)				
Maximum: 3.2-3.9 Average: 1.4-1.8	W; SW	19-21	No	Overcast and breezy
Baseline Survey – 16 May 2011 (evening, 20:00-22:00)				
Maximum: 2.6-4.2 Average: 0.7-1.4	W	16-17	No	Cloudy, dry, light breeze
Baseline Survey – 17 May 2011 (night-time, 00:00-04:00)				
Maximum: 3.3-4.6 Average: 0.9-1.7	W, WSW	13-15	No	Cloudy, dry and breezy

Measurement locations

G.1.23 Vol 25 Table G.3 details the measurement locations which are also presented in Vol 17 Figure G.1 Noise – measurement locations (see separate volume of figures), and shown in Vol 25 Plate G.1 to Vol 25 Plate G.3.

Vol 25 Table G.3 Noise – measurement locations

Measurement location number	Description	Co-ordinates	
		X	Y
AMP01	On public footpath adjacent to Bisson Road	538479	183119
AMP02	Within private grounds of Abbey Mills Pumping Station	538673	183180
AMP03	On eastern edge of Abbey Mills Pumping Station grounds, adjacent to Abbey Creek	538808	183026

Results

G.1.24 The range of values for each of the parameters collected during the baseline survey are summarised in Vol 25 Table G.4 – Vol 25 Table G.6.

Vol 25 Table G.4 Noise – sampled noise survey results - AMP01

Location Detail: AMP01, on public footpath at the end of Bisson Road, on the western edge of Abbey Mills Pumping Station grounds						
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)	90	49	53-67	61	64*	65
Evening (20.00-22.00)	71	46	54	54	57*	55
Night (00.00-04.00)	62	43	47-48	47	50*	50
Weekend day (14.00-18.00)	75	48	53-55	54	57*	55
Weekend night (00.00-04.00)	63	40	41-45	44	47*	45

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

Vol 25 Table G.5 Noise – continuously logged noise survey results – AMP03

Location Detail: AMP03, on the eastern edge of Abbey Mills Pumping Station grounds, adjacent to Abbey Creek							
Day	**Period**	**Period noise level (dB(A) free-field)**			**Period noise level (dB(A) façade)**		
		L_{AFmax}	**L_{A90}**	**L_{Aeq}**	**L_{AFmax}**	**L_{A90}**	**L_{Aeq}**
Weekday	07.00-08.00	99	51	61	102	54	64
	08.00-18.00	89	51	59	92	54	62
	18.00-19.00	71	50	54	74	53	57
	19.00-22.00	76	48	54	79	51	57
	22.00-	73	43	51	76	46	54

Location Detail: AMP03, on the eastern edge of Abbey Mills Pumping Station grounds, adjacent to Abbey Creek							
Day	Period	Period noise level (dB(A) free-field)			Period noise level (dB(A) façade)		
		L_{AFmax}	L_{A90}	L_{Aeq}	L_{AFmax}	L_{A90}	L_{Aeq}
	07.00						
Sunday	07.00-21.00*	82	47	53	85	56	88
	21.00-07.00	71	42	49	74	45	52

** The data presented in this row is deemed to be representative of the reference period. The continuous monitors only started collecting data from noon onwards*

Vol 25 Table G.6 Noise – continuously logged noise survey results – AMP02

Location Detail: AMP02, within private grounds of Abbey Mills Pumping Station							
Day	Period	Period noise level (dB(A) free-field)			Period noise level (dB(A) façade)		
		L_{AFmax}	L_{A90}	L_{Aeq}	L_{AFmax}	L_{A90}	L_{Aeq}
Weekday	07.00-08.00	73	51	55	76	54	58
	08.00-18.00	86	52	59	89	55	62
	18.00-19.00	74	51	55	77	54	58
	19.00-22.00	74	49	54	77	52	57
	22.00-07.00	93	45	52	96	48	55
Sunday	07.00-21.00*	74	49	54	77	52	57
	21.00-07.00	71	45	49	74	48	52

**The data presented in this row is deemed to be representative of the reference period. The continuous monitors only started collecting data from noon onwards*

Plates of noise measurement locations

G.1.25 The following plates (Vol 25 Plate G.1 to Vol 25 Plate G.3) illustrate the noise measurement locations.

Vol 25 Plate G.2 Noise – measurement location AMP01

Note: On public footpath alongside Bisson Road, looking west

Vol 25 Plate G.3 Noise – measurement location AMP03

Note: On the eastern edge of Abbey Mills Pumping Station grounds, looking east towards Abbey Creek

Vol 25 Plate G.4 Noise – measurement location AMP02

Note: Within private grounds of Abbey Mills Pumping Station, looking south

G.2 Construction noise prediction results

G.2.13 The construction noise prediction methodology follows the methodology provided in Vol 2 Section 9.

G.2.14 The assessment has been carried out based on a typical construction programme which has been used to calculate the average monthly noise levels.

G.2.15 Construction plant assumptions used in the assessment are presented in Vol 25 Table G.7.

G.2.16 Time histories of the predicted daytime construction noise levels across the programme of construction works are shown in Vol 25 Plate G.4 to Vol 25 Plate G.9.

Vol 25 Table G.7 Noise – typical construction plant schedule

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

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
					Item 5	held pneumatic breaker, 1 t
	Generator200 kVA	1	94	100	BS5228-1: Table C.4, Item 78	Diesel generator,
	Cutting equipment (diamond saw)	2	108	10	BS5228-1: Table C.4, Item 93	Angle grinder (grinding steel), 4.7 kg
	Telescopic Handler/FLT	1	99	30	BS5228-1: Table C.2, Item 35	Telescopic handler, 10 t
	Wheel wash	1	91	20	BS5228-1: Table C.3, Item 13	Water Jet Pump, ,
	Hiab lorry/crane	1	105	5	BS5228-1: Table C.4, Item 53	Lorry with lifting boom, 6 t
	Dewatering Pump	1	96	100	BS5228-1: Table C.4, Item 88	Water pump,
	Water settling/treatment	1	104	100	Measured	Dirty water plant
	JCB with hydraulic breaker	1	116	25	BS5228-1: Table C.5, Item 1	Backhoe Mounted Hydraulic Breaker, —
	Fuel delivery vehicle	1	104	5	BS5228-1: Table C.4, Item 15	Fuel tanker lorry,
	Well drilling Rig	1	107	50	Manufacturer	BauerBBA Well Drilling Rig,
Demolition General site	Service Crane 25T mobile Crane	1	98	30	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
equipment also applicable during this phase	22T Excavator c/w hydraulic hammer	1	118	30	BS5228-1: Table C.1, Item 9	Tracked excavator fitted with breaker, 200 kg·m
	Site dumper	1	104	30	BS5228-1: Table C.4, Item 3	Dumper, 7 t
	Pneumatic breaker	1	111	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
Diaphragm wall construction General site equipment also applicable during this phase	Diaphragm wall rig (grab)	1	114	10	BS5228-1: Table D.4, Item 10	D wall rig,
	Diaphragm wall rig (hydrofraise)	2	110	40	Measured	Hydrofraise D wall rig,
	Concrete deliveries (discharging)	1	95	20	BS5228-1: Table C.4, Item 24	Concrete pump + cement mixer truck (discharging), 8 t / 350 bar
	150t crawler crane	2	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	Concrete pump	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
	Diaphragm wall slurry treatment plant	1	100	100	Manufacturer	Slurry treatment plant,
	Waste water treatment plant	1	104	100	Measured	Dirty water plant

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
	Compressor 400cfm	1	105	90	BS5228-1: Table D.6, Item 41	Compressor, 7m^3/min
	Dumper	1	104	50	BS5228-1: Table C.4, Item 3	Dumper, 7 t
Shaft excavation General site equipment also applicable during this phase	Dewatering pump	4	96	100	BS5228-1: Table C.4, Item 88	Water pump (diesel), 100 kg
	Long reach excavator	1	106	80	BS5228-1: Table C.7, Item 1	Long reach tracked excavator, 21 m arm / 39 t
	20t excavator with breaker	1	118	50	BS5228-1: Table C.1, Item 8	Breaker mounted on excavator, 15 t
	80t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	150t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	25t excavator	1	105	80	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t
	Ventilation fans	1	100	100	Measured	Ventilation fans,
	Dumper	1	104	50	BS5228 Table C 4, Item 3	Dumper, 7 t
Main Tunnel drive	250t mobile (disassembly)	1	106	80	BS5228 Table C 4, Item 38	Wheeled mobile telescopic crane, 400 t
	500t mobile (disassembly)	1	106	80	BS5228 Table C 4,	Wheeled mobile

Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
					Item 38	telescopic crane, 400 t
Main Tunnel secondary lining	Gantry cranes 30t, 25m span with cantilever one end	2	105	80	Measured	Gantry crane,
	Concrete pump	4	106	100	BS5228-1: Table C.3, Item 25	Concrete pump
	Air compressor 600cfm	2	93	100	BS5228-1: Table D.5, Item 5	Compressor for hand-held pneumatic breaker, 1 t
	Mains substation	1	94	5	BS5228-1: Table C.4, Item 78	Diesel generator,
General site equipment also applicable during this phase	Waste water treatment plant	1	104	100	Measured	Dirty water plant
	Concrete batching plant 40m3/hr	1	95	80	Measured	Batching,
	25T loading shovel	1	114	50	BS5228-1: Table C.9, Item 8	Wheeled loader, 50 t
	Sump pumps 150mm	1	96	100	BS5228-1: Table C.4, Item 88	Water pump (diesel), 100 kg
Shaft secondary lining General site equipment also applicable	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
	Fixed and portable concrete vibrators	4	106	20	BS5228-1: Table C.4, Item 33	Poker vibrator,

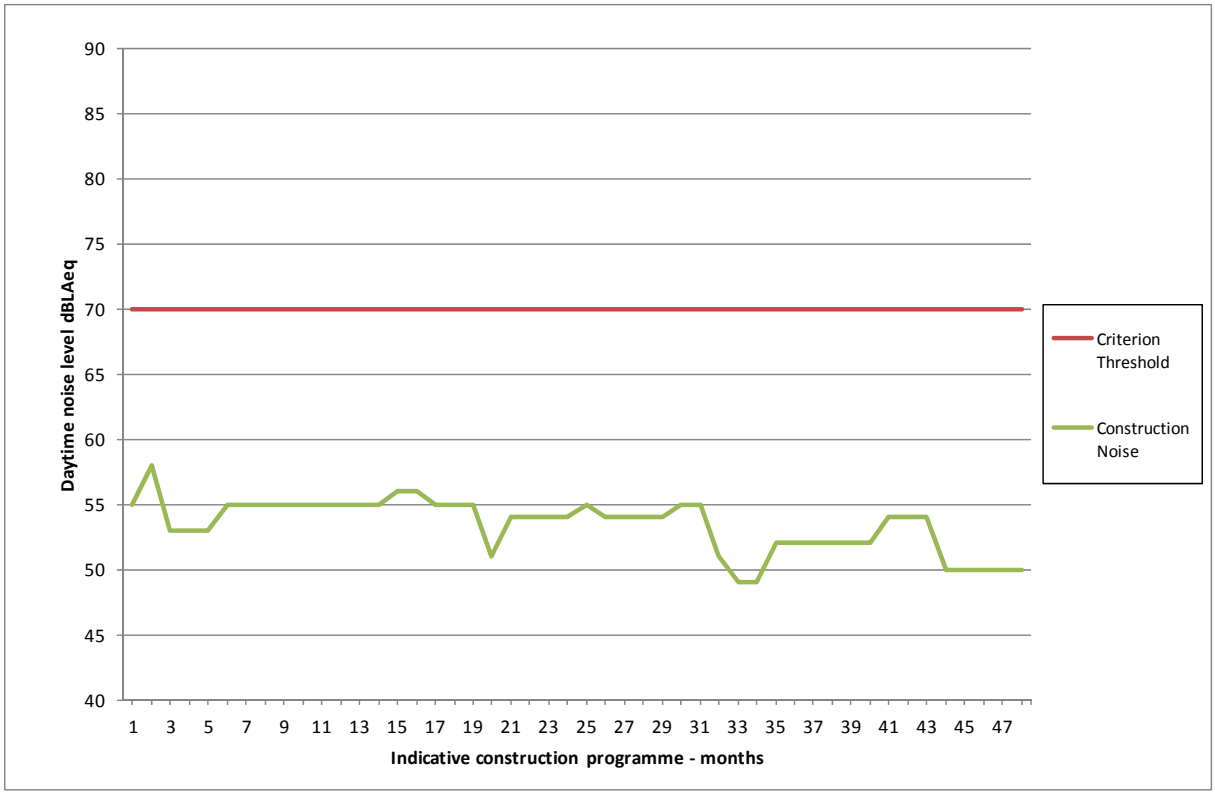
Construction activity	Plant	Unit No(s)	Activity LWA (dB)	% on-time	Data Source	Description of equipment used in the assessment
during this phase	Hand tools (e.g. drills and wrenches)	4	95	80	Estimated	Impact wrench and compressor,
	Concrete deliveries (discharging)	2	95	20	BS5228-1: Table C.4, Item 24	Concrete pump + cement mixer truck (discharging), 8 t / 350 bar
	Concrete pump	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
Piling for culvert support	100t crawler crane	1	103	50	BS5228-1: Table C.4, Item 52	Tracked mobile crane, 105 t
	25t mobile crane	1	98	50	BS5228-1: Table C.4, Item 43	Wheeled mobile crane, 35 t
	Vibratory piling rig	1	116	80	BS5228-1: Table C.3, Item 8	Vibratory piling rig, 52 t
Culvert and chamber works General site equipment also applicable during this phase	Service crane100T mobile crane	1	99	50	BS5228-1: Table C.4, Item 41	Mobile telescopic crane, 100 t
	25t excavator	1	105	50	BS5228-1: Table C.2, Item 19	Tracked excavator, 25 t
	Fixed and portable concrete vibrators	4	106	20	BS5228-1: Table C.4, Item 33	Poker vibrator,
	Concrete deliveries (discharging)	1	103	20	BS5228-1: Table C.4, Item 18	Cement mixer truck (discharging),
	Concrete boom pump	1	108	20	BS5228-1: Table C.4, Item 29	Truck mounted concrete pump + boom arm, 26 t

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
	Hand tools (e.g. drills and wrenches)	4	95	80	Estimated	Impact wrench and compressor,
	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
Landscaping General site equipment NOT applicable during this phase	Hiab lorry/crane	1	105	5	BS5228-1: Table C.4, Item 53	Lorry with lifting boom, 6 t
	Compressor for hand-held breaker	1	93	10	BS5228-1: Table D.5, Item 5	Compressor for hand-held pneumatic breaker, 1 t
	Hand-held percussive breaker	1	111	10	BS5228-1: Table C.1, Item 6	Hand-held pneumatic breaker,
	Plate compactors	2	108	10	BS5228-1: Table C.2, Item 41	Vibratory plate (petrol), 62 kg
	Vibrating rollers	1	101	70	BS5228-1: Table C.2, Item 38	Roller, 18 t

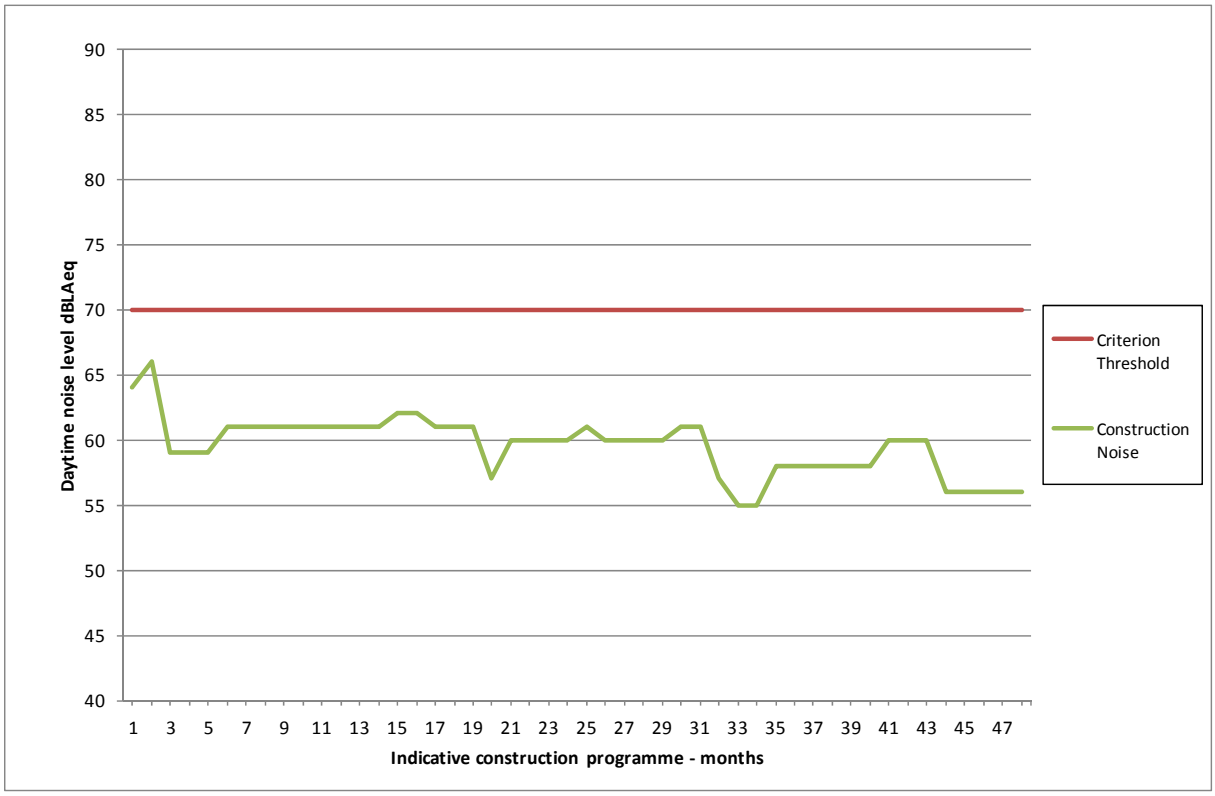
Note: This schedule provides an illustration of typical plant that could be used in the construction of the Thames Tideway Tunnel at this site. The appointed Contractor must comply with section 6 of the CoCP but may vary the method and plant to be used. This schedule therefore represents the most reasonable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

G.2.17 The predicted construction noise over time at each receptor is shown in the plates 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 plates 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 but not presented here.

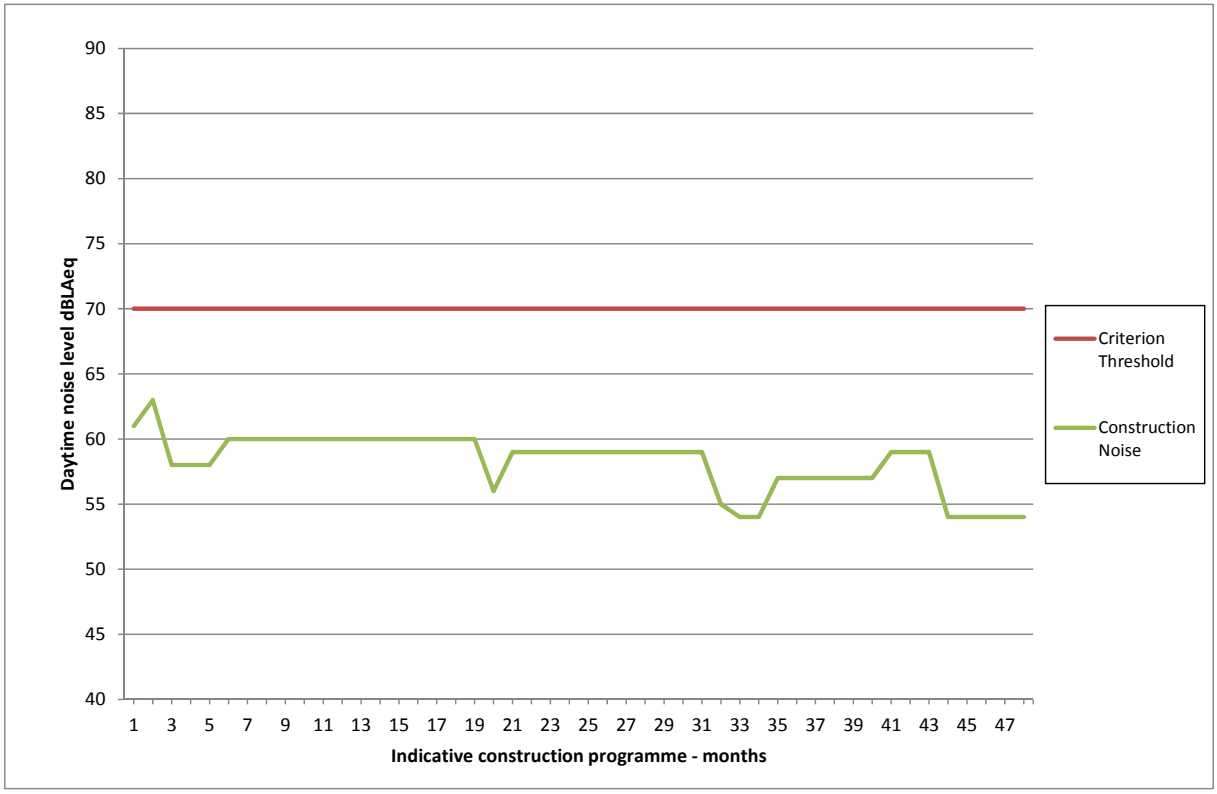
Vol 25 Plate G.5 Noise – Average monthly daytime noise level over duration of construction – Three Mills Wall House boats (residential) (AM1)



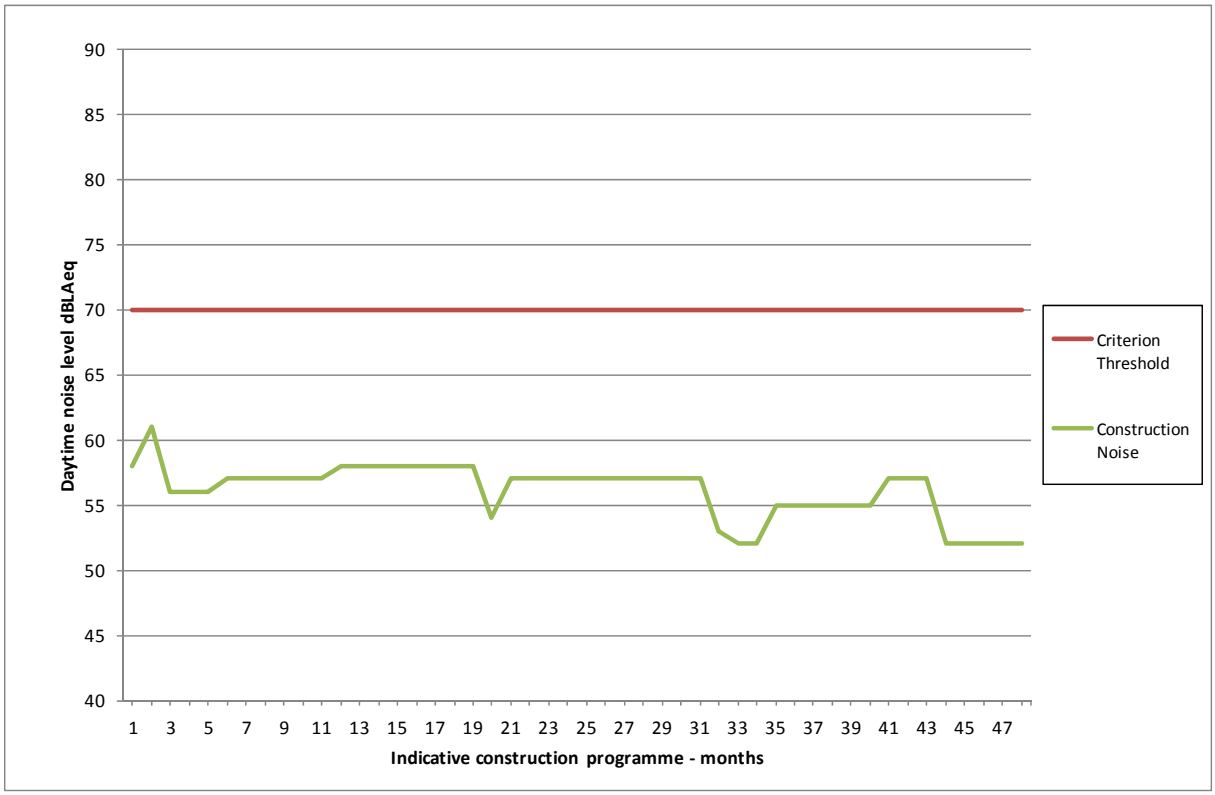
Vol 25 Plate G.6 Noise – Average monthly daytime noise level over duration of construction – 2 Riverside Road (residential) (AM2)



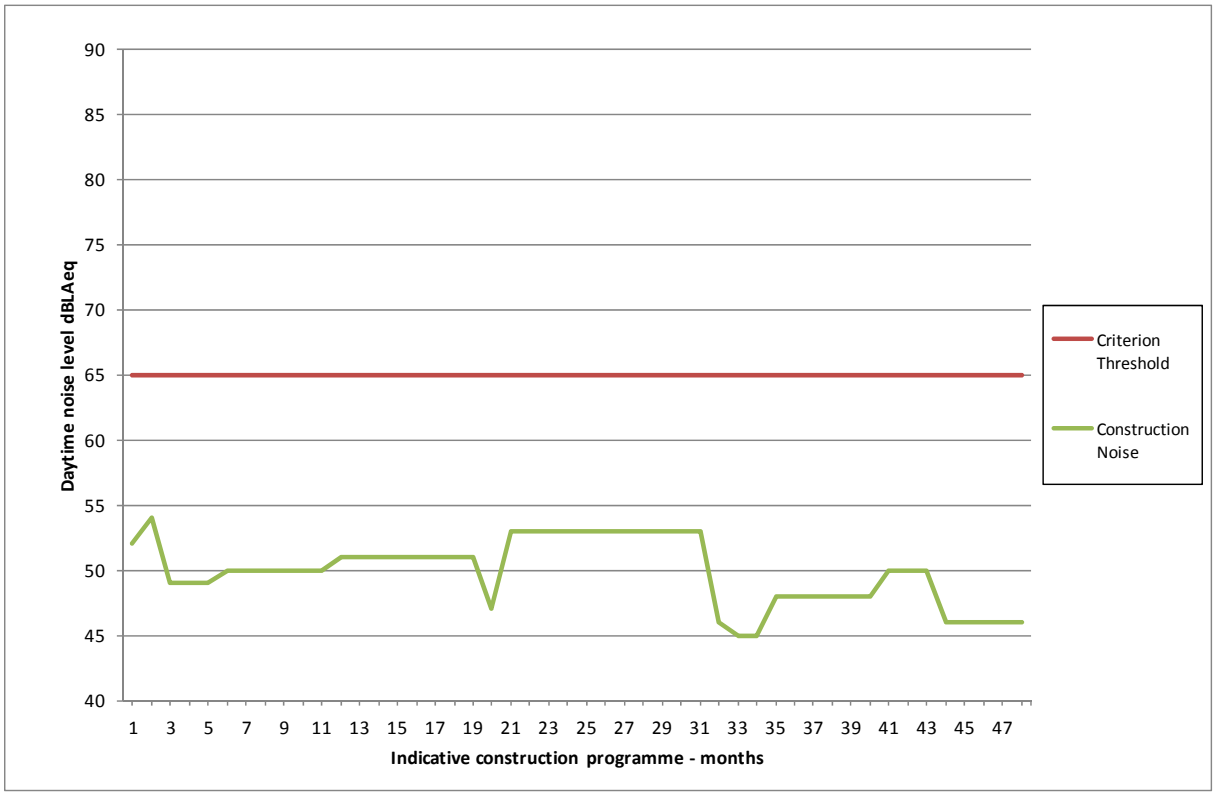
Vol 25 Plate G.7 Noise – Average monthly daytime noise level over duration of construction – 24 Riverside Road (residential) (AM3)



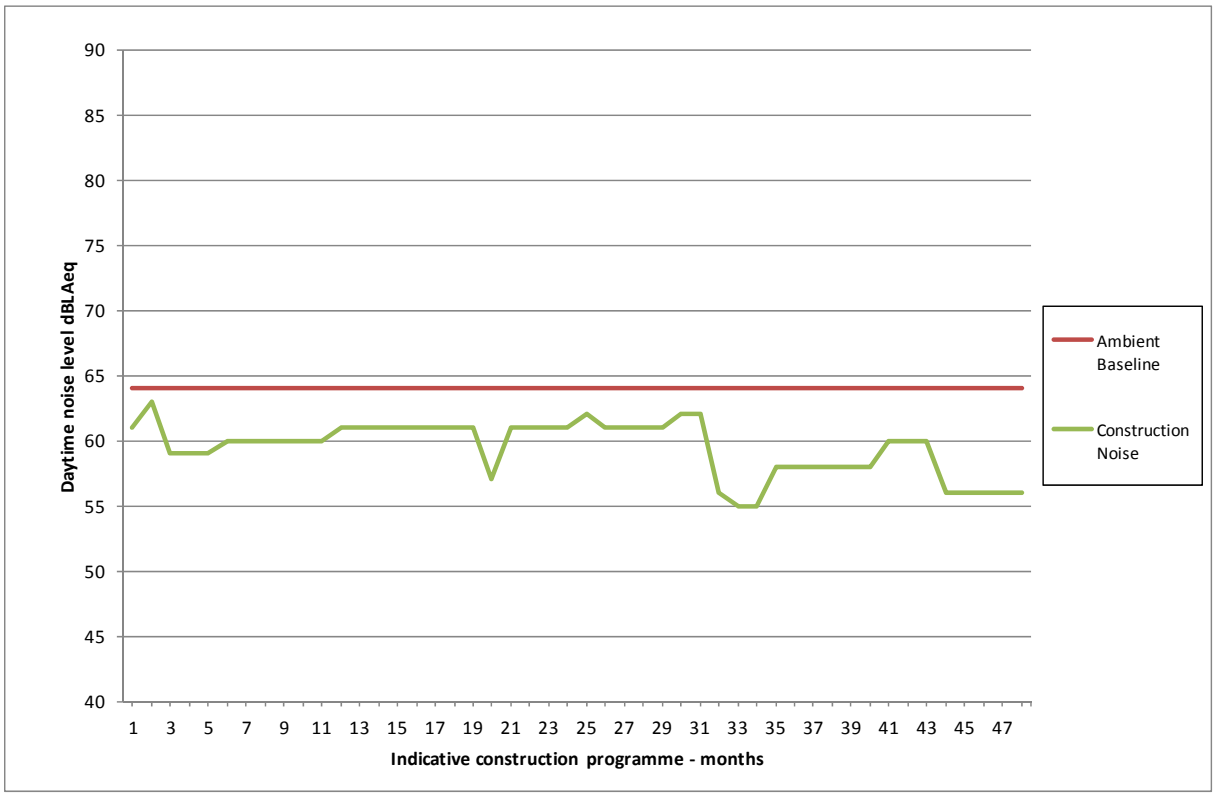
Vol 25 Plate G.8 Noise – Average monthly daytime noise level over duration of construction – Gay Road / Abbey Lane (residential) (AM4)



Vol 25 Plate G.9 Noise – Average monthly daytime noise level over duration of construction – Crows Road (residential) (AM5)



Vol 25 Plate G.10 Noise – Average monthly daytime noise level over duration of construction – 3 Mills Studio (studio) (AM6)



References

[1] 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

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Doc Ref: **6.2.25**

Volume 25: Abbey Mills Pumping Station appendices

Appendix H: Socio-economics

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Appendix H: Socio-economics

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Appendix H: Socio-economics

H.1 Baseline community profile

H.1.1 The community profile is based on both 'Output Area' (OA) and local authority level data from the Office of National Statistics (ONS). The data have been obtained from four sources: Census 2001[1] (the last census for which data are available[i]), Department of Communities and Local Government Deprivation Indices 2010[2], London Public Health Observatory 2012[3], and the Network of Public Health Observatories 2011[4] (see Volume 2 Methodology). Data are 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 Newham).

H.1.3 The main protected characteristic group concentrated[iii] within 250m of the proposed construction site is persons suffering from income and overall deprivation.

H.1.4 Further detail on the socio-economic profile of the local community is provided below.

Resident population

H.1.5 The resident population was approximately 450 people within 250m of the site at the time of the last census.

Gender and age

H.1.6 Of the total population within 250m of the site 51.3% residents are male, by comparison in the LB of Newham (50.9%) and Greater London (51.6%) there is a slight predominance of females.

H.1.7 Vol 25 Table H.1 outlines the age breakdown by assessment area, it illustrates that the proportion of under 16 year olds within 250m (29.4%) is slightly higher than within the LB of Newham (26.2%) and somewhat higher than within Greater London (20.2%). Within both 250m (7.2%) and the LB of Newham (8.9%) the proportion of over 65 year olds is moderately lower than within 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 situation of a higher than average, or lower than average proportion of persons belonging to a particular protected characteristic, in comparison with the borough-wide average.

Vol 25 Table H.1 Socio-economics – age breakdown by assessment area

Age group	Assessment area		
	Immediate area (250m)	Borough wide (LB of Newham)	Greater London
Under 16 years old	29.4%	26.2%	20.2%
Over 65 years old	7.2%	8.9%	12.4%

Ethnicity

H.1.8 Vol 25 Table H.2 outlines ethnicity by assessment area, showing that within 250m of the site, White residents comprise approximately half the population (47.3%) with Black and Minority Ethnic groups comprising the remainder.

H.1.9 The proportion of White residents within 250m (47.3%) is somewhat higher than the LB of Newham level (39.4%) and moderately lower than across Greater London (71.2%).

H.1.10 Within 250m, the proportion of Black residents (30.1%) is moderately higher than within the LB of Newham overall (21.6%) and considerably higher than the average across Greater London (10.9%).

H.1.11 Within 250m, the proportion of Asian residents (15.5%) is considerably lower than within the LB of Newham (32.5%) but only slightly higher than across Greater London (12.1%).

Vol 25 Table H.2 Socio-economics – ethnicity by assessment area

Ethnicity	Assessment area		
	Immediate area (250m)	Borough wide (LB of Newham)	Greater London
White	47.3%	39.4%	71.2%
BME	52.7%	60.6%	28.8%
Asian	15.3%	32.5%	12.1%
Black	30.1%	21.6%	10.9%
Other	3.3%	3.1%	2.7%
Mixed	4.1%	3.4%	3.2%

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

Religion and belief

H.1.12 Within 250m of the site, Christians are the predominant religious group at 54.8% of the population, somewhat higher than the average within the LB of Newham (46.8%).

H.1.13 Muslims are the second most predominant religious group accounting for 18.3% of residents, somewhat lower than within the LB of Newham (24.3%) and considerably higher than within Greater London (8.5%).

Health indicators

H.1.14 Vol 25 Table H.3 outlines health indicators by assessment area, noting that within 250m of the site, the proportion of residents suffering from a long term illness (14.7%) is somewhat lower than within the LB of Newham (17.3%) and within Greater London (15.5%).

H.1.15 The proportion of residents who claim disability living allowance within 250m (6.1%) is somewhat higher than within the LB of Newham (5.6%) and moderately higher than within Greater London (4.5%).

Vol 25 Table H.3 Socio-economics – health indicators by assessment area

Health indicator	Assessment area		
	Immediate area (250m)	Borough wide (LB of Newham)	Greater London
Long term limiting sick	14.7%	17.3%	15.5%
Disability living allowance	6.1%	5.6%	4.5%

H.1.16 For the Middle Layer Super Output Area (MSOA)[iv5] in which the construction site falls, levels of adult obesity fall within the second highest quintile (ie, the highest being the worst) measured relative to Greater London.

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

H.1.18 For male life expectancy the MSOA ranks within the highest quintile (ie, the highest being the best) relative to Greater London. Female life expectancy is slightly lower and the local MSOA falls within the middle quintile. The average life expectancy of male residents is 84.9 to 93.1 years old and for females it is 81.2 to 83.2 years old.

Lifestyle and deprivation indicators

H.1.19 Vol 25 Table H.4 outlines lifestyle and income deprivation indicators by assessment area, showing that within 250m of the site, approximately half of all households do not own a car (50.1%). This is similar to within the LB of Newham (48.9%) and moderately higher than within Greater London (37.5%).

[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.

Vol 25 Table H.4 Socio-economics – lifestyle and income deprivation levels by assessment area

Indicator	Assessment area		
	Immediate area (250m)	Borough wide (LB of Newham)	Greater London
No car households	50.1%	48.9%	37.5%
Income	100%	90.7%	21.5%
Overall	100%	80.7%	18.3%

H.1.20 Levels of deprivation[v] measured by both income deprivation (100.0%) and overall deprivation (100.0%) within 250m are slightly higher than LB of Newham levels (90.7% and 80.7% respectively). Both income deprivation and overall deprivation within 250m and within the LB of Newham are considerably higher than the respective measures across Greater London (21.5% and 18.3%).

[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 Abbey Mills 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 LB of Newham) 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 650 jobs[vii]. Vol 25 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 5% of total employment within 250m. It can be seen that:

a. Administrative and Support Service Activities account for 27% of employment within 250m which is more than three times that within the LB of Newham (7%) and Greater London (8%).

b. Real Estate Activities account for 11% of employment within 250m, considerably greater than within both the LB of Newham (4%) and Greater London (3%).

c. Education accounts for 10% of employment within 250m, slightly less than within the LB of Newham (11%) and somewhat more than within Greater London (7%).

d. Information and Communication accounts for 9% of employment within 250m, more than double that within the LB of Newham (4%) and Greater London (7%).

e. Construction accounts for 5% to 7% of employment at all three geographical levels.

f. Transportation and Storage accounts for 6% of employment within 250m, almost half that within the LB of Newham (11%) and slightly more than within Greater London (4%).

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

Sector (Standard Industrial Code 2007)	Assessment area		
	Immediate area (250m)	Borough wide (LB of Newham)	Greater London
Administrative and Support Service Activities	27%	7%	8%
Real Estate Activities	11%	4%	3%
Education	10%	11%	7%
Information and Communication	9%	4%	7%
Construction	7%	6%	5%
Transportation and Storage	6%	11%	4%
Other (including unclassified)	30%	57%	66%
Administrative and Support Service Activities	27%	7%	8%

H.2.5 Within approximately 250m of the site there are approximately 90 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 25 Table H.5, with a large proportion of businesses engaged in Administrative and Support Service Activities (14%), Education (10%), Real Estate Activities (10%), Information and Communication (10%). and Construction (6%).

H.2.6 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 (one1 to nine employees) account for the majority. Within approximately 250m of the site 82% of businesses employ one to nine employees, somewhat less than within both the LB of Newham (92%) and Greater London (88%). Business units employing ten to 24 employees account for 15% of the total, which is three times greater than within the LB of Newham (5%) and almost double that within Greater London (8%).

H.2.7 For the sectors accounting for the greatest proportions of jobs and businesses within approximately 250m, the size banding of businesses varies. Both Administrative and Support Service Activities (62%) and Real Estate Activities (78%) have smaller proportions of small businesses employing one to nine employees, than the average across all sectors (82%). Instead, both of these sectors have a considerably higher proportion (31% and 22% respectively) of businesses employing ten to 24

[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.

employees than the average across all sectors (15%) and within the LB of Newham (5%).

H.2.8 The Education sector has a somewhat higher than average proportion of businesses (eg, schools) employing one to nine employees (89%) within 250m. Additionally this sector has a considerably higher proportion of businesses employing between 25 to 49 people (11%) compared to the average across all sectors (2%).

H.2.9 Within approximately 250m of the site, the Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles and Professional, Scientific and Technical Activities sectors are comprised wholly (100%) of businesses employing 1 to 9 employees.

Vol 25 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)	82%	15%	2%	0%	1%	0%
Administrative and Support Service Activities	62%	31%	0%	0%	8%	0%
Education	89%	0%	11%	0%	0%	0%
Real Estate Activities	78%	22%	0%	0%	0%	0%
Wholesale and Retail Trade / Repair of Motor Vehicles and Motorcycles	100%	0%	0%	0%	0%	0%
Professional, Scientific and Technical Activities	100%	0%	0%	0%	0%	0%
Borough wide (LB of Newham)	92%	5%	1%	1%	0%	0%
Greater London	88%	8%	2%	1%	1%	0%

References

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

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

[3] London Public Health Observatory. *Fair Society, Healthy Lives: The Marmot Review* (2012). Available from: http://www.lho.org.uk/LHO_TOPICS/NATIONAL_LEAD_AREAS/MARMOT/MARMOT INDICATORS.ASPX. Accessed 30 August 2012

[4] Network of Public Health Observatories. *Health Profiles: London* (2011-2012) Available at: http://www.apho.org.uk/resource/view.aspx?QN=HP_REGION_H. Accessed February 2012.

[5] Office of National Statistics. *Super Output Areas: Introduction* (2012). Accessed from: http://www.neighbourhood.statistics.gov.uk/dissemination/Info.do;jessionid=vtvdPZRWZ3yhT9ShjB6TcwQ00WNTZcPQgyVpGLvZjTzh7nYnBhqL!1624269762!1327075798387?m=0&s=1327075798387&enc=1&page=aboutneighbourhood/geography/superoutputareas/soa-intro.htm&nsjs=true&nsck=true&nssvg=false&nswid=1225. Accessed 29 May 2012.

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

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

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Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

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Appendix I: Townscape and visual

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Appendix I: Townscape and visual

I.1 Introduction

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

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Appendix J: Transport

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Appendix J: Transport

J.1 Introduction

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

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Appendix K: Water resources - groundwater

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Appendix K: Water resources – groundwater

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Appendix K: Water resources – groundwater

K.1 Geology

K.1.1 A summary of the anticipated geological succession at the Abbey Mills Pumping Station site is shown Vol 25 Table K.1.

Vol 25 Table K.1 Groundwater – anticipated geological succession

Period	Series	Group	Formation
Quaternary	Holocene	Superficial deposits	Made ground
			Alluvium
	Pleistocene		River Terrace Deposits
Palaeogene	Eocene	Thames	London Clay
			Harwich
	Palaeocene	Lambeth	Upper Shelly Beds
			Upper Mottled Beds
			Laminated Beds
			Lower Shelly Beds
			*Mid-Lambeth Hiatus**
			Lower Mottled Beds
			Upnor
		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 the British Geological Survey (BGS) (BGS, 2009)[1], is shown in Vol 25 Figure 13.4.1 and Vol 25 Figure 13.4.2 respectively (see separate volume of figures).

K.1.3 The ground investigation undertaken for the Thames Tideway Tunnel project has involved drilling boreholes both on the banks and within the main river channel for the purposes of understanding the geology and hydrogeology within the assessment area. The depths and thicknesses of

the geological layers have been based on the two ground investigation boreholes located up to 115m from the Abbey Mills Pumping Station shaft site: these are boreholes SR3001 (33m) and SR3002 (115m). In addition, data has been obtained from the Lee Tunnel boreholes, 00426B/13A, 13B, 13C and 13D, as well as a preliminary Tideway investigation borehole, 00426A/2. The locations of these boreholes around the site are shown in Vol 25 Figure 13.4.1 (see separate volume of figures). The depths and thicknesses of geological layers encountered are summarised in Vol 25 Table K.2.

Vol 25 Table K.2 Groundwater – anticipated ground conditions

Formation	Top elevation* (mATD)**	Depth below ground level (m)	Thickness (m)
Made Ground	105.0	0	4.0
Alluvium	101.0	4.0	1.0
River Terrace Deposits	100.0	5.0	3.5
London Clay (A2)	96.5	8.5	5.1
Harwich Formation	91.4	13.6	0.9
Lambeth Group:			
USB	90.5	14.5	2.0
UMB	88.5	16.5	1.0
LtB	87.5	17.5	2.5
LSB	85.0	20.0	2.5
LMB	82.5	22.5	1.5
UPN(Gv)	81.0	24.0	1.5
UPN	79.5	25.5	5.5
Thanet Sand	74.0	26.0	12.5
Seaford Chalk	61.5	43.5	Not proven

** Based on an assumed ground level of 105.00mATD*
***mATD = metres above tunnel datum.*
USB–Upper Shelly Beds; UMB–Upper Mottled Beds; LtB–Laminated Beds
LSB-Lower Shelly Beds; LMB-Lower Mottled Beds; UPN (Gv)-Upnor Formation (Gravel); UPN-Upnor Formation

K.1.4 The main tunnel shaft at Abbey Mills Pumping Station site would extend down to approximately 40.25mATD and would pass through the Made Ground, Alluvium, River Terrace Deposits, London Clay Formation, Harwich Formation, Lambeth Group, Thanet Sand and be founded in the Chalk. The base slab would extend to approximately 34.25mATD and also be founded in the Chalk.

K.1.5 The Made Ground, consisting of slightly clayey, gravely sand or sandy gravely clay with brick, clinker, ash, coal, concrete, glass, slate, cloth and ceramics, and is expected to be 4.0m thick at the Abbey Mills site.

K.1.6 The Alluvium, comprising slightly sandy, slightly gravely clay with some pockets of organic clay and peat, is expected to be 1.0m thick at the Abbey Mills site.

K.1.7 The River Terrace Deposits are formed by extensive alluvial sand and gravel deposits laid down in river terraces by a braided river system of approximately 5km width, in river terraces since the Anglian glaciation. The River Terrace Deposits are expected to be 3.5m thick at the Abbey Mills site and relatively thin compared to other parts of London.

K.1.8 The London Clay is described by the BGS as "fine, sandy, silty clay/silty clay, glauconitic at base" (BGS, 2012)[2] and is comprised of stiff to very stiff clay at the Abbey Mills site. The London Clay is divided into sub-units referred from oldest to youngest as A to E, with some of these sub-units dividing further, for example A2, A3i-iii, B in decreasing age order. The London Clay Formation is expected to be 5.1m thick at the Abbey Mills site.

K.1.9 The Harwich Formation comprises fine-grained glauconitic sand and rounded black flinty pebble beds, commonly deposited in a series of superimposed channels and is expected to be 0.9m thick at the Abbey Mills site.

K.1.10 The Upper Shelly Beds (USB) of the Lambeth Group comprises grey, shelly clays with scattered glauconite grains and are expected to be 4.5m thick at the Blackfriars Bridge Foreshore site.

K.1.11 The Upper Mottled Beds (UMB) of the Lambeth Group comprises silty clay and clay, generally un-bedded, fissured and blocky, with up to 50% silt and sand and are expected to be 1.0m thick at the Abbey Mills site.

K.1.12 The Laminated Beds (LtB) of the Lambeth Group comprise thinly interbedded fine to medium grained sand, silt and clay with shells, with sand lenses found locally and are expected to be 2.5m thick at the Abbey Mills site.

K.1.13 The Lower Shelly Beds (LSB) of the Lambeth Group comprises dark grey to black clay with abundant shells and are expected to be 2.5m thick at the Abbey Mills site.

K.1.14 The Lower Mottled Beds (LMB) of the Lambeth Group comprises silty clay and clay, generally un-bedded, fissured and blocky, with up to 50% silt and sand and are expected to be 1.5m thick at the Abbey Mills site.

K.1.15 The Upnor Formation (UPN) is a variably bioturbated fine- to medium-grained sand with glauconite, rounded flint pebbles and minor clay, with distinctive pebble beds at the base and top (UPN (Gv)). The Upnor Formation is expected to be 7.0m thick at the Abbey Mills site.

K.1.16 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 (BGS, 2000)[3]. The Thanet Sand is expected to be 12.5m thick at the Abbey Mills site.

K.1.17 The base of the Thanet Sands is a unit known as the 'Bullhead Bed', consisting of sandy clay or clayey, sandy gravel and expected to be 0.08m thick at the Abbey Mills site.

K.1.18 The Seaford Chalk is the upper unit of the White Chalk, comprising of firm to soft non-nodular Chalk with flint beds. Thin marl seams are found in the lower 8m and absent higher up. A hard ground marks the top of the Seaford Chalk. It is underlain by the Lewes Nodular Chalk and New Pit Chalk Formations. The total thickness of the Seaford Chalk was not proven through the available ground investigation.

K.1.19 In terms of geological structure, it is noted that there is a series of N-S and SSW-NNE trending faults are identified between Battersea and Chelsea bridges – referred to as the Chelsea Embankment (Albert Bridge) Fault Zone - intersecting the tunnel alignment at near to the perpendicular. It is reported that there is up to 5m vertical displacement of strata over this zone (Royse, 2008)[4], resulting in uplift of the top of the Lambeth Group deposits into the proposed tunnel invert on the east side of Albert Bridge and tunnel construction at Chelsea Embankment. The Abbey Mills Pumping Station site is to the east of this fault zone, however, there may be minor faulting and fractures local to the site, together with localised displacement. Faults may also enhance or impede groundwater movement.

K.2 Hydrogeology

K.2.3 A summary of the anticipated hydrogeological conditions at the Abbey Mills Pumping Station site is shown in Vol 25 Table K.3.

Vol 25 Table K.3 Groundwater – anticipated hydrogeological units

Group	Formation		Hydrogeology
Superficial deposits	(Made Ground) Alluvium		Hydraulic continuity with upper aquifer
	River Terrace Deposits		Upper aquifer
Thames	London Clay		Aquiclude*
	Harwich		Aquitard** / Aquifer
Lambeth	Upper Shelly Beds Upper Mottled Beds Laminated Beds Lower Shelly Beds Lower Mottled Beds		Aquitards/ Aquifers
	Upnor		Lower aquifer
No Group	Thanet Sand		
White Chalk	White	Undivided mainly	

Group	Formation		Hydrogeology
Sub group	Chalk	Seaford Chalk	

** Aquiclude - a hydrogeological unit which, although porous and capable of storing water, does not transmit it at rates sufficient to furnish an appreciable supply for a well or spring (USGS, 1989)*[5].
*** Aquitard - a poorly-permeable geological formation that does not yield water freely, but may still transmit significant quantities of water to or from adjacent aquifers (EA, 2012)*[6].

K.2.4 The Made Ground and Alluvium overlie the River Terrace Deposits or upper aquifer and are likely to be in hydraulic continuity with the upper aquifer.

K.2.5 The upper aquifer (River Terrace Deposits) is defined by the Environment Agency (EA) as a secondary A aquifer. These deposits are described as "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers" (EA, 2012)[7].

K.2.6 The lower aquifer comprises the Upnor and the Thanet Sand formations (both classified as secondary aquifers by the EA), and the Seaford Chalk (classified as a principal aquifer by the EA). A principal aquifer is described by the EA as "layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer".

K.2.7 The main tunnel shaft would pass through the upper aquifer and then the London Clay Formation. The London Clay Formation is generally acknowledged as an aquiclude between the upper and lower aquifers. Any groundwater present in a majority of the London Clay Formation is likely to consist of localised seepages and/or minor flows. It is anticipated that below the River Terrace Deposits the shaft would be excavated in predominantly dry London Clay Formation with the exception of minor seepage at various horizons, namely silt or claystone horizons. In unit A3ii, the presence of fine sand laminea/lenses at this horizon, may act as horizontal conduits for migration of groundwater from a nearby source.

K.2.8 The main tunnel shaft would then pass through the Harwich Formation, which may form a minor aquifer unit where it is isolated from the lower aquifer (Chalk / Thanet Sands) by the Lambeth Group. There may be limited connection via erosive features to the lower aquifer.

K.2.9 The main tunnel shaft would also pass through the Lambeth Group, in which several confined groundwater layers are anticipated to be encountered. Groundwater inflows are expected during excavation within the Upper Shelly Beds (USB) with potentially small inflows and more significantly at sub-artesian pressures within the Laminated Beds (formerly part of the Woolwich Formation).

K.2.10 The main tunnel shaft would finally pass through the Upnor Formation, the Thanet Sand and into the Chalk. These units have been considered to be in hydraulic continuity with each other.

K.2.11 The hydrogeological properties of the Chalk (principal aquifer) are defined by its transmissivity [the ability of rock to transmit water and is a function of its permeability and aquifer thickness] and storativity [the amount of water which the aquifer releases per unit change in water level]. The Chalk in the area around Abbey Mills Pumping Station is expected to have a high transmissivity value of between 700m^2/d and 1200m^2/d (average of 1000m^2/d). The storativity value is expected to be approximately 1 x10^{-4} (EA and ESI, 2011)[8].

K.2.12 The type of White Chalk present in the face of tunnel excavation is anticipated to be Seaford Chalk, and either Cuckmere Member and Belle Tout Member. The Seaford Chalk forms a highly transmissive aquifer, with rapid preferential flow commonly established along fissures and enhanced fractures, often along or above flint and marl layers within the Chalk. Transmissivity and groundwater storage therefore vary considerably both laterally and vertically.

K.3 Groundwater level monitoring

K.3.3 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 observation monitoring boreholes, mainly within the lower aquifer, across London which records are available dating back over 50 years.

K.3.4 Information on groundwater levels for this assessment was collected from two ground investigation boreholes located up to 115m from the Abbey Mills shaft site (SR3001(33m) and SR3002 (115m)). These boreholes have response zones[i] and monitor groundwater levels in the Seaford Chalk. The response zone depths and the frequency of monitoring are detailed in Vol 25 Table K.4. The manual dip and logger data collected from these monitoring boreholes is shown in Vol 25 Table K.5.

Vol 25 Table K.4 Groundwater – monitoring boreholes

Borehole	Response zone depths mATD	Strata	Monitoring
SR3001	41.105 (tip)	Seaford Chalk	Fortnightly dips
SR3002	30.511 (tip)	Seaford Chalk	Fortnightly dips and historic logger data
TQ38/446	Not known	Chalk	Monthly dips

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

Vol 25 Table K.5 Groundwater – summary level data

Borehole	Period of record	Maximum Month Year		Minimum Month Year		Average	
		mbgl	mATD	mbgl	mATD	mbgl	mATD
SR3001	09/04/2009 - 06/06/2011	23.39 (November 2011)	82.72 (November 2011)	25.02 (May 2009)	81.09 (May 2009)	23.97	82.13
SR3002	09/04/2009 – 28/06/2011	23.04 (June 2011)	82.47 (June 2011)	24.45 (May 2010)	81.06 (May 2010)	23.46	82.05
TQ38/446	18/07/1975 – 25/09/2012	11.61 (November 2001)	90.12 (November 2001)	28.1 (September 1977)	73.68 (September 1977)	20.00	81.73

K.3.5 The water levels (piezometric head[ii]) in the Seaford Chalk are monitored at two locations. The recorded water levels at SR3001 range from 81.09mATD to 82.72mATD and at SR3002 range from 81.06mATD to 82.47mATD. The recorded water levels are very similar and remain above the top of the formation at 61.5mATD, indicating that the Chalk is fully saturated at this location.

K.3.6 The nearest EA groundwater level monitoring borehole with up to date records is TQ38/446 and is located at 860m to the east of the Abbey Mills shaft site. This borehole monitors water levels in the lower aquifer (the Chalk) and the location is shown on Vol 25 Figure 13.4.4 (see separate volume of figures). The manual dip and logger data collected from TQ37/254A only is shown in Vol 25 Table K.5.

K.3.7 A plot of groundwater levels within the Chalk in the vicinity of the Abbey Mills site is shown in Vol 25 Figure 13.4.3 (see separate volume of figures). The Lee Tunnel project monitoring has indicated groundwater levels in the lower aquifer at Abbey Mills Pumping Station have not been affected by activities related to the construction of the Lee Tunnel, where internal dewatering methods have been used. However, there has been a recent decline in water levels observed in the area around Abbey Mills Pumping Station between December 2011 and September 2012, as shown in Vol 25 Figure 13.4.3 (see separate volume of figures).

K.3.8 Monitoring data collected by Crossrail suggests that a groundwater divide has existed between the Connaught Tunnel site (approximately 2,5km away to the southeast) and the Lee Tunnel (Eastern alignment) by dewatering at the Crossrail construction sites since December 2011. The generally north-northwest hydraulic gradient has been interrupted by the appearance of the groundwater divide located approximately 600m to the south of Abbey Mills Pumping Station. However, groundwater movement

[ii] Piezometric head – the level or pressure head to which confined groundwater would rise to in a piezometer if it is open to the atmosphere.

in the lower aquifer at the Abbey Mills Pumping Station site remains generally to the north-northwest. This compares with the published EA regional groundwater contour plots produced in January 2011, which shows the groundwater flowing in a west-northwest direction across site (EA, 2011)[9].

K.3.9 A number of site investigations (SI) have been undertaken at Abbey Mills Pumping Station in different parts of the site. The nearest SI boreholes to the proposed shaft site were drilled in August and September 1975. The groundwater levels recorded in the River Terrace Deposits are at around 6,7m below the surface (between 105.5 and 105.8 mATD). The general direction of groundwater level from three boreholes (156/101, 156/102 and 156/103) is from north northeast to south southwest. A further investigation undertaken in 2008, at a distance of 200m to the northeast of the shaft site, where groundwater levels were <1m below the surface (between 102.8 and 104 mATD). The general direction of groundwater flow in this area (borehole 101A and 807) was from northeast to southwest. These directions are both broadly in-line with slope of land surface which is down towards the channels (tributaries of the River Lee) which run long the western and southern boundaries of the Abbey Mills Pumping Station site.

K.4 Groundwater abstractions and protected rights

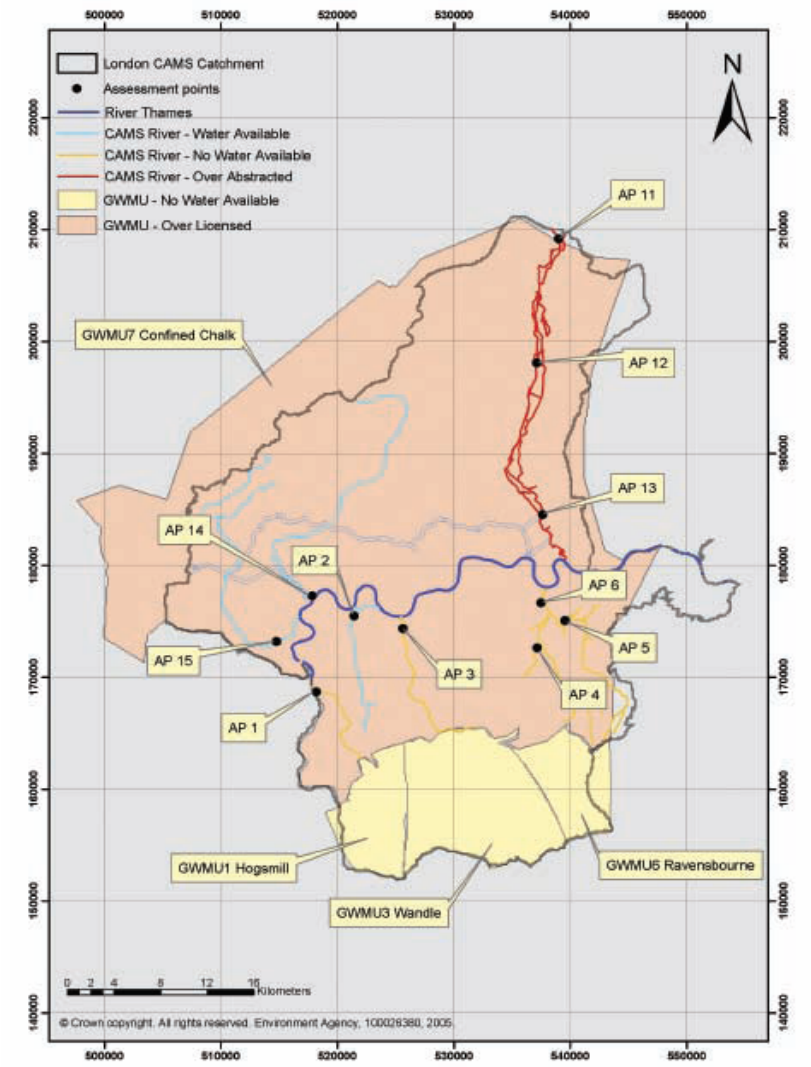
Groundwater licensing policy

K.4.3 The London Catchment Abstraction Management Strategy (CAMS), (EA, 2006)[10] does not identify a condition status for the upper aquifer.

K.4.4 The EA identifies a condition status for the lower aquifer and defines a policy through its London CAMS, which restricts new abstractions in central, east and south London and further abstraction in areas approaching their sustainable limit (EA, 2006)[11]. The Abbey Mills site is located within the confined Chalk groundwater management unit GWM7, which is classified as being over-licensed (see Vol 25 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).

K.4.5 The estimated dewatering volumes required at Abbey Mills Pumping Station from the lower aquifer of less than 200m^3/d and 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.

Vol 25 Plate K.1 Groundwater – confined chalk licensing



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

Licensed abstractions

K.4.6 The EA licenses abstraction from groundwater within London for all sources in excess of 20m^3/d. Groundwater abstractions within 1km of the site have been identified.

K.4.7 There are no licensed groundwater abstractions from the River Terrace Deposits or upper aquifer located within 1km of the Abbey Mills Pumping Station site; however, there are two licensed groundwater abstractions from the Chalk or lower aquifer.

K.4.8 The licensed abstraction (29/38/09/0149) consists of two abstraction points, which are located within a kilometre to the east of the Abbey Mills site. The licence is held by the Abbey Mills Riverine Centre and is used for non-evaporative cooling purposes.

K.4.9 A second licensed abstraction (28/39/9/113) from the lower aquifer (Chalk) is located <1km to the north of the main tunnel shaft site. The use of this

licence is for drinking water supply purposes and the source is operated by Thames Water Utilities Ltd.

K.4.10 The details of the licensed abstraction are summarised in Vol 25 Table K.6.

Vol 25 Table K.6 Groundwater – licensed abstraction

Licence number	Licence holder	Purpose	Aquifer
29/38/09/0149	Abbey Mills Riverine Centre)	Industrial, commercial and public service and non-evaporative cooling	Chalk
28/39/9/113	Thames Water Utilities Ltd	Drinking water supply	Chalk

K.4.11 There are no known unlicensed groundwater abstractions within 1km of the Abbey Mills site.

K.5 Groundwater source protection zones

K.5.3 The EA defines Source Protection Zones (SPZ) around all major public water supply abstractions sources and large licensed private abstractions in order to safeguard groundwater resources from potentially polluting activities.

K.5.4 The Abbey Mills site is not within any modelled SPZ's. The nearest SPZ for a Chalk source lies approximately 0.6km to the north of the site.

K.6 Environmental designations

K.6.3 There are no environmental designations relevant to groundwater such as SSSI, SAC and SNCIs within 1km of the Abbey Mills site.

K.7 Groundwater quality and land quality assessment

K.7.3 The historical land use mapping at Abbey Mills, reviewed as part of the land quality assessment, identified evidence of fuel tanks on site c1893-c1970 (Vol 25 Section 8). The mapping also identified one notification of an installation that involves hazardous substances within a 250m radius of the site. This is on the site of the gas works to the northeast at 130m from the Abbey Mills Pumping Station site. There is also one historical landfill site immediately adjacent to the gas works. Land quality may impact on groundwater quality through the creation or promotion of preferential pathways for existing contamination during construction of the proposed development. Further details are provided in the land quality assessment (see Vol 25 Appendix F).

K.7.4 The groundwater quality data presented in Vol 25 Table K.7 has been sourced from the ground investigation and monitoring works undertaken

as part of the Thames Tideway Tunnel project and includes data from monitoring boreholes located at SR3001 33m, SR3002 115m and SR3003 457m (for locations see Vol 25 Figure 13.4.1 in separate volume of figures) and all within the Chalk. Any exceedances of the UK drinking water standards (*The Water Supply Regulations, 2000*)[12] or relevant Environmental Quality Standards (EQS) (*River Basin Districts Typology* ..., 2010)[13] are shaded in blue in this table.

K.7.5 The data shows exceedances of the relevant standards within the Chalk with respect to ammonium and arsenic at SR3003 and with respect to polycyclic aromatic hydrocarbons (PAH's) at SR3002. PAH's may be formed during a range of human activities, including incomplete combustion of carbon-based fuels and other industrial processes (EA, 2010)[14]. In addition, PAH's are considered to be Priority Hazardous Substances under the Water Framework Directive (Commission of the EU Communities, 2009)[15].

K.7.6 The land quality data from the ground investigation boreholes used in the groundwater quality assessment show exceedances of the human health screening values (EA, 2009)[16] (soil guideline values designed to be protective of human health) within the Made Ground, Alluvium, London Clay Formation and Upper Shelly Beds with respect to ammonia, hydrocarbons, PAH's and heavy metals. Further detail is provided in the land quality assessment (see Vol 25 Appendix F).

K.7.7 The EA monitors groundwater quality at a number of points across London. The nearest EA monitoring is PGWU1827 at Mile End Park in Tower Hamlets. The distance of this location from the site (approximately 2.3km to the southwest) makes it difficult to extrapolate the quality observed at the EA monitoring location.

K.7.8 The Lee Tunnel project monitoring has indicated a number of exceedances of screening 'alert levels' between July 2011 and July 2012 at Abbey Mills Pumping Station[17]. The majority of exceedances which occurred were observed to peak in one or two rounds of sampling and have subsequently fallen below 'alert levels' in subsequent monitoring rounds. Following the detection of total petroleum hydrocarbons (TPH) in the River Terrace Deposits and Harwich Formation which is unrelated to construction of the Lee Tunnel project. Groundwater in the Chalk close to Abbey Mills Pumping Station has continually exceeded alert levels in both major ions and metals.

Vol 25 Table K.7 Groundwater – groundwater quality results

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
1,1 - Dichloroethane	10	ug/l	WFD 2010	-	-	-
1,1 - Dichloroethene	30	ug/l	WHO 2004	-	-	-
1,1,1 - Trichloroethane	100	ug/l	SW Regs 98	-	-	-
1,1,2 - Trichloroethane	400	ug/l	SW Regs 98	-	-	-
1,2 - Dichlorobenzene	1000	ug/l	WHO 2004	-	-	<10
1,2 - Dichloroethane {Ethylene Dichloride}	3	ug/l	WS Regs 20	-	-	-
1,2 - Dichloroethene (Trans)	30	ug/l	WHO 2004	-	-	-
1,2,4 - Trichlorobenzene	-	ug/l	-	-	-	<10
1,2,4 - Trimethylbenzene	-	ug/l	-	-	<1.7	<5
1,3 - Dichlorobenzene	-	ug/l	-	-	-	<15
1,3,5 - Trimethylbenzene	-	ug/l	-	-	<1.8	<5
2 - Chloronaphthalene	-	ug/l	-	-	-	<20
2 - Chlorophenol	50	ug/l	WFD 2010	-	-	<20
2 - Methylnaphthalene	-	ug/l	-	-	-	<50
2 - Methylphenol {O-Cresol}	-	ug/l	-	-	-	<20
2 - Nitroaniline	-	ug/l	-	-	-	<50
2 - Nitrophenol	-	ug/l	-	-	-	<20
2,3 - Dimethylphenol {2,3-Xylenol}	-	ug/l	-	-	-	-
2,3,4,6 - Tetrachlorophenol	-	ug/l	-	-	-	<30
2,3,5,6 - Tetrachloroaminobenzene {2,...Aniline}	-	ug/l	-	-	-	-
2,3,6 - TBA {2,3,6-Trichlorobenzoic Acid}{Cas Rn 50-31-7}	-	ug/l	-	-	-	-
2,4 - Dichlorophenol	20	ug/l	WFD 2010	-	-	<20
2,4 - Dimethylphenol {2,4-Xylenol}	-	ug/l	-	-	-	<20
2,4 - Dinitrotoluene	-	ug/l	-	-	-	<20
2,4,5 - Trichlorophenol	-	ug/l	-	-	-	<20
2,4,6 - Trichlorophenol	-	ug/l	-	-	-	<20
2,4-D {2,4-Dichlorophenoxyacetic acid}	0.1	ug/l	DWS 2010	-	-	-

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
2,4-DB {4-(2,4-dichlorophenoxy)butyric acid}	0.1	ug/l	DWS 2010	-	-	-
2,6 - Dichlorophenol	-	ug/l	-	-	-	<20
2,6 - Dimethylphenol {2,6 Xylenol}	-	ug/l	-	-	-	-
2,6 - Dinitrotoluene	-	ug/l	-	-	-	<30
3 - Chlorophenol	-	ug/l	-	-	-	-
3 - Methylphenol {M-Cresol}	-	ug/l	-	-	-	-
3 - Nitroaniline	-	ug/l	-	-	-	<50
3,4 - Dimethylphenol {3,4 Xylenol}	-	ug/l	-	-	-	-
3,5 - Dimethylphenol {3,5-Xylenol}	-	ug/l	-	-	-	-
4 - Chloro - 3- Methylphenol {P-Chloro-M-Cresol}	40	ug/l	WFD 2010	-	-	<20
4 - Chloroaniline	-	ug/l	-	-	-	<50
4 - Chlorophenol	-	ug/l	-	-	-	-
4 - Chlorophenyl phenyl ether	-	ug/l	-	-	-	<15
4 - Chlorotoluene	-	ug/l	-	-	<1.9	-
4 - Nitroaniline	-	ug/l	-	-	-	<50
4 - Nitrophenol	-	ug/l	-	-	-	<50
4-Methylphenol {para-Cresol}	-	ug/l	-	-	-	<20
Acenaphthene	-	ug/l	-	<0.015	<0.015	<0.09
Acenaphthylene	-	ug/l	-	<0.011	<0.011	<0.09
Acenapthene	-	ug/l	-	-	-	-
Acenapthylene	-	ug/l	-	-	-	-
Aldicarb	0.1	ug/l	DWS 2010	-	-	-
Aldicarb Sulphone	-	ug/l	-	-	-	-
Aldrin	0.03	ug/l	DWS 2010	-	-	-
Aliphatics >C10-C12	-	ug/l	-	<10	<10	<10
Aliphatics >C12-C16 (Aqueous)	-	ug/l	-	<10	<10	<10
Aliphatics >C16-C21 (Aqueous)	-	ug/l	-	<10	<10	<10
Aliphatics >C21-C35 (Aqueous)	-	ug/l	-	<10	<10	<10
Aliphatics >C6-C8	-	ug/l	-	<10	<10	<10

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
Aliphatics >C8-C10	-	ug/l	-	<10	<10	<10
Aliphatics C5-C6	-	ug/l	-	<10	<10	<10
Alkalinity (Carbonate)	-	mg/l as CaCO3	-	-	-	-
Alkalinity Ph 4.5 - As CaCO3	-	mg/l as CaCO3	-	-	-	-
Aluminium Dissolved	200	ug/l as Al	DWS 2010	-	-	-
Aluminium Total	200	ug/l as Al	DWS 2010	-	-	-
Ammonia - As N	0.39	mg/l as N	WS Regs 20	-	-	-
Ammoniacal nitrogen	-	mg/l	-	0.226	0.318	6.7
Ammonium as NH4	0.5	mg/l as NH4	WS Regs 20	-	-	8.6
Aniline	-	ug/l	-	-	-	<40
Anions	-	meq/l	-	-	-	-
Anthracene	0.1	ug/l	SW WFD	<0.015	0.0827	<0.01
Anthraquinone	-	ug/l	-	-	-	<30
Antimony Total	5	ug/l	DWS 2010	-	-	-
Aromatics >C7-C8	50	ug/l	WFD 2010	<10	<10	<10
Aromatics >EC10-EC12	-	ug/l	-	<10	<10	<10
Aromatics >EC12-EC16 (Aqueous)	-	ug/l	-	<10	<10	<10
Aromatics >EC16-EC21 (Aqueous)	-	ug/l	-	<10	<10	<10
Aromatics >EC21-EC35 (Aqueous)	-	ug/l	-	<10	<10	<10
Aromatics >EC8-EC10	-	ug/l	-	<10	<10	<10
Aromatics C6-C7	1	ug/l	DWS 2010	<10	<10	<10
Arsenic Total	10	ug/l as As	DWS 2010	1.07	1.5	37
Asulam	-	ug/l	-	-	-	-
Atrazine { }	0.1	ug/l	DWS 2010	-	-	-
Atrazine Desethyl {De-Ethyl Atrazine}	-	ug/l	-	-	-	-
Atrazine Desisopropyl	-	ug/l	-	-	-	-

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
Azinphos-Ethyl	-	ug/l	-	-	-	-
Azinphos-Methyl	0.1	ug/l	DWS 2010	-	-	-
Azobenzene	-	ug/l	-	-	-	<30
Barium Dissolved	100	ug/l as Ba	SW Regs 96	-	-	-
Barium Total	100	ug/l as Ba	SW Regs 96	-	-	-
Benazolin	-	ug/l	-	-	-	-
Bendiocarb	-	ug/l	-	-	-	-
Bentazone	0.1	ug/l	DWS 2010	-	-	-
Benz[a]-Anthracene	-	ug/l	-	-	-	-
Benzene	1	ug/l	DWS 2010	<10	<10	<5
Benzene (1,2,3 Trichlorobenzene)	-	ug/l	-	-	-	-
Benzene (1,2,4 Trichlorobenzene)	-	ug/l	-	-	-	-
Benzene (1,3,5 Trichlorobenzene)	-	ug/l	-	-	-	-
Benzene (Ethylbenzene)	20	ug/l	FW List II	-	-	-
Benzo (a) anthracene	-	ug/l	-	<0.009	<0.009	<0.09
Benzo[a]Pyrene	0.01	ug/l	DWS 2010	<0.009	<0.009	<0.09
Benzo[b]Fluoranthene	0.03	ug/l	WFD D 10	<0.023	<0.023	<0.09
Benzo[g,h,i]Perylene	0.002	ug/l	WFD D 10	<0.016	<0.016	<0.09
Benzo[k]Fluoranthene	0.03	ug/l	WFD D 10	<0.027	<0.027	<0.09
Beryllium Total	0	ug/l as Be	GW Regs 98	-	-	-
Bifenthrin	-	ug/l	-	-	-	-
Biphenyl	25	ug/l	WFD 2010	-	-	<40
Bis (2 - chloroethoxy) methane	-	ug/l	-	-	-	<15
Bis (2 - chloroethyl) ether	-	ug/l	-	-	-	<15
Bis(2-chloroisopropyl)ether	-	ug/l	-	-	-	<10
Bis(2-ethylhexyl) phthalate	1.3	ug/l	WFD 2010	-	-	<50
Boron Dissolved	1000	ug/l as B	DWS 2010	-	-	-
Boron Total	1000	ug/l as B	DWS 2010	56.4	98.9	630
Bromate	10	ug/l as BrO3	DWS 2010	-	-	-

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
Bromide ion	2	ug/l as Br	FW List II	-	-	-
Bromo phenyl phenyl ether	-	ug/l	-	-	-	<30
Bromodichloromethane	100	ug/l	WS Regs 20	-	-	-
Bromoform	100	ug/l	WS Regs 20	-	-	-
Bromoxynil	0.1	ug/l	DWS 2010	-	-	-
Bupirimate	-	ug/l	-	-	-	-
Butyl benzyl phthalate	-	ug/l	-	-	-	<60
Cadmium Dissolved	5	ug/l as Cd	DWS 2010	-	-	-
Cadmium Total	5	ug/l as Cd	DWS 2010	<0.22	<0.22	<1
Calcium Dissolved	250	mg/l as Ca	DWS 2010	-	-	-
Calcium Total	250	mg/l as Ca	DWS 2010	-	-	-
Carbaryl	-	ug/l	-	-	-	-
Carbazole	-	ug/l	-	-	-	<50
Carbendazim / Benomyl	0.1	ug/l	FW List II	-	-	-
Carbetamide	-	ug/l	-	-	-	-
Carbofuran	0.1	ug/l	DWS 2010	-	-	-
Carbon Dioxide	-	ug/l	-	-	-	-
Carbon Organic Dissolved	-	mg/l as C	-	-	-	-
Carbon tetrachloride	3	ug/l	DWS 2010	-	-	-
Carbophenothion	-	ug/l	-	-	-	-
Cations	-	meq/l	-	-	-	-
Chlordane (cis)	0.1	ug/l	DWS 2010	-	-	-
Chlordane Trans	0.1	ug/l	DWS 2010	-	-	-
Chlorfenvinphos	0.1	ug/l	DWS 2010	-	-	-
Chloridazon	-	ug/l	-	-	-	-
Chloride	250	mg/l as Cl	DWS 2010	-	-	-
Chlormequat	-	ug/l	-	-	-	-
Chlorodibromomethane	-	ug/l	-	-	-	-
Chloroform	100	ug/l	WS Regs 20	-	-	-

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
Chloroxuron	-	ug/l	-	-	-	-
Chlorpropham	-	ug/l	-	-	-	-
Chlorpyrifos	0.03	ug/l	WFD 2010	-	-	-
Chlorpyriphos-Methyl	-	ug/l	-	-	-	-
Chlorthalonil	-	ug/l	-	-	-	-
Chlortoluron	2	ug/l	FW List II	-	-	-
Chromium Dissolved	50	ug/l as Cr	DWS 2010	-	-	-
Chromium Total	50	ug/l as Cr	DWS 2010	3.84	<0.7	10
Chrysene	-	ug/l	-	<0.013	<0.013	<0.09
cis-1-2-Dichloroethene	-	ug/l	-	-	-	-
Clopyralid	-	ug/l	-	-	-	-
Cobalt - As Co	0	ug/l	GW Regs 98	-	-	-
Conductivity @ 20°C	2500	uS/cm	WS Regs 20	999	-	1420
Copper Dissolved	2000	ug/l as Cu	DWS 2010	-	-	-
Copper Total	2000	ug/l as Cu	DWS 2010	3.18	<1.6	<5
Coumaphos	0.1	ug/l	DWS 2010	-	-	-
Cyanazine	0.1	ug/l	DWS 2010	-	-	-
Cyanide (Free)	50	ug/l as CN	DWS 2010	<50	<50	<20
Cyanide (Total)	50	ug/l as CN	DWS 2010	-	-	-
Cyfluthrin	0.1	ug/l	DWS 2010	-	-	-
Cypermethrin	0.0001	ug/l	WFD 2010	-	-	-
Cypermethrin ID	-	Code	-	-	-	-
Dalapon	-	ug/l	-	-	-	-
DDD (OP)	0.1	ug/l	DWS 2010	-	-	-
DDD (PP)	0.1	ug/l	DWS 2010	-	-	-
DDE (OP)	0.1	ug/l	DWS 2010	-	-	-
DDE (PP)	0.1	ug/l	DWS 2010	-	-	-
DDT (OP)	0.1	ug/l	DWS 2010	-	-	-
DDT (PP)	0.1	ug/l	DWS 2010	-	-	-

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
Deltamethrin	-	ug/l	-	-	-	-
Diazinon	0.1	ug/l	DWS 2010	-	-	-
Dibenz-[A,H]-Anthracene	-	ug/l	-	<0.016	<0.016	<0.09
Dibenzofuran	-	ug/l	-	-	-	<50
Dicamba {3,6-Dichloro(O-Methoxybenzoic Acid)}	-	ug/l	-	-	-	-
Dichlobenil	-	ug/l	-	-	-	-
Dichlor(2,4+2,5)phenols	-	ug/l	-	-	-	-
Dichloromethane	20	ug/l	WFD 2010	-	-	-
Dichlorprop	0.1	ug/l	DWS 2010	-	-	-
Dichlorvos	0.1	ug/l	DWS 2010	-	-	-
Dieldrin	0.03	ug/l	DWS 2010	-	-	-
Diethyl phthalate	-	ug/l	-	-	-	<30
Diflurobenzuron	-	ug/l	-	-	-	-
Dimethoate	-	ug/l	-	-	-	-
Dimethyl phthalate	-	ug/l	-	-	-	<20
Di-n-butyl phthalate	-	ug/l	-	-	-	<30
Diuron	0.1	ug/l	DWS 2010	-	-	-
Endosulphan Alpha	0.1	ug/l	DWS 2010	-	-	-
Endosulphan Beta	0.1	ug/l	DWS 2010	-	-	-
Endrin	0.1	ug/l	DWS 2010	-	-	-
Enterococci (Species)	-	Nr/100ml	-	-	-	-
Escherichia coli (Confirmed)	0	Nr/100ml	WS Regs 20	-	-	-
Ethiofencarb	-	ug/l	-	-	-	-
Ethion	-	ug/l	-	-	-	-
Ethofumesate	-	ug/l	-	-	-	-
Ethyl Tertiary Butyl Ether (ETBE)	-	ug/l	-	-	-	-
Ethylbenzene	-	ug/l	-	<10	<10	<5
Fenchlorphos {Ronnel.}	0.1	ug/l	DWS 2010	-	-	-
Fenitrothion	0.1	ug/l	DWS 2010	-	-	-

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
Fenoprop	0.1	ug/l	DWS 2010	-	-	-
Fenpropimorph	-	ug/l	-	-	-	-
Fenthion	-	ug/l	-	-	-	-
Fenuron	-	ug/l	-	-	-	-
Flumethrin	-	ug/l	-	-	-	-
Fluoranthene	0.2	ug/l	EEC MAC	<0.014	0.0171	<0.09
Fluorene	-	ug/l	-	<0.014	<0.014	<0.09
Fluoride	1.5	mg/l as F	DWS 2010	-	-	-
Fluroxypyr	-	ug/l	-	-	-	-
Flutriafol	-	ug/l	-	-	-	-
Fonofos	-	ug/l	-	-	-	-
Glyphosate	-	ug/l	-	-	-	-
GRO C4-C12	-	ug/l	-	<10	<10	-
Hardness Total - As CaCO3	-	mg/l as CaCO3	-	-	-	-
Heptachlor	0.03	ug/l	DWS 2010	-	-	-
Hexachloro 1,3 Butadiene	0.1	ug/l	WFD 2010	-	-	<10
Hexachlorobenzene	0.01	ug/l	WFD 2010	-	-	<20
Hexachlorocyclohexane (alpha)	0.1	ug/l	DWS 2010	-	-	-
Hexachlorocyclohexane (beta)	0.1	ug/l	DWS 2010	-	-	-
Hexachlorocyclohexane (delta)	0.1	ug/l	DWS 2010	-	-	-
Hexachlorocyclohexane (gamma)	0.1	ug/l	DWS 2010	-	-	-
Hexachlorocyclopentadiene	-	ug/l	-	-	-	<50
Hexachloroethane	-	ug/l	-	-	-	<40
Indeno-[1,2,3-Cd]-Pyrene	0.002	ug/l	WFD D 10	<0.014	<0.014	<0.09
Iodide Ion	-	ug/l as I	-	-	-	-
Iodofenphos	-	ug/l	-	-	-	-
Ionic Balance (Anions/Cations)	-	%	-	-	-	-
Ioxynil	0.1	ug/l	DWS 2010	-	-	-

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
Iprodione	-	ug/l	-	-	-	-
Irgarol 1051	-	ug/l	-	-	-	-
Iron Dissolved	200	ug/l as Fe	DWS 2010	-	-	-
Iron Total	200	ug/l as Fe	DWS 2010	-	-	-
Isodrin	0.1	ug/l	DWS 2010	-	-	-
Isophorone	-	ug/l	-	-	-	<20
Isoproturon (Diip1,3Dithiolan-2-Ylidenemalonate)	0.1	ug/l	DWS 2010	-	-	-
Lambda Cyhalothrin	-	ug/l	-	-	-	-
Lead Dissolved	10	ug/l	WS Regs 20	-	-	-
Lead Total	10	ug/l	WS Regs 20	<0.4	<0.4	<5
Linuron	0.1	ug/l	DWS 2010	-	-	-
Lithium Dissolved	-	ug/l as Li	-	-	-	-
Lithium Total	-	ug/l as Li	-	-	-	-
Magnesium Dissolved	50	mg/l as Mg	EEC MAC	-	-	-
Magnesium Total	50	mg/l as Mg	EEC MAC	-	-	-
Malathion	0.1	ug/l	DWS 2010	-	-	-
Manganese Dissolved	50	ug/l as Mn	DWS 2010	-	-	-
Manganese Total	50	ug/l as Mn	DWS 2010	-	-	-
MCPA {2-methyl-4-chlorophenoxyacetic acid }	0.1	ug/l	DWS 2010	-	-	-
MCPB	10	ug/l	WHO 2004	-	-	-
Mecoprop { }	0.1	ug/l	DWS 2010	-	-	-
Mercury Total	1	ug/l Hg	WS Regs 20	<0.01	<0.01	<0.05
Metalaxyl	-	ug/l	-	-	-	-
Metazachlor	-	ug/l	-	-	-	-
Methabenzthiazuron	-	ug/l	-	-	-	-
Methane	-	ug/l	-	-	-	-
Methiocarb	-	ug/l	-	-	-	-
Methomyl	-	ug/l	-	-	-	-
Methoxychlor	0.1	ug/l	DWS 2010	-	-	-

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
Metoxuron	-	ug/l	-	-	-	-
Metsulfuron - Methyl	-	ug/l	-	-	-	-
Mevinphos	0.1	ug/l	DWS 2010	-	-	-
Molybdenum Total	0	ug/l	GW Regs 98	-	-	-
Monolinuron	-	ug/l	-	-	-	-
Monuron	-	ug/l	-	-	-	-
MTBE {Methyl Tert-Butyl Ether}	-	ug/l	-	<10	<10	<5
Multi Residual Scan	-	ug/l	-	-	-	-
Naphthalene	1.2	ug/l	WFD D 10	<0.1	<0.1	<0.09
Napropamide	-	ug/l	-	-	-	-
Neburon	-	ug/l	-	-	-	-
Nickel Total	20	ug/l as Ni	DWS 2010	4.91	4.71	<5
Nitrate - N	11.3	mg/l as N	WS Regs 20	<0.0677	<0.0677	<0.5
Nitrite - N	0.03	mg/l as N	WS Regs 20	-	-	-
Nitrobenzene	-	ug/l	-	-	-	<20
Nitrogen Total Oxidised	11.3	mg/l as N	WS Regs 20	-	-	-
N-nitrosodi-n-propylamine	-	ug/l	-	-	-	<15
Orthophosphate	-	mg/l as P	-	-	-	-
Oxamyl	-	ug/l	-	-	-	-
o-Xylene	-	ug/l	-	<10	<10	<5
PAH 16 Total	0.1	ug/l	DWS 2010	<0.1	0.12	0
PAHs Total	0.1	ug/l	DWS 2010	-	-	-
Parathion (Parathion-ethyl)	1	ug/l	SW Regs 96	-	-	-
Parathion (Parathion-methyl)	1	ug/l	SW Regs 96	-	-	-
PCB Congener 028	0.1	ug/l	DWS 2010	-	-	-
PCB Congener 052	0.1	ug/l	DWS 2010	-	-	-
PCB Congener 101	0.1	ug/l	DWS 2010	-	-	-
PCB Congener 105	0.1	ug/l	DWS 2010	-	-	-
PCB Congener 118	0.1	ug/l	DWS 2010	-	-	-

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
PCB Congener 138	0.1	ug/l	DWS 2010	-	-	-
PCB Congener 153	0.1	ug/l	DWS 2010	-	-	-
PCB Congener 156	0.1	ug/l	DWS 2010	-	-	-
PCB Congener 180	0.1	ug/l	DWS 2010	-	-	-
Pendimethalin	0.1	ug/l	DWS 2010	-	-	-
Permethrin (Cis + Trans)	0.01	ug/l	WFD D 10	-	-	-
pH	10	pH units	DWS 2010	8.07	8.07	7.5
Phenanthrene	-	ug/l	-	<0.022	<0.022	<0.1
Phenol	0.5	ug/l	EEC MAC	<2	<2	<10
Phenol (Pentachlorophenol (PCP))	-	ug/l	-	-	-	-
Phenols Total For SWAD (7 Compounds)	-	ug/l	-	-	-	-
Pichloram	-	ug/l	-	-	-	-
Pirimephos (Pirimephos-methyl)	-	ug/l	-	-	-	-
Pirimicarb	1	ug/l	FW List II	-	-	-
Potassium Dissolved	-	mg/l as K	-	-	-	-
Potassium Total	-	mg/l as K	-	-	-	-
Prochloraz	4	ug/l	FW List II	-	-	-
Promethryn	-	ug/l	-	-	-	-
Propachlor	-	ug/l	-	-	-	-
Propazine	0.1	ug/l	DWS 2010	-	-	-
Propetamphos	0.1	ug/l	DWS 2010	-	-	-
Propoxur	-	ug/l	-	-	-	-
Propyzamide	-	ug/l	-	-	-	-
Pyrene	-	ug/l	-	<0.015	0.0293	<0.1
Qualitative Scan (Volatiles By GCMS) NP	-	Text	-	-	-	-
Selenium	10	ug/l as Se	DWS 2010	1.15	1.08	10
Silicate Reactive Dissolved - As SiO2	-	mg/l	-	-	-	-
Silver Total	0	ug/l	GW Regs 98	-	-	-
Simazine	0.1	ug/l	DWS 2010	-	-	-

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
Sisumxylene	-	ug/l	-	<10	<10	-
Sodium Dissolved	200	mg/l as Na	DWS 2010	-	-	-
Sodium Total	200	mg/l as Na	DWS 2010	-	-	-
Strontium Dissolved	-	ug/l as Sr	-	-	-	-
Strontium Total	-	ug/l as Sr	-	-	-	-
Sulphate	250	mg/l as SO4	DWS 2010	67.6	84.8	150
Sulphide	-	ug/l	-	-	-	-
Sum of BTEX	-	ug/l	-	<10	<10	-
Tecnazene	0.1	ug/l	DWS 2010	-	-	-
Terbutryn	0.1	ug/l	DWS 2010	-	-	-
Tertiary Amyl Methyl Ether (TAME)	-	ug/l	-	-	-	-
Tetrachloroethane	10	ug/l	DWS 2010	-	-	-
Tetrachloroethylene	-	ug/l	-	-	-	-
Tetrachlorothioanisole	-	ug/l	-	-	-	-
Thallium Total	0	ug/l as Tl	GW Regs 98	-	-	-
Tin Total	0	ug/l as Sn	GW Regs 98	-	-	-
Titanium	0	ug/l as Ti	GW Regs 98	-	-	-
Toluene (Methylbenzene)	50	ug/l	WFD 2010	<10	<10	<5
Total Aliphatics & Aromatics >C12-C44 (Aqueous)	-	ug/l	-	<10	<10	-
Total Aliphatics >C12-C35 (Aqueous)	-	ug/l	-	<10	<10	<10
Total Aliphatics C5-C12	-	ug/l	-	<10	<10	-
Total Aliphatics C5-C35	-	ug/l	-	-	-	<10
Total Aromatics >EC12-EC35 (Aqueous)	-	ug/l	-	<10	<10	-
Total Aromatics C5-C35	1	ug/l	DWS 2010	-	-	<10
Total Aromatics C6-C12	1	ug/l	DWS 2010	<10	<10	-
Total Hydrocarbons C5-C35	-	ug/l	-	-	-	<10
Total Monohydric Phenols	-	ug/l	-	-	-	<10
Total Monohydric Phenols (W)	-	ug/l	-	<15	<15	-
Triazophos	0.1	ug/l	DWS 2010	-	-	-

Source of data*				SI	SI	SI
Name				SR3001	SR3002	SR3003
Hydrogeological unit**				CK	CK	CK
Distance from site	**EQS Criteria**			33m	115m	457m
Chemical	**Value**	**Units**	**Source**	2009	2009	2009
Trichloroethene (Trichloroethylene)	10	ug/l	DWS 2010	-	-	-
Trichlorophenoxyacetic Acid (2,4,5)	-	ug/l	-	-	-	-
Triclopyr	-	ug/l	-	-	-	-
Trietazine	-	ug/l	-	-	-	-
Trifluralin	0.1	ug/l	DWS 2010	-	-	-
Turbidity	1	FTU	WS Regs 20	-	-	-
Uranium	0	ug/l as U	GW Regs 98	-	-	-
Vanadium	0	ug/l as V	GW Regs 98	-	-	-
Volatile Hydrocarbons (C5-C12)	-	mg/l	-	-	-	<0.01
Xylene (Meta & Para){1,3+1,4-Dimethylbenzene}	30	ug/l	WFD 2010	<10	<10	<5
Xylene (ortho)	30	ug/l	SW Regs 98	-	-	-
Zinc Dissolved	50	ug/l as Zn	DWS 2010	-	-	-
Zinc Total	50	ug/l as Zn	DWS 2010	5.71	<5	10
Notes:						
xx	GAC1 exceedance					
' - '	Not tested					
' < '	Less than MDL					

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

K.8 Groundwater status

K.8.3 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.8.4 The Thames River Basin Management Plan (RBMP) (EA, 2009)[18] shows that the Lambeth Group, Thanet Sands and Chalk Formation in the area of the Abbey Mills site are designated as the Greenwich Chalk and Tertiaries groundwater body.

K.8.5 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.8.6 The predicted quantitative and chemical quality was poor for 2015 due to treatment or improvement being disproportionately expensive or technically infeasible.

K.8.7 The baseline assessment for groundwater status classification for the nearby Lower Thames Gravels is good quantitative status and poor quality status for 2009. The predicted chemical quality was poor for 2015 due to treatment or improvement being disproportionately expensive or technically infeasible.

K.8.8 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).

K.8.9 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.9.3 A list of data used for the Abbey Mills Pumping Station assessment is given in Vol 25 Table K.8.

Vol 25 Table K.8 Groundwater – desk based baseline data sources

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

Source	Data	Date received	Notes
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 Borough*

References

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

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Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

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Appendix L: Water resources - surface water

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

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Appendix L: Water resources – surface water

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Appendix L: Water resources – surface water

L.1 Introduction

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

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Appendix M: Water resources - flood risk

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Appendix M: Water resources – flood risk

M.1 Policy considerations

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

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

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

Local policy

Strategic Flood Risk Assessment

M.1.4 The site lies within the London Borough (LB) of Newham. The LB of Newham produced a Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA) (Capita Symonds Ltd, 2010)[2], which outline the main flood sources to the borough.

M.1.5 The SFRA confirms that there is no actual risk of tidal flooding in the 0.5% AEP[i] return period event, inclusive of climate change. There is also no actual risk of fluvial flooding during a 1% AEP event, inclusive of climate change.

M.1.6 According to the SFRA:

a. The proposed development site lies within the Environment Agency (EA) Flood Zone 3, which extends across the majority of the wider Abbey Mills site area.

b. The surrounding area is bordered by man-made raised defences.

c. The site is defended against inundation from the River Thames up to the 0.1% AEP tidal event by the Thames Tidal Flood Defences (including the Thames Barrier and the River Thames tidal flood defence walls).

d. The construction of Three Mills Lock and the Prescott Channel excludes the tidal influence of the Thames upstream of these features and may alter flood mechanisms.

e. The site is located outside the 0.1% AEP flood zone of the River Lee.

f. There is a medium risk of groundwater flooding in the SFRA but no records of groundwater flooding.

g. The site is less susceptible to surface water flooding.

[i] A flood with a 0.5% Annual Exceedance Probability (AEP) has a 1 in 200 chance of occurring in any given year.

h. The majority of the Abbey Mills site is within a key development area (Major Opportunity Zone 3) at Three Mills Island.

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

Surface Water Management Plan

M.1.8 The Council, in partnership with the Greater London Authority (GLA), Thames Water and the EA 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.1.9 According to the SWMP:

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

b. Areas of the site have a surface water flood hazard rating for the 1% AEP + 30% climate change rainfall event ranging from caution (very low hazard) to danger for all (extreme). Most of the site is in the very low hazard category.

c. There are 1-5 recorded sewer flooding incidents in the postcode area E15 2.

Regional policy

Thames Estuary 2100

M.1.10 Abbey Mills Pumping Station lies within the Royal Docks Policy Unit which has been assigned flood risk management policy 'P4' within the Thames Estuary 2100 (TE2100) Plan (EA, 20012)[4], meaning that further action will be taken to sustain the current scale of flood risk into the future.

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

a. tidal/fluvial flooding from the River Thames/River Lee

b. surface water (heavy rainfall) and urban drainage sources.

M.1.12 Defence systems currently managing flooding from these sources include:

c. the Thames Tidal Defences and River Lee defences

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

M.1.13 The TE2100 Plan seeks to promote, where possible, defence improvements that are sensitive to ensure views are maintained and impacts to river access/views are minimised, and to improve the appearance of the river frontage and provide environmental enhancement and amenity opportunities by using opportunities provided by future development to modify the layout of flood defences. Where defence raising in the future to manage the consequences of climate change is not possible, secondary defences and floodplain management should be

[ii] Area susceptible to surface water flooding.

introduced. There is also a vision to increase flood risk awareness within the area.

Thames Region Catchment Flood Management Plan

M.1.14 The Thames Region Catchment Flood Management Plan (CFMP) (EA, 2007)[5] covers fluvial and non-tidal sections of the River Thames, ie, fluvial tributaries of the River Thames and the River Thames upstream of Teddington weir.

M.1.15 The Thames Region CFMP advocates the reduction in flood risk through the design and layout of developments within the floodplain; redevelopment should be compatible with its location within the floodplain (ie, flood resilience measures should be incorporated). This should be achieved through re-creating more natural river systems and giving space for flood water, aiming for a balance between attenuation and conveyance.

M.1.16 The specific recommendations for developed flood plain with built defences are: 'At present it is still possible and effective to maintain these flood defences. Climate change will mean that these defences will become less effective in the future. Therefore any redevelopment needs to reduce flood risk in the area benefiting from these flood defences and the natural floodplain needs to be used to accommodate additional floodwater upstream and downstream of these areas.'

London Regional Flood Risk Appraisal

M.1.17 For the reach between Hammersmith Bridge and the Thames Barrier (City reach [does not specify inclusion of River Lee]) the London Regional Flood Risk Appraisal (RFRA) (Greater London Authority, [Oct 2009]) 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.1.18 There is particular concern surrounding confluences of tributaries and the interactions between tidal and fluvial flows in the future due to climate change, such as the River Lee. This should be taken into consideration during the re-development process.

M.1.19 The RFRA indicates that SuDS should be included within developments to reduce surface water discharge.

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Appendix N: Development schedule

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Appendix N: Development schedule

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Appendix N: Development schedule

N.1 Summary

N.1.1 The assessments undertaken for this site take account of other relevant development projects within the vicinity of the site which are under construction, permitted but not yet implemented or submitted but not yet determined. In order to identify the relevant developments for consideration, the Planning Inspectorate, local planning authorities and the Greater London Authority have been consulted on the methodology (see Volume 2) and asked to assist in identifying and verifying the development projects included in the assessment. A schedule is provided in Vol 25 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 25 Table N.1 Development schedule for Abbey Mills 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		2018 (Site Year 1 of construction)	2019 (peak construction traffic year)	2023 (Year 1 of operation)		
The Lee Tunnel & Beckton STW Extension	On site	08/01159/LTGDC (and subsequent amendments)	Thames Water	The Lee Tunnel and Beckton STW extension scheme incorporating the following elements at Abbey Mills PS: works to enable the interception of combined sewer overflows and transfer into the Lee Tunnel including shafts, transfer tunnels, connecting culverts, connection chambers and associated odour control units.	A	100% complete & operational	100% complete & operational	100% complete & operational	Thames Water	Base case (all years)
Land south of Otis Street and Three Mills Lane, east of the A12 and North of the Railway Line	Approx 250m southwest	PA/09/02574	Tesco Stores Ltd.	Hybrid planning application for comprehensive mixed-use redevelopment of the site comprising: Outline Application (all matters reserved, except for access). Demolition of existing buildings and redevelopment of land to provide a new District centre of 23,790 sqm including a superstore and various other units falling within classes of A1,A2,A3,A4,A5,B1,C1 & D1 together with 468 no. car parking spaces.	B	100% complete & operational	100% complete & operational	100% complete & operational	Transport chapter of the Environmental Statement specifies an opening year of 2012. Given construction has not commenced, a delay is expected but anticipated to be complete & operational by Site Year 1 of construction.	Base case (all years)
Site At Bromley by Bow North, Hancock Road	Approx 250m southwest	PA/10/01076	East Thames Group	HYBRID PLANNING APPLICATION FOR MIXED-USE DEVELOPMENT COMPRISING 790 RESIDENTIAL UNITS (C3 USE CLASS), FLEXIBLE OFFICE SPACE (B1 USE CLASS), CAR DEALERSHIP (SUI GENERIS), AND A BAR/RESTAURANT (A3/A4 USE CLASS), ASSOCIATED INFRASTRUCTURE, INCLUDING NEW ACCESS/EGRESS, BASEMENT LEVEL PARKING, PUBLIC OPEN SPACE, LANDSCAPING, AND UPGRADE WORKS TO EXISTING TOWPATH ADJACENT TO RIVER LEA.	B	100% complete & operational	100% complete & operational	100% complete & operational	Market Report (appended to Planning Statement) states that: *'The site which is currently fragmented in ownership is likely to be developed in a number of phases, the first of which is the subject of a detailed planning application for 225 residential units and 11,617 sq ft of flexible office accommodation which is expected to be delivered to the market in 2013.'* It is assumed that the remainder of the outline application will be delivered by Site Year 1 of construction.	Base case (all years)
Strand East, Sugar House Lane	Approx 300m west	12/00336/LTGOUT	Land Prop	Amended Plans and Documents Received. Outline element: All matters reserved except access; demolition of buildings where stated; 1192 residential units (C3) of which 10% of properties wheelchair accessible; 12,593sqm flexible uses including retail (A1), financial	C	Plots MU1, MU3, MU5, R3, R4, R6 & R8 complete and	Plots MU1, MU3, MU4, MU5, R3, R4, R5, R6, R7 & R8 complete and	100% complete & operational	From Environmental Statement (Section 2.5): Construction will last about nine years, from 2013 to 2022 (assuming grant of planning	**2018:** Base case = Plots MU1, MU3, MU5, R3, R4, R6 & R8 Cumulative = Plots

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		2018 (Site Year 1 of construction)	2019 (peak construction traffic year)	2023 (Year 1 of operation)		
				and professional services (A2), restaurants, cafes and bars (A3/4), offices and workshops (B1), non-residential institution (D1) and assembly and leisure (D2); 33,950sqm offices and works shops (B1); 350 bed hotel (C1); pedestrian bridge across Three Mills River; a riverside park; car, motorcycle and bicycle parking; servicing and ancillary works. Detailed elements: Demolition of existing buildings where stated; 8 residential units (C3) within Sugar House only; 300sqm financial and professional services (A2); 500sqm public house/bar (A4); 2,620sqm office and workshops/non-residential institution (B1/D1); 8,170sqm offices (B1); public square; access including limited emergency services access along Three Mills Wall River and east-west along Sugar House Lane; 28 parking spaces; hard and soft landscaping.		operational Plots MU2-south, MU4, R2, R5 & R7 under construction	operational Plots MU2-south, MU2-west, R1 & R2 under construction		permission). The development will be built in phases as set out in the ES (Table 2.2)	MU2-south, MU4, R2, R5 & R7 **2019:** Base case = Plots MU1, MU3, MU4, MU5, R3, R4, R5, R6, R7 & R8 Cumulative = MU2-south, MU2-west, R1 & R2 **2023:** Base case = all plots No cumulative
St Andrews Hospital	Approx 750m southwest	PA/08/01161 PA/08/01162	London Development Agency and Barratt Homes	The proposal is submitted as outline for development up to 27 storeys (plus basement) to provide 964 residential units, 151 car parking spaces and up to 3,351 sq.m. non-residential floorspace (including retail, food and drink, health care, education and cultural uses). The development also includes one hectare of public open space on the site. In addition, a hybrid detailed application has also been submitted concurrently for phase one of the outline application, which includes 194 residential units, 2,004 sq.m. floor space for a Primary Care Trust facility, 80 sq.m. commercial floor space and 4,890 sq.m. open space.	A	100% complete & operational	100% complete & operational	100% complete & operational	The construction programme for the entire St Andrew's masterplan is likely to last approximately six years (demolition commenced in October 2007). Therefore assumed that construction will be complete by end of 2013.	Base case (all years)

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

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