Thames Tideway Tunnel
Thames Water Utilities Limited

Thames Water

Development Consent Order

Application Reference Number: WWO10001

Documents for Certification
September 2014

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

Lindsay Speed   Sarah Fairbrother

September 2014

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

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Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

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

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Section 1: Introduction

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1 Introduction

1.1.1 This volume of the Environmental Statement of the Thames Tideway Tunnel project presents the results of the environmental impact assessment (EIA) of the proposed development at the Putney Embankment Foreshore site.

1.1.2 The proposal at this site is to intercept the existing combined sewer overflow (CSO), which currently discharges approximately 33 times in a typical a year. The total discharge volume is approximately 68,000m^3 in a typical year.

1.1.3 The site and environmental context are described in Section 2. The proposed development, comprising both the construction and operational phases, is described in Section 3. Those elements of the proposal for which development consent is sought are described followed by a description of the assumptions applied to the assessment of construction and operational effects. Finally in Section 3.6, the main alternatives which have been considered for this site are presented.

1.1.4 Sections 4 to 15 present the environmental assessments for each topic, which are presented alphabetically. The order of these topics and the structure of each assessment remains the same across different sites.

1.1.5 Figures and appendices for this site are appended separately (see Vol 7 Putney Embankment Foreshore figures and Vol 7 Putney Embankment Foreshore appendices). In addition, there is a separate glossary and abbreviations document which explains technical terms used within this assessment.

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Section 2: Site context

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2 Site context

2.1.1 The proposed development site is located in the London Borough (LB) of Wandsworth. It is made up of two areas along the River Thames foreshore: the Putney Embankment Foreshore combined sewer overflow (CSO) interception site (termed 'the main site') and the Putney Embankment Temporary Slipway (termed 'the secondary site'). The main and secondary sites are defined by the limits of land to be acquired or used (LLAU) and would cover areas of approximately 1.6 hectares and 1.2 hectares, respectively. The site context and location is indicated in Vol 7 Figure 2.1.1 (see separate volume of figures).

2.1.2 The main site is bounded by the River Thames to the north, the Grade II* listed St Mary's Church to the east, the Embankment carriageway and Lower Richmond Road to the south and Putney Pier to the west. The secondary site is approximately 300m northwest of Putney Bridge, and is bounded by the Embankment carriageway to the south and the River Thames on all other sides. The wider area includes residential, commercial and retail use, and includes Putney town centre (see Vol 7 Figure 2.1.2, see separate volume of figures). Vol 7 Plate 2.1.1 below provides an aerial view of the site.

Vol 7 Plate 2.1.1 Putney Embankment Foreshore site – aerial photograph

2.1.3 The majority of the main site is an area of the River Thames and its foreshore, made up of shingle and silt and a gently downward sloping shoreline, with no marginal vegetation. The river is contained by a vertical river wall at this location. The main site is shown in Vol 7 Plate 2.1.2 below. The main site also includes an area of pavement along the

Embankment, an existing public drawdock / slipway, Putney Pier and Waterman's Green, an open space containing mature trees. The secondary site similarly includes an area of the River Thames and its foreshore, a slipway, and part of the Embankment pavement.

Vol 7 Plate 2.1.2 Putney Embankment Foreshore – view of main site from Putney Bridge

Note: Public drawdock/slipway and Waterman's Green shown in centre of frame

2.1.4 The general pattern of existing land uses within and around the site is shown in Vol 7 Figure 2.1.2 (see separate volume of figures). Land uses directly fronting the main and secondary sites include community facilities, restaurants and drinking establishments, dwelling houses, mixed uses (typically commercial and residential) and recreational uses.

2.1.5 Currently access to the site is via the Embankment carriageway. The main site is close to both Putney High Street (A219) and the Transport for London Road Network (the A205, Upper Richmond Road). The closest station is Putney Bridge underground station approximately 600m walking distance to the northeast of the site. Within the boundaries of the main site there is an existing pier, Putney Pier, which has two residential moorings (see Vol 7 Plate 2.1.3). The Thames Path public right of way (PRoW) runs along the southern boundary of the site.

Vol 7 Plate 2.1.3 Putney Embankment Foreshore − view from river looking south to Putney Pier in west of main site

Note: Locally listed Star and Garter Public House and Mansions to rear of frame

2.1.6 There are a number of receptors in proximity to the site and these include residential, community, commercial and recreational receptors as follows (approximate closest distance to the proposed main site hoarding is given):

a. residential

   i Ruvigny Mansions to the north west of the main site, approximately 240m from the main site hoarding

   ii Dwellings in Ruvigny Gardens to the north west of the main site, approximately 155m from the main site hoarding

   iii Star and Garter Mansions to the north west of the main site, approximately 52m from the main site hoarding

   iv Kenilworth Court, opposite the main site, approximately 21m from the main site hoarding

   v Richmond Mansions, opposite the main site, approximately 21m from the main site hoarding

   vi Putney Pier houseboats, within the LLAU

   vii Putney Wharf Tower to the south east of the main site, approximately 100m from the main site hoarding

b. community facilities

i St Mary's Church adjacent to the southern end of the LLAU, approximately 37m from the main site hoarding to the west of Putney Bridge

ii Winchester House Club (formerly the Constitutional Club) to the northwest of the main site, approximately 118m from the main site hoarding

c. restaurants and drinking establishments

i The Thai Square, opposite the main site, approximately 10m from the main site hoarding

ii The Duke's Head public house to the north west of the main site, approximately 103m from the main site hoarding

iii Star and Garter public house, opposite the main site, approximately 21m from the main site hoarding

d. mixed uses

i Chas Newens Marine (boat builders) to the north west of the main site, approximately 207m from the main site hoarding

ii the closest premises at the junction of Lower Richmond Road and Putney High Street are approximately 21m from the main site hoarding

e. recreational

i Thames Path located adjacent and within the site.

2.1.7 Environmental designations for the site and immediate surrounds are shown in Vol 7 Figure 2.1.3 (see separate volume of figures).

2.1.8 The Wandsworth air quality management area (AQMA), designated to manage nitrogen dioxide (NO_2) and particulate matter (PM_{10}) levels, encompasses both the main site and secondary site.

2.1.9 The foreshore parts of the main and secondary sites fall within the River Thames and Tidal Tributaries Site of Importance for Nature Conservation (SINC) (Metropolitan importance).

2.1.10 The southern end of the Grade II listed Putney Bridge (see Vol 7 Plate 2.1.4) falls within the main site, and there are several listed buildings in the vicinity of the main and secondary sites. These include the Grade II* listed St Mary's Church and the Grade II listed White Lion Hotel, Winchester House (formerly the Putney Constitutional Club) and numbers 37, 39 and 41 Lower Richmond Road. Locally listed buildings in the vicinity include the Star and Garter Public House and Star and Garter Mansions on Embankment (see Vol 7 Plate 2.1.3).

Vol 7 Plate 2.1.4 Putney Embankment Foreshore − view of the main site from the river looking south

Note: Grade II listed Putney Bridge and Grade II listed St Mary's Church to left of frame and Richmond Mansions and Kenilworth Court to right.*

2.1.11 The site lies within the Wandsworth Thames Riverside archaeological priority area (APA) and the Putney Embankment Conservation Area.

2.1.12 Mature trees protected by Tree Preservation Orders (TPOs) are a key component of the wider townscape, particularly along the river frontage around St Mary's Church.

2.1.13 Given the site's location within the foreshore of the River Thames, the potential for contamination to be present is considered to be low. Local geology comprises of River Terrace Deposits, London Clay, Lambeth Group and Thanet Sand.

2.1.14 The site is located within the River Thames Foreshore and hence is considered to be functional flood plain (Flood Zone 3b).

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Section 3: Proposed development

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3 Proposed development

3.1 Overview

3.1.1 The Putney Embankment Foreshore site would intercept the Putney Bridge CSO. A temporary cofferdam area would be constructed in the foreshore in front of embankment to provide a construction platform to build a CSO drop shaft. The finished development would include a permanent foreshore structure to accommodate the permanent infrastructure. The drop shaft, located within the permanent foreshore structure, would be connected to the main tunnel via a short connection tunnel under the river.

3.1.2 The geographic extent of the proposals for which development consent is sought, is defined by the LLAU.

3.1.3 This section of the assessment provides a description of the proposed development. The defined project for which consent is sought is described in Section 3.2. In Section 3.3, assumptions are presented on how the development at this site is likely to be constructed and includes the assumed programme and typical construction activities. Section 3.4 sets out operational assumptions in terms of operational structures and typical maintenance regime. These construction and operational assumptions underpin the assessment.

3.1.4 Other developments may become operational in advance of or during the Thames Tideway Tunnel project thereby changing the baseline conditions. In order to undertake an accurate assessment it is necessary to compare the predicted situation with the Thames Tideway Tunnel project in place with this future baseline conditions (‘base case’) (rather than comparing it with the current conditions). In addition, other developments may be under construction at the same time as construction or operation of the Thames Tideway Tunnel project and this could lead to cumulative effects. Information regarding schemes included in the base case and in the cumulative assessment is summarised in Section 3.5 with details included in Vol 7 Appendix N. The methodology for identifying these schemes is explained in Volume 2 Section 3.8. Finally, Section 3.6 describes any on-site alternatives considered.

3.2 Defined project

3.2.1 This section identifies the proposals for which consent is sought and so those which can be regarded, subject to approval, as being ‘certain’ or nearly so (eg, indicative locations).

3.2.2 Vol 7 Table 3.2.1 below, sets out documents and plans for which consent is sought and which have been assessed.

Vol 7 Table 3.2.1 Putney Embankment Foreshore - plans and documents defining the proposed development

Document /plan title	Status	Location
Proposed schedule of works	For approval	Schedule 1 of *The Draft Thames Water Utilities Limited (Thames Tideway Tunnel) Development Consent Order 201[ ] (Draft DCO)* (and extracts below)
Site works parameter plan	For approval	Vol 7 Putney Embankment Foreshore figures – Section 1
Demolition and site clearance plans	For Approval	Vol 7 Putney Embankment Foreshore figures – Section 1
Access plan	For Approval	Vol 7 Putney Embankment Foreshore figures – Section 1
Proposed landscape plan	Indicative – save for layout of above ground structures which is illustrative	Vol 7 Putney Embankment Foreshore figures – Section 1
As existing listed structure interface – kiosk	For information – save for maximum extent of loss of listed structures which is for approval	Vol 7 Putney Embankment Foreshore figures – Section 1
Proposed listed structure interface – kiosk	Indicative	Vol 7 Putney Embankment Foreshore figures – Section 1
Foreshore kiosk design intent	Indicative	Vol 7 Putney Embankment Foreshore figures – Section 1
Listed structure interface - interception chamber	Indicative - save for maximum extent of loss of listed structures which is for	Vol 7 Putney Embankment Foreshore figures – Section 1

Document /plan title	Status	Location
	approval	
Typical river wall design intent	Indicative	Vol 7 Putney Embankment Foreshore figures – Section 1
Existing and proposed listed bollard location plan	Indicative	Vol 7 Putney Embankment Foreshore figures – Section 1
Design Principles: Generic	For approval	*Design Principles* report Section 3 (see Vol 1 Appendix B)
Design Principles: Site Specific principles (Putney Embankment Foreshore)	For approval	*Design Principles* report Section 4.4 (see Vol 1 Appendix B)
Code of Construction Practice (CoCP) Part A: General Requirements	For approval	*CoCP* Part A (see Vol 1 Appendix A)
Code of Construction Practice (CoCP) Part B: Site-specific Requirements (Putney Embankment Foreshore)	For approval	*CoCP* Part B Putney Embankment Foreshore (see Vol 1 Appendix A)

Description of the proposed works

3.2.3 Schedule 1 to the *Draft DCO* describes the proposed works for which development consent is sought. The schedule describes the main tunnel, connection tunnels and also the works which would be required at each of the proposed sites within the project. This includes the works comprising the nationally significant infrastructure (NSIP) and associated development (which are described in Part 1 of Schedule 1) and ancillary works (which are described in Part 2 of Schedule 1).

3.2.4 The following sections provide a description of the proposed works at this site under three headings: Nationally significant infrastructure project, Associated development and Ancillary works. The description of the proposed works has been taken from Schedule 1 to the *Draft DCO* and the codes given for the works are those given within that schedule.

3.2.5 In accordance with the *Draft DCO*, all distances, directions and lengths referred to are approximate. All distances for scheduled linear works referred to are measured along the centre line of the limit of deviation for that work. Internal diameters for tunnels and shafts are the approximate internal dimensions after the construction of a tunnel lining. Unless otherwise stated, depths are specified to invert level and are measured from the proposed final ground level.

Nationally Significant Infrastructure Project

3.2.6 The proposed structures and works required at this site which comprise the nationally significant infrastructure project are as follows:

a. **Work No. 5a**: Putney Embankment Foreshore CSO drop shaft - A shaft with internal diameter of 6 metres and a depth (to invert level) of 36 metres

b. **Work No. 5b**: Putney Bridge connection tunnel - A tunnel between Putney Bridge Foreshore CSO drop shaft (Work No. 5a) and the main tunnel (west) (Work No. 1a).

Associated Development

3.2.7 The proposed structures and works required at this site which comprise the associated development are as follows:

a. **Work No. 5c:** Putney Embankment Foreshore associated development - Works to intercept and divert flow from the Putney Bridge CSO to the Putney Embankment Foreshore CSO drop shaft (Work No. 5a) and into the Putney Bridge connection tunnel (Work No. 5b) including the following above and below ground works and structures

i dredging and construction of a cofferdam including the placement of fill material, connection to the existing river wall and construction of a campshed

ii partial demolition of existing river wall and construction of new river wall including connection to and alteration of the existing river wall to reclaim land and to enclose Work Nos. 5a and 5c(iv), (vi), (vii) and (viii) and scour protection works, relocation of Putney Bridge CSO, and a new CSO outfall apron

iii removal of existing CSO apron in the foreshore

iv construction of an interception chamber, hydraulic structures, chambers with access covers and other structures including culverts, pipes and ducts to modify, connect, control, ventilate, de-aerate, and intercept flow

v construction of electrical and control kiosks

vi works to the listed Putney Bridge including attaching the interception chamber (Work No. 5(c)(iv) to the bridge abutment including protection to the underside of the bridge arch, installing ventilation ducts through the listed bridge, and attaching ventilation column through the bridge structure

vii works to attach an electrical kiosk to the listed wall behind Waterman's Green, including coming through the listed wall

viii relocation and replacement of listed bollards

- ix construction of structures for air management plant and equipment including filters and ventilation columns and associated below ground ducts and chambers
- x construction of pits, chambers, ducts and pipes for cables, hydraulic pipelines, utility connections, utility diversions and drainage
- xi works for the protection and reinstatement of public drawdock/slipway
- xii construction of a new permanent access off the Embankment
- xiii temporary relocation of existing houseboat to the west of the existing Putney Pier including provision of associated mooring and access.

b. **Work No. 5d:** Putney Embankment Foreshore temporary slipway – Works to provide a replacement temporary slipway, including [temporary works to existing river wall to the north-east of numbers 5 to 10 Ruvigny Gardens,]demolition of part of the existing river wall and slipway and construction of the temporary public slipway and its subsequent removal and reinstatement of land.

3.2.8 The maximum heights of above-ground structures, which are for approval, and shown on the Site works parameter plan (see separate volume of figures – Section 1) are as follows:

a. ventilation column(s) serving the drop shaft - 8m (with minimum 4.0m)

b. ventilation column(s) serving the interception chamber - 6.0m

c. electrical and control kiosk(s) assigned to the foreshore structure - 4.0m from existing pavement and 2.5m from new foreshore structure

d. electrical and control kiosk assigned to Waterman's Green – 3m

e. interception chamber – the maximum height of interception chamber would not be above springing point of the bridge arch.

3.2.9 In addition, further works are required at this site that constitute associated development within the meaning of section 115(2) of the Planning Act 2008. These comprise:

a. establishment of temporary construction areas at each works site to include, as necessary, site hoardings/means of enclosure, demolition (including of existing walls, fences, planters, and other buildings and other above and below ground structures), provision of services, including telecommunications, water and power supplies (including substations) including means of enclosure, and ground preparation works including land remediation and groundwater de-watering

b. provision of welfare/office accommodation, workshops and stores, storage and handling areas, facilities for and equipment for processing of excavated materials, treatment enclosures and other temporary facilities, plant, cranes, machinery, temporary bridges and accesses, and any other temporary works required

c. in connection with Work Nos. 5, 6, [8] , 11, 12, 13, 14, 15, 16, 17, 19, [23], 24 [and 26] the provision of temporary moorings (including dolphins) and other equipment and facilities for temporary use by barges, pontoons and other floating structures and apparatus (including as necessary piling for support of such structures) for use in construction of those works, and works for the strengthening of river walls and other flood protection defences

d. temporary removal of coach and car parking bays and creation of temporary replacement coach and car-parking as required and temporary footpath diversions

e. restoration of temporary construction areas, works to restore and make safe temporary work sites and work areas, including (as necessary) removal of hardstanding areas, temporary structures and other temporary works and works to re-establish original ground levels

f. works to trees

g. works to create temporary or permanent landscaping, including drainage and flood compensation, means of enclosure, and reinstatement / replacement of, or construction of, boundary walls and fences including gates

h. formation of construction vehicle accesses and provision of temporary gated or other site accesses and other works to streets

i. diversions (both temporary and permanent) of existing traffic and pedestrian access routes and subsequent reinstatement of existing routes, and works to create permissive rights of way

j. modifications of existing accesses, railings and pedestrian accesses

k. provision of construction traffic signage

l. relocation of existing bus stops and provision of temporary bus lay-bys

m. construction of new permanent moorings and piers, including access brows, bank seats, gangways and means of access

n. permanent and temporary works for the benefit or protection of land or structures affected by the authorised project (including protective works to buildings and other structures, and works for the monitoring of buildings and structures)

o. temporary landing places, moorings or other means of accommodating vessels in the construction and/or maintenance of the authorised project

p. provision of buoys, beacons, fenders and other navigational warning or ship impact protection works

q. such other works as may be necessary or expedient for the purposes of or in connection with the construction of the authorised project which do not give rise to any materially new or materially different environmental effects from those assessed in the Environmental Statement

3.2.10 The works defined by bullet d, as it relates to coach parking, k, and l (in the list above) are not considered likely to be applicable to the works proposed at this site.

Ancillary Works

3.2.11 These works are not “development” as defined in section 32 of the Planning Act 2008, they do however form part of the Thames Tideway Tunnel project for which development consent will be sought and are included within Schedule 1 of the *Draft DCO*.

3.2.12 The following ancillary works are set out in Schedule 1 to the *Draft DCO*:

a. works within the existing sewers, chambers and culverts and other structures that comprise the existing sewerage network for the purposes of enabling the authorised project, including reconfiguring, modifying, altering, repairing, strengthening or reinstating the existing network

b. works within existing pumping stations including structural alterations to the interior fabric of the pumping station(s), works to reconfigure existing pipework, provision of new pipework, new penstock valves and associated equipment, modification of existing electrical, mechanical and control equipment, and installation or provision of new electrical, mechanical and control equipment, installation of electrical, mechanical and control equipment in other buildings and kiosks and modification to existing electrical, mechanical and control equipment in such buildings and kiosks

c. installation of pumps in chambers and buildings

d. works to trees and landscaping works not comprising development

e. works associated with monitoring of buildings and structures

f. provision of construction traffic signage

g. the relocation of boats/vessels

3.2.13 The works defined by bullet b and c in above list are not considered likely to be applicable to the works proposed at this site.

Design Principles

3.2.14 The design principles for the project have been developed with stakeholders and set the parameters that must be met in the final detailed design of the above-ground structures and spaces associated with the project. The principles apply only to the operational phase of the project (ie, the permanent structures).

3.2.15 The generic principles include principles for the integration of functional components and also principles for heritage, in-river structures, landscape, lighting and site drainage.

3.2.16 The design principles form an integral part of the project and are assumed to be implemented within the design of the operational development. Where individual principles are relevant to a particular topic, this is indicated within the relevant assessments.

3.2.17 The *Design Principles* report is provided in Vol 1 Appendix B.

Site features and landscaping

3.2.18 Landscaping is shown on the Proposed landscape plan (see separate volume of figures – Section 1), for example, features such as a metal marking strip feature to align with the boat race stone, and has been considered within the technical assessments as appropriate. The layout of above-ground structures shown on the plan, such as the electrical and control kiosk, are illustrative only and have not been assessed. The possible locations of these above-ground structures, as well as the drop shaft, are defined by the zones on the Site works parameter plan (see separate volume of figures – Section 1).

3.2.19 Given that works at Putney Embankment Foreshore would involve works to listed buildings, and introduction of above-ground structures into the setting of listed buildings, a series of additional plans form part of the defined project for which consent is being sought at this site and which have been assessed. These define the maximum extent of loss of listed structures, which includes some loss of the fabric of the Grade II listed Putney Bridge, where the kiosk would interface with the wingwall of the bridge behind Waterman's Green, and where the existing CSO screens would be removed under the bridge arch (see As existing listed structure interface – kiosk plan, Proposed listed structure interface – kiosk plan, and Listed structure interface - interception chamber plan in separate volume of figures – Section 1). The design intent for the kiosk and river wall around the permanent foreshore structure are also shown in plans (see Foreshore kiosk design intent plan and Typical river wall design intent plan in separate volume of figures – Section 1). The proposed location for relocating a series of listed bollards is also detailed (see Existing and proposed listed bollard location plan in separate volume of figures – Section 1).

3.2.20 Landscaping proposals and measures to ensure sensitive interfacing with listed buildings are also captured by the design principles for this site.

Code of Construction Practice

3.2.21 All works would be undertaken in accordance with the *Code of Construction Practice (CoCP)*. The *CoCP* sets out a series of measures to protect the environment and limit disturbance from construction activities as far as reasonably practicable. These measures would be applied throughout the construction process at this site, and would be the responsibility of the contractor to implement. The *CoCP* is provided in Vol 1 Appendix A and comprises two parts, Part A and Part B. Part A presents measures which are applicable at all sites across the project and Part B defines measures which are only applicable at individual sites.

3.2.22 The *CoCP* forms an integral part of the project and all of the measures contained therein are assumed to be in place during the construction process described in Section 3.3 below. The measures are not described within Section 3.3 although further details on the measures within the *CoCP* Part B Putney Embankment Foreshore are given within the relevant assessments.

3.3 Construction assumptions

3.3.1 This section describes the approach to construction which has been assumed for the purposes of the EIA. The construction programme, layouts and working methods are illustrative and do not form part of the project for which consent is sought. However the maximum extent of the temporary works platform within the river is shown on the Site works parameter plan (see Section 3.2 and separate volume of figures – Section 1) and is for approval.

3.3.2 Although the programme, layouts and working methods described are illustrative, they represent what is considered to be the likely approach, given the existing site constraints, the adjacent land uses and the construction requirements. This section describes the main activities with the focus on those that are relevant for the assessment of environmental effects.

3.3.3 The assumed construction programme is described first, followed by a description of typical construction activities.

3.3.4 It is also assumed that, where the appropriate powers do not form part of the Development Consent Order, further consents may be required before certain construction activities are progressed. These could include various consents issued by the Environment Agency (EA) (including flood defence consents, abstraction licenses and discharge consents) and the Port of London Authority (PLA) (including river works licenses) as appropriate.

Assumed construction programme and working hours

3.3.5 Construction at this site would be likely to commence in 2016 (Site Year 1) and would be completed in 2020 (Site Year 4). The infrastructure at the site would only become operational in 2023 when the Thames Tideway Tunnel project as a whole becomes operational

3.3.6 Construction at Putney Embankment Foreshore is anticipated to take approximately three and a half years and would involve the following steps (with some overlaps):

a. Site Years 1 to 2 – Site set up (approximately 12 months)

b. Site Years 1 to 2 – CSO drop shaft construction (approximately six months)

c. Site Year 2 - Tunnelling (approximately two months)

d. Site Years 2 to 3 – Construction of other structures (approximately 16 months)

e. Site Year 3 – Completion of works and site restoration (approximately ten months).

3.3.7 System-wide commissioning would take place following site restoration and is not included in the above programme

3.3.8 This site would operate to the standard and continuous working hours for various phases and activities as set out in the *CoCP* Parts A and B (Section 4). Standard working hours would be applied to all of the above phases of construction work, apart from for a short duration (approximately two months) for tunnelling of the Putney Bridge short connection tunnel. It is noted that there would be periods of activity within this phase where continuous 24 hour working would not be required.

3.3.9 During these periods only those activities directly connected with the task would be permitted within the varied hours.

Typical construction activities

3.3.10 Vol 7 Table 3.3.1 identifies the construction phasing plans used for the assessment of construction effects. These plans have been prepared to illustrate possible site layouts for the principal construction phases and relevant activities:

Vol 7 Table 3.3.1 Putney Embankment Foreshore − construction phase plans

Plan title	Activities	Status	Location
Temporary slipway – construction phase	Temporary slipway construction	Illustrative	Vol 7 Putney Embankment Foreshore figures – Section 1
Construction phases – phase 1	Site setup	Illustrative	Vol 7 Putney Embankment Foreshore figures – Section 1
Construction phases – phase 2	CSO drop shaft construction and tunnelling	Illustrative	Vol 7 Putney Embankment Foreshore figures – Section 1
Construction phases – phase 3	Construction of other structures	Illustrative	Vol 7 Putney Embankment Foreshore figures – Section 1
Construction phases – phase 4	Site Demobilsation	Illustrative	Vol 7 Putney Embankment Foreshore figures – Section 1

3.3.11 The methods, order and timing of the construction work outlined herewith are illustrative, but representative of a practical method to construct the works and suitable upon which to base the assessment.

3.3.12 The following construction activities are described:

a. site setup

b. river works

c. shaft construction

d. tunnel construction

e. tunnel and shaft secondary lining

f. construction of other structures

g. completion of works and site restoration

h. excavated materials and waste

i. access and movement.

Site setup

3.3.13 Prior to commencement of the construction works at the main site, a temporary slipway, located approximately 300m west of Putney Bridge, would be constructed. This would enable public access to the river to be maintained during the period in which the permanent slipway would be unavailable for use, during construction at the main site. The temporary slipway would be constructed from bored tubular piles and prefabricated steel decking. Appropriate traffic management, public rights of way modifications and access works would be put in place to facilitate construction of the temporary slipway.

3.3.14 It is anticipated that a number of existing vessel moorings would be temporarily relocated during construction of the temporary slipway and again during its removal.

3.3.15 It is further anticipated that an existing public drawdock/slipway, in front of a marine chandlers on Embankment, would be temporarily closed during the construction and later removal of the temporary slipway.

3.3.16 Prior to any works commencing at the main site, the hoarded site boundary would be established and would consist of close boarded hoarding panels to the heights specified in the *CoCP* Part B Putney Embankment Foreshore Section 4. Welfare and office facilities would also be set up.

3.3.17 Other works during this first phase would include the setting up of the required site access via gates on Embankment. Full pedestrian access would be maintained along the Embankment with the Thames Path being diverted parallel to its existing course. Appropriate site access signage would be provided to inform and remind pedestrians and lorry drivers of pedestrian safety.

3.3.18 Site utilities would be provided during this phase, including a water supply, electrical supply, connection to the foul water sewer and telecommunications links. A number of existing utilities would be diverted or, where left in situ, protected as part of this phase.

3.3.19 The extent of demolition and site clearance works are shown on the Demolition and site clearance plans (see separate volume of figures – Section 1). A number of trees would be cut back.

3.3.20 The approach to any land remediation that might be required cannot be defined at this stage. However it is assumed that any remediation that is required would occur within this earliest phase of construction and that any associated lorry movements would be substantially lower than the subsequent peak during the main construction phases.

River works

3.3.21 It has been assumed that a temporary cofferdam would extend out into the river beyond the existing river wall to create a working platform during construction. This would remain in place until the end of the construction period when it would be removed, as described in para 3.3.51. The temporary cofferdam would extend around and over the existing public drawdock/slipway and tie back at each end to the existing river wall. A second area of temporary cofferdam would be installed under Putney Bridge to facilitate construction of an interception chamber at the existing outfall and a connection culvert to the CSO drop shaft. A campshed is assumed to be required at the main site; a campshed may also be utilised at the temporary slipway site, so for the purposes of the assessment it has been assumed to be required. It is assumed that no dredging[i] would be required at this site. The maximum extent of the temporary works in the river is defined on the site works parameter plan (see Section 3.1.4 and separate volume of figures).

3.3.22 The sheet piles used to form the temporary cofferdam would be driven through the foreshore into the impermeable clays from a jack-up barge. The top level of the outer wall of the cofferdam would be set to existing flood defence level to protect the site from flooding. The sheet piling operation for the cofferdam associated with the interception chamber would be undertaken from foreshore level with inter-tidal working assumed.

3.3.23 For the purpose of this assessment it is assumed that the sheet piles would be driven using vibration piling techniques although the intention would be to seek to utilise silent piling techniques where reasonably practical.

3.3.24 Localised removal of sections of the existing public drawdock/slipway would be undertaken to enable construction. Sections of the existing granite paving would be removed, stored and reinstated. The remainder of the slipway would remain in situ and be protected during the works.

3.3.25 Modification to the existing river wall would be required to enable connection of the new permanent foreshore structure area of hardstanding. Works would include removal of the hand railings.

3.3.26 It is assumed for the assessment that the majority of foreshore material within the temporary cofferdam would remain in situ. For structural reasons, soft material located adjacent to the perimeter of the temporary cofferdam and adjacent to the river wall would be removed. The soft material would include silt, peat and other materials. Removal of this

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[i] N.b. campshed construction is not classed as dredging

material would ensure that any settlement of the cofferdam fill material would not adversely affect the ties between the walls of the twin walled temporary cofferdam leading to structural difficulties. All soft material within permanent cofferdams would be removed to ensure sound foundations for permanent construction.

3.3.27 The exact extent and depth of the foreshore deposits to be removed would be informed by geotechnical investigations. Areas of removed material would be filled with granular material similar to the existing bed material. Cofferdam fill material would then be placed onto the foreshore on top of a geotextile layer (with the exception of the cofferdam associated with the interception chamber location, which would not be filled with granular material). Suitable sized plant would be utilised to reduce potential load impacts on the foreshore. A drain sump would be maintained within the filled cofferdam to enable any water entering the cofferdam to be pumped back to the river.

3.3.28 Monitoring of potential scour around, and in the vicinity of, the temporary cofferdam would be undertaken during the temporary construction works. The need for scour protection would be identified using the approach set out in the *Scour Monitoring and Mitigation Strategy* (Vol 3 Appendix L.4).

3.3.29 Scour protection which would be put in place around the permanent foreshore structure is described in para 3.3.49.

Shaft construction

3.3.30 Following construction of the temporary cofferdam, plant, equipment and material storage areas would be set up. Major plant required for drop shaft construction would include cranes, excavators and dumpers.

3.3.31 It is anticipated that the shaft would be constructed using sprayed concrete lining (SCL) techniques and would have a cast *in situ* secondary lining. The final choice of construction method would be made by the contractor who may choose to use a different method.

3.3.32 A piling rig would initially drive sheet piles through the granular fill of the cofferdam and the permeable ground, to cut off any potential ground water ingress. Drop shaft construction would comprise excavating in 1m increments, approximately, and then using SCL techniques to form the drop shaft walls. This process would be repeated until the required depth of shaft is reached.

3.3.33 The drop shaft would be excavated using a small tracked excavator loading excavated material into a shaft skip. The skips would then be hoisted by a crawler crane, and excavated material deposited in the excavated materials handling area. Excavated material would then be transferred into barges by mechanical excavator before being towed off site by tug.

3.3.34 On completion of the SCL cycle, the pump and skips would be washed out into a wash out area located on site.

3.3.35 A steel reinforced concrete plug would be formed at the base of the drop shaft, and a steel bar reinforced portal incorporated within the shaft lining to accommodate construction of the connecting tunnel.

3.3.36 A drop shaft cover slab would be constructed with the required openings for permanent access. This would either be cast *in situ*, or constructed from precast units with an *in situ* reinforced concrete layer.

3.3.37 The concrete for the drop shaft would be either batched on site or delivered by ready mix concrete lorries. Concrete would be transferred into the shaft by a truck mounted concrete pump.

3.3.38 As the drop shaft would be excavated through the London Clay formation, no dewatering is anticipated. Any water entering the drop shaft excavation from either the superficial deposits or from minor seepages through silt layers would be pumped to the sewer network via settlement tanks.

Tunnel works

3.3.39 To connect the CSO drop shaft to the main tunnel at a reception chamber, an approximately 2.2m internal diameter connection tunnel would be driven approximately 54m from the drop shaft.

3.3.40 The connection tunnel would be excavated in 1m increments, approximately. A sprayed concrete lining would then be applied to form the tunnel walls. Excavated material from the connection tunnel would be lifted to surface level, via the drop shaft, using a mobile crane. It would be stored in a temporary stockpile prior to loading to barges for onward disposal.

Secondary lining of tunnel and shaft

3.3.41 For the purposes of assessment, it has been assumed that the connection tunnel and drop shaft would have a reinforced concrete secondary lining. Secondary lining would form an additional layer of concrete cast against the inside of the primary concrete lining to improve durability, water tightness and structural integrity.

3.3.42 It has been assumed that on completion of the tunnelling phase, a batching plant would be mobilised to site to cast the secondary lining for the connection tunnel and drop shaft. Concrete would be batched at the surface and pumped or skipped to the tunnel.

3.3.43 The secondary lining of the connection tunnel would be constructed by installing steel reinforcement into the tunnel, followed by putting in place a cylindrical shutter within a short section of the tunnel and pumping concrete into the gap between the shutter and the primary lining. Following sufficient hardening of the concrete, the shutter would be removed and positioned in the next section of tunnel, and so on, until the secondary lining is complete.

3.3.44 It is likely that the CSO drop shaft secondary lining would be constructed after completion of the connection tunnel. It would either be formed through use of shutters or via a continuous slip-form formwork. If the former system were to be used, the shutter would be assembled at the bottom of the drop shaft, and slowly and continuously winched up the shaft whilst setting steel reinforcement in place from a working platform and continuously pumping concrete in between the steel and shutter.

Construction of other structures

3.3.45 Following completion of the CSO drop shaft, internal structures within the shaft would then be constructed, including concrete access platforms, and a concrete vortex generator and drop tube to direct flows down the drop shaft to the connection tunnel.

3.3.46 For the duration of the construction works, the existing storm relief sewers that outfall to the River Thames would be extended to the temporary cofferdam wall, to maintain flows during the works. The temporary extension would be in the form of steel structures and flumes and would be fully enclosed, with flap valves fitted to prevent tidal ingress either to the working site or existing pipe work.

3.3.47 A permanent interception chamber would be constructed beneath the southern shore arch of Putney Bridge, to intercept flows which currently discharge into the River Thames. A connection culvert to transport flows to the CSO drop shaft would then be constructed using open cut excavation techniques. The culvert would either be constructed using *in situ* concrete or pre-cast concrete sections. A steel bar reinforced concrete capping slab would be constructed over the culvert.

3.3.48 Above-ground structures including the ventilation columns and electrical and control kiosks would also be constructed. These are described further in Section 3.4 below.

Completion of works and site restoration

3.3.49 At the end of the construction period prior to removal of the temporary cofferdam, final treatments to the river wall would be completed, and permanent scour protection would be put in place within the zone indicated on the Site works parameter plan (see separate volume of figures – Section 1). It is assumed for the assessment that permanent scour protection would consist of loose large stones placed just below foreshore level. The size and type of the stone would be defined subsequently. It is assumed that a 1m depth of stone would be placed up to 0.5m below the existing foreshore level. The majority of permanent scour protection would be located within the footprint of the temporary cofferdam. In order to install this, at the end of the construction period prior to removal of the temporary cofferdam, the fill and geotextile layer would be removed and the foreshore excavated by approximately 1.5m by an excavator. For areas outside the temporary cofferdam, the material would be removed by a long reach excavator or grab working either from the cofferdam or from a barge, and scour protection put in place.

3.3.50 Once the permanent scour protection is in place, the bed would be reinstated to match the existing river bed conditions. Within the cofferdam, the bed outside of any areas of scour protection, would be reinstated to match the existing river bed conditions. Cofferdam fill material would be disposed of in accordance with the project’s waste management procedure.

3.3.51 In order to maintain flood protection the temporary cofferdam would be removed only when the permanent river wall is in place. It would be removed by pulling the sheet piling from the river bed.

3.3.52 The temporary slipway would also be removed following reinstatement of the existing public drawdock/slipway.

3.3.53 At this stage the final landscaping works would be undertaken including final treatments and surfaces, planting and installation of street furniture.

Excavated materials and waste

3.3.54 The construction activities described above and in particular the construction of the drop shaft would generate a large volume of excavated material which would require removal. This is estimated at 32,000 tonnes, the main elements of which would comprise approximately 26,000 tonnes of imported fill (which would require later removal), 700 tonnes of Made Ground and 5,000 tonnes of London Clay.

3.3.55 In addition, it is estimated that approximately 1,000 tonnes of construction waste would be generated including 700 tonnes of imported fill and 300 tonnes of concrete.

3.3.56 Excavated materials and construction wastes would be exported from the site in accordance with the *Transport Strategy* which accompanies the application for development consent (the 'application') (see Access and movement below).

Access and movement

3.3.57 For the purposes of the assessment, a single trip to or from the site is referred to as a 'movement', while two trips, one to and one from the site, are referred to as a 'lorry' or 'barge'.

3.3.58 The transport strategy requires that the importation of granular fill for the formation of the temporary working area within the cofferdam and the subsequent removal of the fill would be by barge. The removal of all drop shaft excavations and 'other' excavated material would also be by barge. The assessment assumes that 90% of these materials would be taken by river, with the residual 10% transported by road, to account for periods where river transport is not available or the material is unsuitable for transport by barge.

3.3.59 The highest barge movements would occur during the removal of the temporary cofferdam fill. Peak daily barge numbers, averaged over a one month period, would be two barges per day, equivalent to four barge movements. It is estimated that total barge numbers for this site would be 167, equivalent to 334 barge movements over the construction period. Barge numbers are based upon an assessed barge size of 350T.

3.3.60 The tug dwell time for this site is assessed as being 20 minutes. Barges would sit on campsheds during periods of low tide.

3.3.61 The highest lorry movements at the site would occur during sewer connection works and fit out. The peak daily vehicle numbers at this time, averaged over a one month period, would be 21 HGV lorries, equivalent to 42 vehicle movements per day. It is estimated that total vehicle numbers for this site would be in the order of 3,300 HGV lorries, equivalent to 6,600 movements over the construction period.

3.3.62 A *Traffic management plan* would be developed for the site, produced, coordinated and implemented by the contractor.

3.3.63 A *Draft Project Framework Travel Plan*, which accompanies the application, has been produced setting out the requirements and guidelines for the site-specific *Travel plans* to be developed by the contractor.

3.4 Operational assumptions

3.4.1 This section provides details of the assumptions which have been made for the operational phase for the purposes of the EIA. Unless otherwise also listed in Section 3.2, the details given are illustrative and do not form part of the project for which consent is sought.

3.4.2 The details given are considered to represent the likely approach, given the site constraints, the adjacent land uses and the operational requirements. This section describes only the main operational structures and activities with the focus on those that are relevant for the assessment of environmental effects.

3.4.3 The operational structures are described first, followed by the assumed maintenance regime.

3.4.4 Once operational, the project would intercept flows from the Putney Bridge CSO which is situated beneath the southern arch of Putney Bridge. Flows would be diverted into the CSO drop shaft and conveyed via an underground connection tunnel to the main tunnel.

Operational structures

3.4.5 For the purposes of the application, each of the main operational structures is shown as being located within a defined zone, in which the structure would be located. The operational structures listed within Section 3.2 along with the relevant plans, form part of the proposed development for consent. The defined zones for the structures are shown on the Site works parameter plan (see separate volume of figures – Section 1).

3.4.6 The heights of the main ventilation columns are defined and also form part of the project for consent (see Section 3.2). The following text provides additional clarification on the assumed form, purpose, function and working of these structures where this is considered helpful to the reader.

3.4.7 The assessment for each of the environmental topics has been based on the most appropriate dimensions and siting of the structures to ensure the assessment is robust. For example, the lower height for the ventilation column would typically generate higher odour impacts than a higher height and so the lower height limit has been modelled in the assessment. For other topics such as townscape, the upper height may be more important and has been assessed. The approach that has been adopted in this regard is explained within each topic assessment section, where necessary.

3.4.8 The approximate dimensions provided for underground structures are internal dimensions which are determined by the hydraulic and access requirements at particular sites.

3.4.9 Once constructed and operational the structures listed in the following sections would remain on site.

Shaft

3.4.10 The location, diameter and depth of the CSO drop shaft are described in Section 3.2. Ground level access covers would be located within the drop shaft cover slab, to enable access/egress for operational maintenance inspections.

3.4.11 The finished level of the drop shaft would be flush with the finished level of the new foreshore structure, at approximately 5m above the local existing foreshore level. This elevation would ensure that the access covers are located above the fluvial flood level.

Chambers and culverts

3.4.12 The interception chamber and related culverts are defined in Section 3.2 and would be required to intercept the existing CSO and transfer flows to the shaft. The interception chamber would be located beneath the southern shore arch of Putney Bridge. This would not have access openings due to clearance restrictions beneath the arch of the bridge.

3.4.13 The connection culvert would be constructed beneath the foreshore, and would not be visible when complete.

3.4.14 Other hydraulic chambers would be located adjacent to the shaft and finished at the same level as the new foreshore structure. These chambers would manage the flow of discharges between the interception chamber and the CSO drop shaft.

River wall

3.4.15 The location of the new river wall is defined in Section 3.2. It would run around the riverward side of the new foreshore structure. It would be built to the required flood defence level. The river wall would be finished in natural stone and timber cladding, with localised vertical timber fenders to assist with navigation.

Air management structures

3.4.16 The heights and locations of above-ground air management structures, which comprise the ventilation columns, are defined in Section 3.2. Treated air would be released through a ventilation column located on the new foreshore structure. The ventilation column would serve to primarily allow air inflow. A small diameter ventilation column serving the interception chamber would be located on Putney Bridge.

3.4.17 Below-ground air treatment structures would contain passive filters serving the ventilation columns. These would have ground level covers to allow access and inspection.

Electrical and control kiosk

3.4.18 The height and location of the above ground electrical and control kiosks are defined in Section 3.2. The majority of the electrical control and monitoring equipment would be located within an electrical control kiosk located on Waterman's Green, adjacent to the existing stairway to the disused public convenience. The design of the kiosk would maintain an existing air vent which is situated to the west of the access stairway.

3.4.19 A secondary electrical and control kiosk would be located on the foreshore structure.

Permanent restoration and landscaping

3.4.20 The Proposed landscape plan is presented in a separate volume of figures (Section 1). The final landscape and restoration proposals would be subject to both the generic and site-specific design principles (see Section 3.2).

3.4.21 Landscaping would include final treatments and surfaces, planting and installation of street furniture. The area of Waterman's Green affected by construction works would also be reinstated.

3.4.22 The area around the drop shaft, valve chamber and ventilation column would be finished in hardstanding to allow crane access to the shaft and chambers. This would provide an operational maintenance area, and also new permissive public realm. Right of access to the area would be reserved and temporary security fencing would be erected during maintenance periods.

3.4.23 Operational access would be from the junction of Lower Richmond Road and Embankment. It is possible that access to the public slipway would be restricted during maintenance periods, although access would be maintained during this period where possible.

3.4.24 No new lighting would be provided on Waterman's Green, with the exception of a low level light for maintenance purposes in hours of darkness. This light would only be activated by a directional motion control switch.

Typical maintenance regime

3.4.25 Light commercial vehicles would undertake three to six monthly maintenance works. This would be carried out during normal working hours and would take approximately half a day. There would be no aerial lighting.

3.4.26 Additionally, once every ten years, more substantial maintenance work would be carried out in normal working hours. Vehicular requirements for these visits would include two mobile cranes and associated support vehicles and equipment. Localised tree pruning may be required to facilitate overhead clearance.

3.5 Base case and cumulative development

3.5.1 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, the Greater London Authority and Transport for London 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 7 Appendix N 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.

3.5.2 The development projects which have been included under base case, cumulative or both for the assessment of the proposed development at Putney Embankment Foreshore are listed below. A map showing their location is included in Vol 20 Figure 3.5.1 (see separate volume of figures).

a. No. 2 Putney High Street

b. No. 4-6 Putney High Street

c. 45-53 Putney High Street and 329-339 Putney Bridge Road

d. Former Putney Hospital

e. 113 Upper Richmond Road

f. 131-133 Upper Richmond Road

g. 77-83 Upper Richmond Road and Carlton Court, 26 Carlton Drive

h. 84-88 Upper Richmond Road

i. Carlton House, 27a Carlton Drive.

3.6 On-site alternatives

3.6.1 Project-wide and site selection alternatives are addressed in Volume 1 Section 3. This section describes the on-site alternatives that have been considered and provides the main reasons why these alternatives (to the proposed approach) have not been adopted.

3.6.2 Vol 7 Table 3.6.1 below identifies those items for which alternatives have been considered, the alternatives and provides the main reasons why the alternatives were not taken forward.

Vol 7 Table 3.6.1 Putney Embankment Foreshore – on-site alternatives

Item	Alternatives considered	Main reasons that the alternative (given left) was not progressed
Permanent foreshore structure and associated construction area	Location closer to Putney Bridge	It was decided that it was preferable to increase separation from Grade II Listed Putney Bridge. A location further from the bridge would also allow the historic public drawdock/slipway to be retained along its existing alignment.
	Larger permanent foreshore structure	This alternative would involve greater encroachment of permanent structures into the River Thames with consequential impact on aquatic ecology, flood storage levels and visual impact on Putney Embankment Conservation Area and the setting of heritage assets.
Ventilation column	Location on Waterman's Green	This alternative was not taken forward in order to maximise separation between the ventilation column and the Grade II Listed Putney Bridge and Waterman's Green.
	Taller ventilation column	A shorter ventilation column is proposed in line with modified project-wide air management proposals.
Electrical and control kiosk	Larger kiosk on permanent foreshore structure	In order to minimise visual impact and avoid damage to trees a smaller kiosk is proposed on the permanent foreshore structure, along with a second small kiosk on Waterman's Green.
Temporary slipway	Sheet piled structure	This would have required a larger working area and a longer construction duration.
Construction traffic movements	Less use of river transport	This alternative was rejected in order to reduce impact on the local road network by making further use of the river to transport excavated materials from the shaft and short connection tunnel away from the site.

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 4: Air quality and odour

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 7: Putney Embankment Foreshore site assessment

Section 4: Air quality and odour

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4 Air quality and odour

4.1 Introduction

4.1.1 This section presents the findings of the assessment of the likely significant air quality and odour effects of the proposed development at the Putney Embankment Foreshore site. This assessment covers the effects associated with both the main site and secondary site. The project-wide air quality effects are described in Volume 3 Project-wide effects assessment.

4.1.2 The proposed development has the potential to affect air quality and odour due to:

a. construction traffic on the roads leading to an increase in vehicle emissions (air quality)

b. emissions from tugs pulling river barges (air quality)

c. emissions from construction plant (air quality)

d. construction-generated dust (air quality)

e. operation of the tunnel, resulting in air emissions (odour).

4.1.3 Each of these impacts is considered within the assessment. As a result the construction assessment for the Putney Embankment Foreshore site comprises four separate components: effects on local air quality from construction road traffic; effects on local air quality from tugs (for river barges); effects on local air quality from construction plant; and effects from construction dust. The effects on local air quality from construction road traffic, tugs (for river barges) and construction plant are assessed together (within the same model) while construction dust is assessed separately. The operational assessment considers the potential for nuisance odour emissions from the operation of the tunnel. As set out in the *Scoping Report*, local air quality effects are not assessed during operation on the basis that the only relevant operational source of air pollutants would be from the infrequent visits of maintenance vehicles which would not result in a likely significant effect.

4.1.4 The assessment of air quality and odour presented in this section has considered the requirements of the National Policy Statement for Waste Water Sections 4.3 (odour), 4.11 (air quality and emissions) and 4.12 (dust). Further details of these requirements can be found in Vol 2 Section 4.3.

4.1.5 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 7 Putney Embankment Foreshore figures). Appendices supporting this site assessment are contained in Vol 7 Appendix B.

4.2 Proposed development relevant to air quality and odour

4.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to air quality and odour are set out below.

Construction

Construction road traffic

4.2.2 During the proposed construction period there would be construction traffic movements[i] in and out of the site.

4.2.3 The highest number of lorry movements at the Putney Embankment Foreshore site would occur during sewer connection works and fitout (Site Year 2 of construction). The average daily number of vehicle movements during the peak month would be approximately 42 movements per day.

4.2.4 The construction traffic routes, traffic management and access to the site are detailed in Section 12 of this volume.

4.2.5 Construction traffic is likely to affect local air quality as a result of increasing traffic and therefore emissions on the road network.

Tugs for river barges

4.2.6 River barges may affect local air quality through direct emissions from the tugs pulling them.

4.2.7 The peak number of barge movements would be four barge movements a day averaged over a one month period in Site Year 3 of construction. The emissions associated with the tugs are presented in Vol 7 Appendix B.3.

Construction plant

4.2.8 Construction plant is likely to affect local air quality from direct exhaust emissions associated with the use and movement of the plant around the site.

4.2.9 There are a number of items of plant to be used on site that may produce emissions that could affect local air quality. Examples of such plant are excavators, generators and dumper trucks.

4.2.10 Typical construction plant which would be used at the Putney Embankment Foreshore site in the peak construction year and associated emissions data are presented in Vol 7 Appendix B.4.

Construction dust

4.2.11 Activities with the potential to give rise to dust emissions from the proposed development during construction are as follows:

a. site preparation and establishment

[i] A movement is a construction vehicle moving either to or from the site.

b. demolition of existing infrastructure and buildings

c. materials handling and earthworks

d. construction traffic – from moving over unpaved ground and then tracking out mud and dirt onto the public highway (termed 'trackout' hereafter).

4.2.12 At the Putney Embankment Foreshore site there would be approximately $199m^3$ of demolition material generated while the amount of material moved during the earthworks would be approximately 62,000 tonnes. The volume of building material used during construction would be approximately $4,500m^3$.

Code of construction practice

4.2.13 Appropriate dust and emission control measures are included in the *Code of Construction Practice (CoCP)*[ii] *Part A* (Section 7)in accordance with the London Councils Best Practice Guidance[1]. Measures incorporated into the *CoCP* Part A (Section 7) to reduce air quality impacts include measures in relation to vehicle and plant emissions, measures to reduce dust formation and re-suspension, measures to control dust present and measures to reduce particulate emissions. These would be observed across all construction and demolition activities at the Putney Embankment Foreshore site.

4.2.14 The effective implementation of the *CoCP* Part A (Section 7) measures is assumed within the assessment.

Operation

4.2.15 A ventilation structure would treat air released from the tunnel. The air would be treated by passing through a carbon filter housed in a below ground air treatment chamber. Natural pressure during tunnel filling would allow air to pass passively without the need for fans. The capacity of the passive filter would be $0.5m^3/s$. The maximum air release rate during a typical year is expected to be less than $0.1m^3/s$, therefore all air in a typical year would be treated through the passive filter. No nuisance odours are therefore expected.

4.2.16 Air would be released from the ventilation column for about 11 hours in a typical year, all of which would have passed through the passive filter. For the remaining hours, no air would be released although air intake would occur as the tunnel is emptied.

Environmental design measures

4.2.17 A carbon filter would be included as part of the ventilation structure design and construction. The passive filter would remove odours by adsorption onto the filter. Full details of the Thames Tideway Tunnel project ventilation system can be found in the *Air Management Plan*.

[ii] The CoCP is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B)

4.3 Assessment methodology

Engagement

4.3.1 Volume 2 Environmental assessment methodology (Section 4.2) documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of air quality and odour are presented here (Vol 7 Table 4.3.1).

Vol 7 Table 4.3.1 Air quality and odour – stakeholder engagement

Organisation	Comment	Response
LB of Wandsworth, April 2011	Agree monitoring locations with of LB of Wandsworth	Locations agreed with LB of Wandsworth Project Manager - Air Quality.
LB of Wandsworth, March 2011	Odour complaints in the area should be considered	No odour complaints around Putney Embankment Foreshore site - confirmed by LB of Wandsworth Environmental Team Leader (Environmental Initiatives).
LB of Wandsworth, Scoping response, April 2011	Putney Bridge is the busiest bridge across the Thames, Putney High Street is a TfL Major Strategic Road joining the A4 and the A3, the High Street is narrow. In addition to high pedestrian flows the High Street traffic is extremely busy with a multitude of buses, cars, commercial vehicles. It is characterised by frequent jams and queues of slow moving traffic. This and the relatively high and narrow high street produce a canyon effect which contributes to the poor air quality with very high levels of nitrous oxides and other pollutants.	This concern has been noted and Putney High Street has been considered separately within the verification process to allow for the narrow and enclosed nature of the street.

Baseline

4.3.2 The baseline methodology follows the methodology described in Vol 2 Section 4. There are no site specific variations for identifying baseline conditions for this site.

Construction

4.3.3 The assessment methodology for the construction phase follows that described in Vol 2 Section 4. There are no site specific variations for undertaking the construction assessment of this site.

4.3.4 Section 4.5 details the likely significant effects arising from the construction at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could elevate construction dust nuisance effects within the assessment area (see para. 4.3.5 below). Also, it is noted that when assessing construction dust at the Putney Embankment Foreshore site, the effect of the two parts of the site (the main site and the secondary site) have been considered in combination to ensure a robust assessment. With regard to local air quality, the effect of all relevant traffic associated with Thames Tideway Tunnel project sites using the highway network in the vicinity of the site is taken into account in the assessment as traffic data used for the assessment includes traffic associated with all Thames Tideway Tunnel project sites.

Construction assessment area

4.3.5 The assessment area for the local air quality assessment during construction covers a square area of 600m by 600m centred on the Putney Embankment Foreshore site. This assessment area has been used for the assessment of road transport, tugs for river barges, construction plant and construction dust and has been selected on the basis of professional judgement to ensure that the effects of the Putney Embankment Foreshore site are fully assessed. A distance of 200m is generally considered sufficient[2] to ensure that any significant effects are considered. The selected assessment area exceeds this considerably.

Construction assessment year

4.3.6 The peak construction year in terms of construction traffic movements (Site Year 2 of construction) has been used as the year of assessment for construction effects (effects from construction road and river transport, construction plant and construction dust) in which the development case (with the Thames Tideway Tunnel project) has been assessed against the base case (without the Thames Tideway Tunnel project) to identify likely significant effects of the Thames Tideway Tunnel project. The peak construction year (Site Year 2 of construction) in terms of construction traffic movements is expected to lead to the largest local air quality effects, so has been used in preference to the year with the largest number of barge movements (Site Year 3 of construction).

4.3.7 The assessment of construction effects also considers the extent to which the effects on local air quality would be likely to be materially different should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Other developments

4.3.8 As indicated in the site development schedule (see Vol 7 Appendix N), there are three new developments (café developments at 2 Putney High Street and 4-6 Putney High Street and a mixed use development at 45-53 Putney High Street/329-339 Putney Bridge Road) identified within the air quality assessment area. The developments are relevant to the air quality assessment as they represent sensitive receptors within 200m of the site. These developments are therefore considered as receptors in the air quality assessment. Trips associated with the developments are taken into account in the traffic data used for the air quality assessment.

4.3.9 The developments at 2 Putney High Street, 4-6 Putney High Street and 45-53 Putney High Street/329-339 Putney Bridge Road would not be under construction at the same time as construction works at the Putney Embankment Foreshore site (in the peak construction year). Therefore, there are no cumulative construction effects to assess.

Operation

4.3.10 The odour assessment methodology for the operational phase follows that described in Vol 2 Section 4. There are no site specific variations for undertaking the operational assessment of this site.

4.3.11 Section 4.6 details the likely significant effects arising from the operation at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites that could give rise to additional effects on odour within the assessment area for this site and therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

Operational assessment area

4.3.12 Odour dispersion modelling has been carried out over an area of 300m by 250m centred on the Putney Embankment Foreshore site. The assessment area has been selected on professional judgement on the basis of it being considered the potential maximum extent of the impact area.

Operational assessment year

4.3.13 The assessment, undertaken for a typical use year (as described in Vol 2 Section 4), applies equally to all operational years. Therefore no specific year of operation has been assessed.

Other developments

4.3.14 As indicated in the site development schedule (see Vol 7 Appendix N), there are three new developments (café developments at 2 Putney High Street and 4-6 Putney High Street and a mixed use development at 45-53 Putney High Street/329-339 Putney Bridge Road) identified within the assessment area. These developments are relevant to the odour assessment as they represent sensitive receptors within 200m of the site. These developments are therefore considered as receptors in the odour assessment.

4.3.15 Due to the nature of the developments there are however no cumulative operational odour effects to assess.

Assumptions and limitations

Assumptions

4.3.16 The general assumptions associated with this assessment are presented in Vol 2 Section 4.

Construction

4.3.17 The site specific assumptions in terms of model inputs for the local air quality dispersion modelling are set out in Vol 7 Appendix B.1.

Operation

4.3.18 The site specific assumptions in terms of the assumed capacity of the carbon filter and air release rate used for the odour dispersion modelling are described in paras. 4.2.15 - 4.2.17.

4.3.19 Odour dispersion modelling only includes emissions from the ventilation structure and does not take account of background concentrations from other sources. Background odour concentrations in the area are assumed to be low as there have only been 19 complaints in the surrounding area over the last five years (see para. 4.4.12) and seasonal spot measurements of hydrogen sulphide (H_2S) carried out in 2011/12 indicate that concentrations are typical of urban areas[3].

4.3.20 Following dispersion modelling, the maximum concentration predicted at any location has been reported whether this is at a building where people could be exposed or on open land. As a reasonable worst case assumption, it has been assumed that this is a relevant receptor. This means that should the ventilation structure be moved within the zone identified on the Site parameter plan (see separate volume of figures - Section 1), the impact would not be worse than that reported in Section 4.6.

Limitations

4.3.21 The general limitations associated with this assessment are presented in Vol 2 Section 4.

Construction

4.3.22 There are no limitations specific to the assessment of this site.

Operation

4.3.23 There are no limitations specific to the odour assessment of this site.

4.4 Baseline conditions

4.4.1 The following section sets out the baseline conditions for air quality and odour within and around the site. Baseline conditions (base case) are also described.

Current baseline

Local air quality

4.4.2 The current conditions with regard to local air quality are best established through long-term air quality monitoring.

4.4.3 As part of their duties under Part IV of the Environment Act 1995[4], local authorities, especially in urban areas, where air quality is a significant issue, undertake long-term air quality monitoring within their administrative areas.

4.4.4 There are three continuous monitoring stations and two diffusion tubes which collect data pertinent to the Putney Embankment Foreshore site and associated construction traffic routes operated by the LB of Wandsworth and the LB of Richmond upon Thames. The location of these sites is shown in Vol 7 Figure 4.4.1 (see separate volume of figures). Monitoring data for the local authority monitoring sites for the period 2007-2011 are contained in Vol 7 Table 4.4.1 (NO_2 concentrations) and Vol 7 Table 4.4.2 (PM_{10} concentrations).

Vol 7 Table 4.4.1 Air quality – measured NO_2 concentrations

Monitoring site	Site type	Annual mean (µg/m³)					Number of exceedances of hourly standard				
		2011	2010	2009	2008	2007	2011	2010	2009	2008	2007
Continuous monitoring sites											
Putney High Street (WA7)	Kerbside	**154**	**168***	**155****	NM	NM	**2775**	**2485***	**1109****	NM	NM
Putney High Street façade (WA8)	Roadside	**128**	**135*****	NM	NM	NM	**1676**	**1064*****	NM	NM	NM
Putney (WA9)	Urban background	**45********	NM	NM	NM	NM	11 (187)****	NM	NM	NM	NM
London Wetland Centre (RI2)	Suburban	26	30	29	29	31	0	0	0	1	0
Diffusion tube monitoring sites											
Putney High Street (W9)	Roadside	**105**	**101**	**103**	**119**	**114**	NM				
Werter Road, Putney (W10)	Urban background	33	38	38	**44**	37	NM				

*Note: NM indicates not measured. Emboldened figures indicate an exceedance of the objective / limit value which is 40µg/m³ for the annual mean and 200µg/m³ for the hourly mean which can be exceeded 18 times per year. * Data capture of 85%.*
*** Data capture of 45%. *** Data capture of 51%. **** Data capture of 87%, the figure in brackets for the hourly exceedances is the 99.8th percentile. Codes in brackets represent monitoring site identifiers used in Vol 7 Figure 4.4.1 (see separate volume of figures).*

4.4.5 The monitoring data at these sites show that the annual mean NO_2 objective / limit value has been exceeded at the roadside, kerbside and urban background sites in Putney, but not at the suburban site at the London Wetland Centre (RI2) and, with the exception of one year, not at the urban background site at Werter Road (W10) in recent years. The hourly mean NO_2 objective / limit value has also been exceeded at the roadside and kerbside sites in all years that data were available.

Vol 7 Table 4.4.2 Air quality – measured PM_{10} concentrations

Monitoring site	Site type	Annual mean (µg/m³)					Number of exceedances of daily standard				
		2011	**2010**	**2009**	**2008**	**2007**	**2011**	**2010**	**2009**	**2008**	**2007**
Continuous monitoring site											
Putney High Street (WA7)	Kerbside	32	29*	30**	NM	NM	31	5 (40.0)*	6 (41.8)**	NM	NM
Putney (WA9)	Urban background	22***	NM	NM	NM	NM	14 (40)***	NM	NM	NM	NM
London Wetland Centre (RI2)	Suburban	22	19	20	19	20	17	1	5	8	19

*Note: NM indicates not measured. Emboldened figures indicate an exceedance of the objective / limit value which is 40µg/m³ for the annual mean and 50µg/m³ for the daily mean which can be exceeded 18 times per year. * Data capture of 88%, the figure in brackets for the daily exceedances is the 90th percentile. ** Data capture of 42%, the figure in brackets for the daily exceedances is the 90th percentile. *** Data capture of 79%, the figure in brackets for the daily exceedances is the 90th percentile. Codes in brackets represent monitoring site identifiers used in Vol 7 Figure 4.4.1 (see separate volume of figures).*

4.4.6 The PM_{10} monitoring at Putney High Street indicates that the annual and daily mean objectives / limit values were met in 2009, 2010 and 2011. Monitoring at this site did not start until July 2009. The PM_{10} monitoring at the urban background site in Putney indicates that the annual and daily mean objectives / limit values were met in 2011. Monitoring at this site did not start until January 2011. The PM_{10} monitoring at the London Wetland Centre indicates that the annual and daily mean objectives / limit values were met in all five years.

4.4.7 The LB of Wandsworth has declared the whole Borough an AQMA for both NO_2 and PM_{10}.

4.4.8 In addition to the local authority monitoring, diffusion tube monitoring has been undertaken as part of the environmental impact assessment (EIA) to monitor NO_2 concentrations in the vicinity of the Putney Embankment Foreshore site. This monitoring comprises five diffusion tubes based at the locations identified in Vol 7 Table 4.4.3. The table shows a 2010 annual mean concentration (baseline year), which has been calculated from the measurements made between April 2011 and April 2012 at each of the sites. To calculate the 2010 annual mean NO_2 concentrations, the 2011/12 measurements are adjusted for bias using the co-located diffusion tubes and are then seasonally adjusted. Annual mean NO_2 concentrations, for the period covered by the diffusion tubes, and for the year 2010 have been collated from four nearby background continuous monitoring sites measuring NO_2 and with data capture rates greater than 90%. The average of the ratios between the period and annual means has been used to calculate the seasonal adjustment factor. To enable any bias to be corrected a triplicate site (comprising three diffusion tubes) was established at the continuous monitoring site in Putney (site PEFM4 – see Vol 7); otherwise all the monitoring locations had single tubes.

Vol 7 Table 4.4.3 Air quality – additional monitoring locations

Monitoring site	Grid reference	Site type	2010 NO_2 annual mean ($\mu g/m^3$)
Putney Embankment (PEFM1)	523996, 175744	Roadside	**49.5**
Lower Richmond Rd (PEFM2)	524110, 175641	Roadside	**131.5**
Putney High Street (PEFM3)	524085, 175474	Roadside	**132.0**
Putney High Street (PEFM4)	524031,175333	Roadside	**172.6**
Montserrat Road (PEFM5)	524133, 175282	Urban background	**53.9**

Note: Emboldened figures indicate an exceedance of the objective / limit value which is $40\mu g/m^3$ for the annual mean.

4.4.9 All five sites recorded concentrations above the NO_2 annual mean standard of 40µg/m^3. The concentrations recorded during the monitoring are similar to those recorded during local authority monitoring at roadside sites and are typical of the high levels in London.

4.4.10 This monitoring has been used in conjunction with existing LB of Wandsworth monitoring to define the baseline situation and also to provide input to model verification[iii].

4.4.11 In addition to monitoring data, an indication of baseline pollutant concentrations in the vicinity of the site has been obtained from the background data on the air quality section of the Defra website[5]. Mapped background pollutant concentrations are available for each 1km by 1km grid square within every local authority's administrative area for the years 2008 to 2020. The background data relating to the Putney Embankment Foreshore site are given in Vol 7 Table 4.4.4 for 2010 (baseline year).

Vol 7 Table 4.4.4 Air quality – 2010 background pollutant concentrations

Pollutant*	2010
NO_2 (µg/m^3)	34.6
PM_{10} (µg/m^3)	20.2

** Average of annual means for 1km grid squares centred on 523500, 175500 and 524500, 175500. An average of two squares has been used as the site straddles two 1km grid squares.*

Odour

4.4.12 The LB of Wandsworth has not received any odour complaints for the local area over recent years[6]. Complaints in the Thames Water database were reviewed within an area of 500m radius of the zones identified for the proposed ventilation column. Over the last five years (2007–2011), 19 complaints were received relating to odour.

4.4.13 Data gathering for the EIA included spot measurements of H_2S made near the site, the results of which are summarised in Vol 7 Table 4.4.5 and the monitoring locations shown in Vol 7 Figure 4.4.2 (see separate volume of figures). The highest concentrations, up to 13.4µg/m^3, were measured on 21 October 2011 during southwesterly wind conditions. These levels are typical of urban areas3 when a faint odour may be detectable on occasions[7,iv].

[iii] Model verification refers to checks that are carried out on model performance at a local level. This basically involves the comparison of predicted (modelled) versus measured concentrations. Where there is a disparity between the predicted and the measured concentrations, the first step should always be to check the input data and model parameters in order to minimise the errors. If required, the second step would be to determine an appropriate adjustment factor that can be applied to the modelled traffic contribution.

[iv] The H_2S odour detection threshold is 7ug/m^3 which is the level at which 50% of the people on an odour panel who have been proven to have a good sense of smell can just detect the gas in laboratory controlled conditions.

Vol 7 Table 4.4.5 Odour – measured H_2S concentrations

Location	Grid reference	Date	Time	H_2S concentration ($\mu g/m^3$)
Past Public House (PEFS1)	523933, 175795	28/08/11	13:40:16	0.0
		28/08/11	13:40:46	0.0
		26/02/12	09:00:26	4.2
		26/02/12	09:00:53	4.6
Opposite Thai Square restaurant (PEFS2)	524069, 175697	28/08/11	13:37:27	0.0
		28/08/11	13:37:56	4.9
		21/10/11	18:05:36	8.4
		21/10/11	18:06:29	9.3
		26/02/12	08:57:28	5.7
		26/02/12	08:57:57	5.4
Slipway (PEFS3)	524104, 175676	28/08/11	13:35:44	0.0
		28/08/11	13:36:14	0.0
		21/10/11	18:03:08	13.4
		21/10/11	18:04:07	11.4
		26/02/12	08:55:27	7.0
		26/02/12	08:55:56	6.8
Meteorological conditions: 28/08/11 SW wind up to 2m/s, partially cloudy, rain on previous day. 21/10/11 SW wind at 0m/s, cloudy. 26/02/12 Last rain was light 23/02, occasional light SW wind.				

Receptors

4.4.14 As set out in Section 4.1 and Vol 2 Section 4, the air quality assessment involves the selection of appropriate receptors, which are shown in Vol 7 Figure 4.4.3 (see separate volume of figures) and the table below (Vol 7 Table 4.4.6) for the Putney Embankment Foreshore site. All of these receptors are relevant, albeit with different levels of sensitivity to each of the elements of the air quality assessment. The sensitivity of identified receptors has been determined using the criteria detailed in Vol 2 Section 4.

4.4.15 It is noted that Vol 7 Table 4.4.6 includes four receptors associated with new developments (2 Putney High Street, 4-6 Putney High Street and 45-53 Putney High Street/329-339 Putney Bridge Road (see site development schedule in Vol 7 Appendix N) for consideration in the air quality and odour assessments.

Vol 7 Table 4.4.6 Air quality and odour – receptors

Receptors (relating to all identified emissions sources)	Approximate distance of modelled receptor from site boundary and direction from site	Receptor sensitivity		
		Air quality (construction traffic, river tugs for barges and construction plant)	Construction dust (on-site demolition and construction processes)	Odour (ventilation column)
Residential – Houseboats at Putney Pier (PEFR5)	10m north of main site	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Residential - Kenilworth Court (PEFR9)	20m south of main site	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Residential - Putney Wharf Tower (PEFR13)	40m southeast of main site	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Residential - Star and Garter Mansions (PEFR4)	65m west of main site	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Residential - 329 - 339 Putney Bridge Road (PEFR18)*	170m southeast of main site	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Residential - 45-53 Putney High Street (PEFR19)*	170m southeast of main site	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Residential - Ruvigny Gardens (PEFR2)	12m south of Putney	High (exposure relevant for annual mean, daily mean and hourly mean	Medium	High

Receptors (relating to all identified emissions sources)	Approximate distance of modelled receptor from site boundary and direction from site	Receptor sensitivity		
		Air quality (construction traffic, river tugs for barges and construction plant)	Construction dust (on-site demolition and construction processes)	Odour (ventilation column)
	Embankment secondary site	standards)		
Residential - Ruvigny Mansions (PEFR15)	12m south of Putney Embankment secondary site	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Commercial/Retail – café at 2 Putney High Street (PEFR10)*	Adjacent to main site	Medium (exposure is relevant for the hourly mean standard only)	Medium	Medium
Commercial/Retail – café at 4-6 Putney High Street (PEFR17)*	Adjacent to main site	Medium (exposure is relevant for the hourly mean standard only)	Medium	Medium
Commercial - Thai Square restaurant (PEFR7)	8m south of main site	Medium (exposure is relevant for the hourly mean standard only)	Medium	Medium
Commercial – Chas Newen Marine (boat repair and builders) (PEFR16)	7m south of Putney Embankment secondary site	Low (exposure not relevant for the local air quality objectives)	Medium	Medium
Duke's Head public house (PEFR11)	19m south of main site	Medium (exposure is relevant for the hourly mean standard only)	Medium	Medium
Place of Worship - St Mary's Church (PEFR12)	5m south of main site	Medium (exposure is relevant for the hourly mean standard only)	Medium	Medium
Recreational - Thames Path (PEFR6)	Adjacent to main site	Low (exposure is relevant for the hourly mean standard only)	Low	Low

Receptors (relating to all identified emissions sources)	Approximate distance of modelled receptor from site boundary and direction from site	Receptor sensitivity		
		Air quality (construction traffic, river tugs for barges and construction plant)	Construction dust (on-site demolition and construction processes)	Odour (ventilation column)
Recreational - River Thames (PEFR8)	Adjacent to main site	Low (exposure is relevant for the hourly mean standard only)	Low	Low
Recreational - Constitutional Club (PEFR3)	8m south of Putney Embankment secondary site	Medium (exposure is relevant for the hourly mean standard only).	Medium	High
Recreational - London Rowing Club (PEFR1)	70m northwest of Putney Embankment secondary site	Medium (exposure is relevant for the hourly mean standard only)	Medium	Medium
Recreational - Odeon Cinema (PEFR14)	82m south of main site	Medium (exposure is relevant for the hourly mean standard only)	Medium	Medium

** Denotes receptor that is altered or constructed after the baseline year.*

Construction base case

4.4.16 The base case conditions for the construction assessment year would be expected to change from the baseline conditions due to modifications to the sources of the air pollution in the intervening period.

4.4.17 For road vehicles, there would be an increase in the penetration of new Euro emissions standards[8] to the London vehicle fleet between the current situation and Site Year 2 of construction. Euro standards define the acceptable exhaust emission limits for new vehicles sold in the EU. These standards are defined through a series of European Union directives staging the progressive introduction of increasingly stringent standards over time. The uptake of newer vehicles with improved emission controls should lead to a reduction in NO_2 and PM_{10} concentrations over time. These changes in fleet composition and the emissions are covered in this assessment.

4.4.18 Other emissions sources should also reduce due to local and national policies. Therefore, the non-road sources of the background concentrations used in the modelling have been reduced in line with Defra guidance LAQM.TG(09)[9]. Background pollutant concentrations for Site Year 2 of construction (peak construction year) used in the modelling are shown in Vol 7 Table 4.4.7.

4.4.19 The background NO_2 concentration has been derived from the 2010 annual mean measured at the background site at Werter Road (W10) while the background PM_{10} concentration has been taken from the LB of Richmond upon Thames background site at the London Wetland Centre (RI2).

Vol 7 Table 4.4.7 Air quality – annual mean background pollutant concentrations

Pollutant	Baseline (2010)	Peak construction year (Site Year 2 of construction)
NO_2 ($\mu g/m^3$)*	38.0	28.9
PM_{10} ($\mu g/m^3$)**	19.2	17.5

** Derived from W10 2010 monitoring. ** Derived from RI2 2010 monitoring.*

4.4.20 As indicated in para. 4.3.8, the base case in Site Year 2 of construction takes into account the proposed developments at 2 Putney High Street, 4-6 Putney High Street and 45-53 Putney High Street/329-339 Putney Bridge Road, including them as receptor locations in the air quality assessment. These developments are included in the receptor list provided in Vol 7 Table 4.4.6.

Operational base case

4.4.21 Base case conditions have been assumed to be the same as baseline conditions with respect to background odour concentrations as no change in background odour concentrations is anticipated.

4.4.22 As indicated in para. 4.3.14, the base case for the odour assessment takes into account the proposed developments at 2 Putney High Street, 4-6 Putney High Street and 45-53 Putney High Street/329-339 Putney Bridge Road, including them as receptor locations in the odour assessment. These developments are included in the receptor list provided in Vol 7 Table 4.4.6.

4.5 Construction effects assessment

Local air quality assessment

4.5.1 Construction effects on local air quality (comprising emissions from construction road traffic, tugs for river barges and construction plant) have been assessed following the modelling methodology set out in Vol 2 Section 4. This involves predicting NO_2 and PM_{10} concentrations in the baseline year (2010), and in the peak construction year (Site Year 2 of construction) without the proposed development (base case) and with the proposed development (development case). Predicted pollutant concentrations for the base case and development case can then be compared to determine the air quality impacts associated with the project and considering these in the context of statutory air quality objectives/limit values to determine the significance of effects at specified receptors (listed in Vol 7 Table 4.4.6).

4.5.2 The assessment has focussed on NO_2 and PM_{10} concentrations as these are the only pollutants whose air quality standards may be exceeded. From professional experience, emissions of other pollutants (eg, volatile organic compounds (VOCs) are very unlikely to be significant and therefore do not need to be assessed.

4.5.3 A model verification exercise has been undertaken at the Putney Embankment Foreshore site in line with the Defra guidance LAQM.TG(09)9. This checks the model performance against measured concentrations. For the NO_2 assessment this was done by using the four roadside monitoring sites established for this assessment and two local authority diffusion tubes (PEFM1-PEFM3, PEFM5 - see Vol 7 Table 4.4.3, WA7 and W9 – see Vol 7 Table 4.4.1). For the PM_{10} assessment, the verification process was undertaken using the continuous monitoring site on Putney High Street (WA7 – see Vol 7 Table 4.4.2). Further details regarding the verification process are included in Vol 7 Appendix B.1. The model adjustment factor derived from the verification process was applied to all model results.

4.5.4 The model inputs for the local air quality assessment for the Putney Embankment Foreshore site are also detailed in Vol 7 Appendix B.2, B.3 and B.4. This includes road traffic data (comprising annual average daily traffic flows, heavy good vehicle proportions and speeds for each road link) and data pertaining to the tugs for river barges and construction plant.

NO_2 concentrations

4.5.5 Predicted annual mean NO_2 concentrations for the modelled scenarios are shown in Vol 7 Table 4.5.1. This table details the forecast NO_2

concentrations at specific sensitive receptors. Annual mean results are shown for all of the sensitive receptors, but the receptors are divided into two groups depending on whether the annual mean objective/limit value applies or not. The annual mean criteria only apply at those receptors which could be occupied continually for a year (eg, residential properties). Exceedances of the hourly criteria are inferred from the annual mean concentration. Additionally, contour plots are provided (Vol 7 Figure 4.5.1 to Vol 7 Figure 4.5.3, see separate volume of figures) showing modelled concentrations for the baseline, base case and development case scenarios over the construction assessment area. A plot showing the change in NO_2 annual mean concentrations between the base and development cases (in the peak construction year) is also presented at Vol 7 Figure 4.5.4 (see separate volume of figures).

4.5.6 The modelled concentrations in Vol 7 Table 4.5.1 show that annual mean NO_2 levels are predicted to decrease between 2010 and the peak construction year with or without the Thames Tideway Tunnel project. This decrease is due to predicted reductions in background concentrations and improved vehicle engine technology. The results for the development case show small increases over the base case at all modelled receptors due to the construction works at the Putney Embankment Foreshore site.

4.5.7 Exceedances of the annual mean objective / limit value (40µg/m^3) are predicted for all receptors in the baseline scenario. In the base and development cases, the annual mean objective / limit value is exceeded at all but five receptors (residential properties at Ruvigny Mansions (PEFR15) and Ruvigny Gardens (PEFR2), Chas Newen Marine (PEFR16), Constitutional Club (PEFR3) and London Rowing Club (PEFR1). In line with LAQM.TG(09)9, modelled concentrations above 60µg/m^3 indicate exceedances of the hourly NO_2 air quality objective. Therefore, exceedances are considered likely at eleven receptors in the baseline case and at ten receptors in the base and development cases.

Vol 7 Table 4.5.1 Air quality – predicted annual mean NO_2 concentrations

Receptor	Predicted annual mean NO_2 concentration (µg/m^3)			Change between base and dev cases (µg/m^3)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak construction year dev case		
Receptors where the annual mean objective / limit value applies					
Houseboat (PEFR5)	**54.7**	**41.8**	**42.5**	0.7	Small
Kenilworth Court residential (PEFR9)	**121.2**	**98.6**	**99.7**	1.1	Small
Putney Wharf	**84.9**	**67.6**	**67.8**	0.2	Negligible

Receptor	Predicted annual mean NO_2 concentration ($\mu g/m^3$)			Change between base and dev cases ($\mu g/m^3$)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak construction year dev case		
Tower residential (PEFR13)					
Star and Garter Mansions residential (PEFR4)	**58.5**	**45.0**	**45.2**	0.2	Negligible
329-339 Putney Bridge Road (PEFR18)*	**119.2**	**96.0**	**96.3**	0.3	Negligible
45-53 Putney High Street (PEFR19)*	**158.0**	**125.5**	**125.7**	0.2	Negligible
Ruvigny Gardens residential (PEFR2)	**48.2**	36.5	36.5	0.0	Negligible
Ruvigny Mansions residential (PEFR15)	**44.5**	33.9	33.9	0.0	Negligible
Receptors where the annual mean objective / limit value does not apply					
2 Putney High Street commercial/ retail (PEFR10)*	**130.5**	**104.3**	**105.4**	1.1	Small
4-6 Putney High Street commercial/ retail (PEFR17)*	**130.3**	**105.5**	**106.4**	0.9	Small
Thai Square restaurant (PEFR7)	**72.6**	**57.4**	**58.6**	1.2	Small
Chas Newen Marine (PEFR16)	**45.4**	34.2	34.3	0.1	Negligible

Receptor	Predicted annual mean NO_2 concentration ($\mu g/m^3$)			Change between base and dev cases ($\mu g/m^3$)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak constructio n year dev case		
Duke's Head public house (PEFR11)	**169.0**	**135.4**	**136.5**	1.1	Small
St Mary's Church (PEFR12)	**158.2**	**126.9**	**127.7**	0.8	Small
Thames Path (PEFR6)	**59.3**	**45.3**	**46.5**	1.1	Small
River Thames (PEFR8)	**97.9**	**78.7**	**79.4**	0.7	Small
Constitutional Club (PEFR3)	**52.7**	39.9	40.0	0.2	Negligible
London Rowing Club (PEFR1)	**43.3**	33.0	33.0	0.0	Negligible
Odeon Cinema (PEFR14)	**160.2**	**128.3**	**128.7**	0.4	Small

*Note: Emboldened figures indicate an exceedance of the criteria which is 40µg/m³ for the annual mean. * Denotes receptor that is altered or constructed after the baseline year. Changes in concentration at each receptor have been rounded to one decimal place.*

4.5.8 The highest increase in annual mean concentration as a result of the construction works at the Putney Embankment Foreshore site is 1.2$\mu g/m^3$ which is predicted at the Thai Square restaurant (PEFR7). However the annual mean objective / limit value (40$\mu g/m^3$) does not apply at this receptor. The largest increase at a receptor where exposure to the annual mean concentration is relevant is 1.1$\mu g/m^3$ at Kenilworth Court (PEFR9). This increase is described as small magnitude according to the criteria detailed in Vol 2 Section 4.

4.5.9 The significance of the effect at residential properties in Kenilworth Court (PEFR9) and the house boat (PEFR5) which have a high sensitivity to local air quality is **minor adverse** (according to the criteria detailed in Vol 2 Section 4). At 2 Putney High Street (PEFR10), 4-6 Putney High Street (PEFR17), the Duke's Head public house (PEFR11) and St Mary's Church (PEFR12) which have a medium sensitivity to local air quality and at which the hourly objective / limit value applies, the significance of the effect would also be **minor adverse**. The significance of effects would be **minor adverse** on the River Thames (PEFR8), the Odeon cinema (PEFR14) and the commercial properties on the Thai Square restaurant (PEFR7), which have a low sensitivity to local air quality and at which the hourly objective /

limit value applies. All other receptors would have a **negligible** effect from NO_2.

PM_{10} concentrations

4.5.10 Predicted annual mean PM_{10} concentrations for the modelled scenarios, taking account of emissions from construction road traffic, tugs for river barges and construction plant, are shown in Vol 7 Table 4.5.2. This table details the forecast PM_{10} concentrations at specific sensitive receptors. Additionally, contour plots are provided (Vol 7 Figure 4.5.5 to Vol 7 Figure 4.5.7, see separate volume of figures) showing modelled concentrations for the baseline, base case and development case scenarios over the construction assessment area. A plot showing the change in annual mean PM_{10} concentrations between the base and development cases (in the peak construction year) is also presented at Vol 7 Figure 4.5.8 (separate volume of figures).

4.5.11 The modelled concentrations in Vol 7 Table 4.5.2 show that annual mean concentrations of PM_{10} are predicted to achieve the annual mean criteria (40µg/m^3) and decrease between 2010 and the peak construction year with or without the Thames Tideway Tunnel project. This decrease is due to predicted reductions in background concentrations and improved vehicle engine technology. The predicted results for the development case show increases over the base case at all modelled receptors due to construction activities at the Putney Embankment Foreshore site.

Vol 7 Table 4.5.2 Air quality – predicted annual mean PM_{10} concentrations

Receptor	Predicted annual mean PM_{10} concentration (µg/m^3)			Change between base and dev cases (µg/m^3)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak construction year dev case		
Receptors where the annual mean objective / limit value applies					
Houseboat (PEFR5)	21.4	19.2	19.5	0.2	Negligible
Kenilworth Court residential (PEFR9)	28.5	24.1	24.7	0.6	Small
Putney Wharf Tower residential (PEFR13)	23.8	20.7	20.8	0.1	Negligible
Star and Garter Mansions residential (PEFR4)	23.2	20.7	20.8	0.1	Negligible

Receptor	Predicted annual mean PM_{10} concentration ($\mu g/m^3$)			Change between base and dev cases ($\mu g/m^3$)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak construction year dev case		
329-339 Putney Bridge Road (PEFR18)*	30.1	25.0	25.1	0.1	Negligible
45-53 Putney High Street (PEFR19)*	30.6	25.2	25.3	0.1	Negligible
Ruvigny Gardens residential (PEFR2)	20.9	18.9	19.0	0.0	Negligible
Ruvigny Mansions residential (PEFR15)	20.4	18.5	18.5	0.0	Negligible
Receptors where the annual mean objective / limit value does not apply					
2 Putney High Street commercial / retail (PEFR10)*	29.5	24.5	25.1	0.5	Small
4-6 Putney High Street commercial/ retail (PEFR17)*	29.3	24.6	25.0	0.5	Small
Thai Square restaurant (PEFR7)	25.9	23.0	23.3	0.4	Small
Chas Newen Marine (PEFR16)	20.5	18.6	18.6	0.0	Negligible
Duke’s Head public house (PEFR11)	32.8	27.0	27.3	0.3	Negligible
St Mary's Church (PEFR12)	31.9	26.4	26.6	0.2	Negligible
Thames Path (PEFR6)	22.6	20.3	20.5	0.2	Negligible

Receptor	Predicted annual mean PM_{10} concentration ($\mu g/m^3$)			Change between base and dev cases ($\mu g/m^3$)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak construction year dev case		
River Thames (PEFR8)	28.0	24.2	24.6	0.4	Small
Constitutional Club (PEFR3)	21.9	19.7	19.8	0.0	Negligible
London Rowing Club (PEFR1)	20.1	18.3	18.3	0.0	Negligible
Odeon Cinema (PEFR14)	31.5	26.0	26.2	0.2	Negligible

*Note: * Denotes receptor that is altered or constructed after the baseline year. Changes in concentration at each receptor have been rounded to one decimal place.*

4.5.12 The largest predicted increase in the annual mean concentration as a result of construction at the Putney Embankment Foreshore site is 0.6$\mu g/m^3$ predicted at the residential properties at Kenilworth Court (PEFR9). This change is described as small according to the criteria detailed in Vol 2 Section 4.

4.5.13 With no exceedances of the annual mean PM_{10} standard (40$\mu g/m^3$), the significance of the effects is **negligible** at all receptors.

4.5.14 With regard to the daily mean PM_{10} concentrations, Vol 7 Table 4.5.3 shows the predicted number exceedances of the daily PM_{10} standard (50$\mu g/m^3$) for each modelled scenario. The objective / limit value allows no more than 35 exceedances in a year.

4.5.15 The results in Vol 7 Table 4.5.3 show that the number of daily exceedances of PM_{10} is predicted to decrease between 2010 and the peak construction year with or without the Thames Tideway Tunnel project. This decrease is due to predicted reductions in background concentrations and improved vehicle engine technology. In the baseline case, there are two receptors which are predicted to exceed the objective / limit value of no more 35 exceedances per year. There are no predicted exceedances in the base or development cases.

4.5.16 At the receptors where the daily objective applies, the predicted results for the development case show a maximum increase of one day with concentrations above 50$\mu g/m^3$ compared with the base case at the residential properties at Kenilworth Court residential (PEFR9) due to construction works at the Putney Embankment Foreshore site.

4.5.17 With no exceedances of the daily PM_{10} criteria in the development case, the significance of the effects would be **negligible** at all sensitive receptors.

Vol 7 Table 4.5.3 Air quality – predicted number of exceedances of the daily PM_{10} standard

Receptor	Predicted number of exceedances of the daily PM_{10} standard			Change between base and dev cases (days)	Magnitude of impact
	2010 baseline	Peak construction year base case	Peak construction year dev case		
Receptors where the objective / limit value does apply					
Houseboat (PEFR5)	5	3	3	0	Negligible
Kenilworth Court residential (PEFR9)	22	10	12	1	Small
Putney Wharf Tower residential (PEFR13)	10	4	4	0	Negligible
Star and Garter Mansions residential (PEFR4)	8	4	4	0	Negligible
329-339 Putney Bridge Road (PEFR18)*	28	12	13	0	Negligible
45-53 Putney High Street (PEFR19)*	30	13	13	0	Negligible
Ruvigny Gardens residential (PEFR2)	5	2	2	0	Negligible
Ruvigny Mansions residential (PEFR15)	4	2	2	0	Negligible
Receptors where the objective / limit value does not apply					
2 Putney High Street commercial/retail (PEFR10)*	26	11	13	1	Small
4-6 Putney High Street commercial/retail (PEFR17)*	25	11	12	1	Small
Thai Square	15	8	9	1	Small

Receptor	Predicted number of exceedances of the daily PM_{10} standard			Change between base and dev cases (days)	Magnitude of impact
	2010 baseline	**Peak construction year base case**	**Peak construction year dev case**		
restaurant (PEFR7)					
Chas Newen Marine (PEFR16)	4	2	2	0	Negligible
Duke's Head public house (PEFR11)	**39**	18	19	1	Small
St Mary's Church (PEFR12)	35	16	17	1	Small
Thames Path (PEFR6)	7	4	4	0	Negligible
River Thames (PEFR8)	21	10	11	1	Small
Constitutional Club (PEFR3)	6	3	3	0	Negligible
London Rowing Club (PEFR1)	4	2	2	0	Negligible
Odeon Cinema (PEFR14)	33	15	15	0	Negligible

*Note: Emboldened figures indicate an exceedance of the criteria (objective / limit value) which is more than 35 exceedances per year. * Denotes receptor that is altered or constructed after the baseline year. Changes at each receptor have been rounded to the nearest whole number.*

Sensitivity test for programme delay

4.5.18 For the assessment of local air quality effects during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the assessment findings reported above for the existing and proposed receptors. Based on the development schedule (Vol 7 Appendix N), there would be no new receptors requiring assessment as a result of a one year delay.

Construction dust

4.5.19 Construction dust would be generated from both on-site activities and from road vehicles accessing and servicing the site.

4.5.20 Dust sensitive receptors have been identified in the vicinity of the Putney Embankment Foreshore site in accordance with the criteria in Vol 2 Section 4, as described in Vol 7 Table 4.4.6. A summary of the approximate numbers of receptors in distance bands from the Putney Embankment Foreshore site is detailed in Vol 7 Table 4.5.4.

Vol 7 Table 4.5.4 Air quality – numbers of dust sensitive receptors

Buffer distance (m)	Number of receptors*	Receptor type
<20	10-100	Residential, commercial/retail, Thames Path, church, public house, cinema, River Thames
20-50	10-100	Residential, commercial/retail
50-100	100-500	Residential, commercial/retail
100-350	More than 500	Residential, commercial/retail, open space, community facilities

** Buildings or locations that could be affected by nuisance dust.*

4.5.21 In line with the IAQM guidance[10], the site has been categorised using the criteria given in Vol 2 Section 4 to assess the likely impacts from demolition, earthworks, construction and trackout activities during construction and the likely effects of these activities on sensitive receptors close to the development.

4.5.22 The demolition for the Putney Embankment Foreshore site is classified as a ‘small’ dust emission class. This classification is based on the small size of the demolition volumes, which would be less than 20,000m^3. As the nearest receptor is within 20m from the construction site, this makes the risk category for demolition activities medium risk.

4.5.23 The earthworks have been assessed to be a ‘large’ dust emission class as the size of the construction site is greater than 10,000m^2 and the total material to be moved is between 20,000 tonnes and 100,000 tonnes. With the nearest receptor 20m away, the site is assessed to be high risk for earthworks.

4.5.24 The construction proposed for the Putney Embankment Foreshore site has a ‘medium’ dust emission class. This classification is based on the medium volumes of building materials, the use of piling for the cofferdam and the use of on-site concrete batching. The risk category for construction activities is therefore assessed to be high risk due to the proximity of sensitive receptors.

4.5.25 There would be 50-100m of unpaved haul roads on site, and the number of construction lorries per day would be 25-100 so the trackout dust emission class is classified as ‘medium’. The closest receptor is within 20m of the affected roads. The risk category from trackout is therefore assessed to be medium risk.

4.5.26 The risk categories for the four activities are summarised in Vol 7 Table 4.5.5. This summary of these risks does not take into account the measures outlined in the *CoCP* Part A (*Parts A* and *B*).

Vol 7 Table 4.5.5 Air quality – summary of construction dust risks

Source	Dust soiling / PM_{10} effects
Demolition	Medium risk site

Source	Dust soiling / PM_{10} effects
Earthworks	High risk site
Construction	High risk site
Trackout	Medium risk site

Note: without CoCP measures

4.5.27 On this basis, the development at the Putney Embankment Foreshore site is classified as a high risk site overall.

4.5.28 Although the receptor sensitivity (with respect to construction dust nuisance) is identified as medium for all receptors apart from the Thames Path and the River Thames (which are low) (as identified in Vol 7 Table 4.4.6), due to the duration of the works and the high PM_{10} background concentrations in the locality, the sensitivity of the area has been defined as ‘high’.

4.5.29 With regard to the significance of effects, a high risk site with a high sensitivity of the area would result in a moderate adverse effect without control measures. When the measures outlined in the *CoCP* Part A (Section 7) are applied, the significance of the effect would be reduced to **minor adverse** for receptors within 20m of the Putney Embankment Foreshore site (in accordance with IAQM guidance). For receptors beyond 20m from the site the significance of the effect would be reduced to **negligible**. The significance of the effect for each receptor is summarised in Vol 7 Table 4.5.6.

Vol 7 Table 4.5.6 Air quality – significance of construction dust effects

Receptor	Significance of effect
Houseboat (PEFR5)	Minor adverse
Kenilworth Court residential (PEFR9)	Minor adverse
Putney Wharf Tower residential (PEFR13)	Negligible
Star and Garter Mansions residential (PEFR4)	Negligible
329-339 Putney Bridge Road residential (PEFR18)	Negligible
45-53 Putney High Street residential (PEFR19)	Negligible
Ruvigny Gardens residential (PEFR2)	Minor adverse
Ruvigny Mansions residential (PEFR15)	Minor adverse
2 Putney High Street commercial/retail (PEFR10)	Minor adverse
4-6 Putney High Street commercial/retail	Minor adverse

Receptor	Significance of effect
(PEFR17)*	
Thai Square restaurant (PEFR7)	Minor adverse
Chas Newen Marine (PEFR16)	Minor adverse
Duke's Head public house (PEFR11)	Minor adverse
St Mary's Church (PEFR12)	Minor adverse
Thames Path (PEFR6)	Minor adverse
River Thames (PEFR8)	Minor adverse
Constitutional Club (PEFR3)	Minor adverse
London Rowing Club (PEFR1)	Negligible
Odeon Cinema (PEFR14)	Negligible

4.6 Operational effects assessment

4.6.1 The operational assessment has been undertaken in accordance with the modelling methodology set out in Vol 2. Vol 7 Table 4.6.1 shows the predicted maximum ground level odour concentrations at the Putney Embankment Foreshore site. These are the highest concentrations that could occur at the worst affected ground level receptor at or near the site in a typical year for the most unfavourable locations of the ventilation columns. In accordance with the odour benchmark set by the Environment Agency, results are presented for the 98th percentile of hourly average concentrations in the year (or the 176th highest hourly concentration in the year) and the number of hours in a year with concentrations above 1.5ou_E/m^3. Achieving the 98th percentile is considered to prevent nuisance and protect amenity. The number of hours with concentrations above 1.5ou_E/m^3 gives an indication of the number of hours in a year that an odour might be detectable at the worst affected receptor. The Environment Agency benchmark permits 175 hours above 1.5ou_E/m^3. The table also identifies the magnitude of the identified impacts in accordance with the criteria detailed in Vol 2 Section 4.

Vol 7 Table 4.6.1 Odour – impacts and magnitude operation

Year	Maximum at ground level locations		Impact magnitude and justification
Typical	98th percentile (ouE/m^3)	0	Negligible 98th percentile concentration is less than 1ou_E/m^3
	No. of hours > 1.5ou_E/m^3	0	

4.6.2 In the table above, the 98^{th} percentile is shown as zero as air would be released from the ventilation column for less than 2% (176 hours) of the year. This means that the odour benchmark would be achieved at all locations. This represents an impact of negligible magnitude.

4.6.3 The highest odour concentrations are predicted to occur within 10m of the ventilation column inside the site boundary with concentrations reducing rapidly away from this area. There would be no hours with an odour concentration greater than $1.5ou_E/m^3$. As such, there would be no detectable odour on an hourly basis either on or off site. With a frequent use year (ie, a more rainy year than average), the number of hours with releases would be higher but the amount of odour released would be lower, resulting in no detectable odour when considering hourly average concentrations, either within or beyond the site.

4.6.4 With regard to the significance of effects, given that the predicted odour concentrations at all locations would not exceed the 98^{th} percentile benchmark of $1.5ou_E/m^3$, it is considered that overall significance would be **negligible**. No significant effects are therefore predicted in relation to odour.

4.7 Cumulative effects assessment

Construction effects

4.7.1 As described in Section 4.3, there would not be any cumulative construction effects. Therefore the effects on air quality would remain as described in Section 4.5 above. This would also be the case if the programme for the Thames Tideway Tunnel project was delayed by approximately one year.

Operational effects

4.7.2 As described in Section 4.3, there would not be any cumulative operational effects. Therefore the effects on odour would remain as described in Section 4.6 above.

4.8 Mitigation

Construction

4.8.1 Control measures of relevance to air quality are embedded in the *CoCP* Part A (Section 7) as summarised in Section 4.2. No mitigation is required because effects are not significant.

Operation

4.8.2 Based on the assessment results (which includes the environmental design measures detailed in para. 4.2.17) which indicate that all effects would be negligible, no mitigation is required.

Monitoring

4.8.3 It is envisaged that an appropriate particulate monitoring regime would be agreed with the LB of Wandsworth prior to commencement of construction at the Putney Embankment Foreshore site.

4.9 Residual effects assessment

Construction effects

4.9.1 As no mitigation measures are required, the residual construction effects remain as described in Section 4.5. All residual effects are presented in Section 4.10.

Operational effects

4.9.2 As no mitigation measures are required, the residual operational effects remain as described in Section 4.6. All residual effects are presented in Section 4.10.

4.10 Assessment summary

Vol 7 Table 4.10.1 Air quality – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential - Houseboat (PEFR5)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Minor adverse	None	Minor adverse
Residential - Kenilworth Court (PEFR9)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Minor adverse	None	Minor adverse
Residential - Putney Wharf Tower (PEFR13)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Negligible	None	Negligible
	Effects from construction dust	Negligible	None	Negligible
Residential - Star and Garter Mansions (PEFR4)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Negligible	None	Negligible
	Effects from construction dust	Negligible	None	Negligible
Residential - 329-339 Putney Bridge Road (PEFR18)*	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Negligible	None	Negligible
	Effects from construction dust	Negligible	None	Negligible
Residential - 45-53	Local air quality – effects from construction	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Putney High Street (PEFR19)*	road traffic, tugs for river barges and plant emissions			
	Effects from construction dust	Negligible	None	Negligible
Residential - Ruvigny Gardens (PEFR2)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Negligible	None	Negligible
	Effects from construction dust	Minor adverse	None	Minor adverse
Residential - Ruvigny Mansions (PEFR15)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Negligible	None	Negligible
	Effects from construction dust	Minor adverse	None	Minor adverse
Commercial/Retail - 2 Putney High Street (PEFR10)*	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Minor adverse	None	Minor adverse
Commercial/Retail – 4-6 Putney High Street (PEFR17)*	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Minor adverse	None	Minor adverse
Commercial - Thai Square restaurant (PEFR7)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Minor adverse	None	Minor adverse
Commercial - Chas	Local air quality – effects from construction	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Newen Marine (PEFR16)	road traffic, tugs for river barges and plant emissions			
	Effects from construction dust	Minor adverse	None	Minor adverse
Duke’s Head public house (PEFR11)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Minor adverse	None	Minor adverse
Place of Worship - St Mary's Church (PEFR12)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Minor adverse	None	Minor adverse
Recreational - Thames Path (PEFR6)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Negligible	None	Negligible
	Effects from construction dust	Minor adverse	None	Minor adverse
Recreational - River Thames (PEFR8)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Minor adverse	None	Minor adverse
Recreational - Constitutional Club (PEFR3)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Negligible	None	Negligible
	Effects from construction dust	Minor adverse	None	Minor adverse
Recreation - London	Local air quality – effects from construction	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Rowing Club (PEFR1)	road traffic, tugs for river barges and plant emissions			
	Effects from construction dust	Negligible	None	Negligible
Recreational - Odeon Cinema (PEFR14)	Local air quality – effects from construction road traffic, tugs for river barges and plant emissions	Minor adverse	None	Minor adverse
	Effects from construction dust	Negligible	None	Negligible

** Denotes receptor that is altered or constructed after the baseline year.*

Vol 7 Table 4.10.2 Odour – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential – Houseboat (PEFR5)	Odour	Negligible	None	Negligible
Residential - Kenilworth Court (PEFR9)		Negligible	None	Negligible
Residential - Putney Wharf Tower (PEFR13)		Negligible	None	Negligible
Residential - Star and Garter Mansions (PEFR4)		Negligible	None	Negligible
Residential - Ruvigny Gardens (PEFR2)		Negligible	None	Negligible
Residential - Ruvigny Mansions (PEFR15)		Negligible	None	Negligible
Commercial/Retail - 2 Putney High Street (PEFR10)*		Negligible	None	Negligible
Commercial - Embankment (PEFR7)		Negligible	None	Negligible
Commercial – Chas Newen Marine (PEFR16)		Negligible	None	Negligible
Duke's Head public house (PEFR11)		Negligible	None	Negligible
Place of Worship - St Mary's Church (PEFR12)		Negligible	None	Negligible
Recreational - Thames Path (PEFR6)		Negligible	None	Negligible
Recreational - River Thames (PEFR8)		Negligible	None	Negligible
Recreational - Constitutional Club (PEFR3)		Negligible	None	Negligible
Recreational - London Rowing Club (PEFR1)		Negligible	None	Negligible
Recreational - Odeon Cinema (PEFR14)		Negligible	None	Negligible

** Denotes receptor that is altered or constructed after the baseline year.*

References

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 5: Ecology - aquatic

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

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Thames Tideway Tunnel

Environmental Statement

Volume 7: Putney Embankment Foreshore site assessment

Section 5: Ecology – aquatic

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5 Ecology – aquatic

5.1 Introduction

5.1.1 This section presents the findings of the assessment of the likely significant effects of the proposed development on aquatic ecology at the Putney Embankment Foreshore site.

5.1.2 The proposed development has the potential to affect aquatic ecology due to both the physical works in-river during construction and the operation of the Thames Tideway Tunnel project. During operation the interception of the combined sewer overflow (CSO) would result in substantially reduced discharges of untreated sewage into the Tidal Thames at this location. There would also be permanent in-river structures at this site. Significant construction and operational effects are therefore considered likely, and an assessment of effects on aquatic ecology for both phases is presented.

5.1.3 The presence of sewage in the aquatic environment has adverse effects on aquatic ecology receptors (habitats, mammals, fish, invertebrates and algae). In particular, discharges of untreated sewage effluent can result in low levels of dissolved oxygen (DO), which can cause mass fish mortalities known as hypoxia events. There are CSOs discharging at locations throughout the Tidal Thames, including the reach upstream and downstream of the Putney Bridge CSO.

5.1.4 The Tidal Thames comprises a dynamic environment, in which tidal action leads to dispersal of discharges. Therefore the effects of the operational Thames Tideway Tunnel project, which is designed to intercept the most problematic CSOs would be most evident at a project-wide level. These effects are therefore reported in Volume 3 Project-wide effects assessment. This section assesses the localised effects at a site-specific level for Putney Embankment Foreshore.

5.1.5 The assessment of the likely significant effects of the project on aquatic ecology has considered the requirements of the *National Policy Statement (NPS) for Waste Water*[1]. In line with these requirements, designations, species and habitats relevant to aquatic ecology are identified and measures incorporated into the proposed development described. Based on assessment findings, measures to address likely significant adverse effects are identified. Vol 2 Section 5 provides further details on the methodology.

5.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 7 Putney Embankment Foreshore Figures).

5.2 Proposed development relevant to aquatic ecology

5.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to aquatic ecology are set out below.

Construction

5.2.2 The construction maximum extent of working at Putney Embankment would be located predominantly on the foreshore. Construction activities would occur over three and a half years, with structures in place for approximately three years. The elements of the construction of the proposed development of relevance to aquatic ecology would be as follows:

a. The installation of sheet piling to create a temporary cofferdam on the foreshore using a temporary jack-up barge as shown in the Site parameter plan (see separate volume of figures – Section 1) and subsequent removal of the temporary cofferdam. The installation of cofferdams would be accomplished using a jack-up barge or similar equipment;

b. It is assumed for the assessment that the majority of foreshore material within the temporary cofferdams would remain in situ. For structural reasons, soft material located adjacent to the perimeter of the temporary cofferdams and adjacent to the river wall would be removed. The soft material would include silt, peat and other materials. Removal of this material would ensure that any settlement of the cofferdam fill material would not adversely affect the ties between the walls of the twin walled temporary cofferdam leading to structural difficulties. All soft material within permanent cofferdams would be removed to ensure sound foundations for permanent construction.

c. The exact extent and depth of the foreshore deposits to be removed at each site would be informed by geotechnical investigations. Areas of removed material would be filled with gravel similar to the existing bed material. Cofferdam fill material would then be placed onto the foreshore on top of a geotextile layer. Suitable sized plant would be utilised to reduce potential load impacts on the foreshore. Upon removal of the temporary cofferdam, the fill and geotextile layer would be removed and the bed would be reinstated to match the existing river bed conditions. Material excavated would be disposed of in accordance with the project's Waste Management procedure.

d. The installation of tubular steel piling to support pre-fabricated steel decking for a temporary slipway at the secondary site, upstream of the main Putney Embankment Foreshore site, as shown in the Site parameter plan (see separate volume of figures – Section 1).

e. The placement and removal of a temporary campshed on the foreshore outside the cofferdam at the main site, suitable for up to a 350 tonne barge. Also the placement and removal of a temporary campshed on the foreshore at the secondary site, suitable for up to a 350 tonne barge.

f. Regular barge movements and resting on the campsheds (with a peak monthly average of four movements per day).

g. Occasional evening night time working (up until 22.00) and winter working, during which there would be lighting of in river structures

5.2.3 The construction of in-river structures, and in particular the temporary works cofferdam, would affect the river regime. There is potential for localised increases in flow velocity to cause scour of the river bed and foreshore, or deposition of sediments. The scour could occur around the face of the cofferdam (abutment scour) or across the channel width (contraction scour). Any potential scour development during construction would be monitored and if relevant trigger levels are reached, appropriate protection measures would be provided. Further details are provided in *Scour monitoring and mitigation strategy* (Vol 3 Appendix L.4).

Code of Construction Practice

5.2.4 The *Code of Construction Practice (CoCP)* sets out the standards, procedures and measures for managing and reducing construction effects. The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B). These measures would be implemented through a *Construction environment management plan* (*CEMP*) prepared by the contractor to control site operations and works.

5.2.5 The *CoCP Part A* includes the following measures, which are an integral part of the project and relevant for the purposes of this assessment:

a. The location of barges resting on the foreshore and river bed would be controlled to reduce the extent of potential environmental impacts. The design of facilities such as campsheds would consider the need to minimise environmental impacts and would consider the use of lattice structure barge grids where appropriate. In-river structures, including campsheds, would be removed on completion of the works unless otherwise agreed. Where concrete is used, such as for campsheds, a membrane would be required to protect the underlying riverbed. The method for reinstatement of the temporary works area would be subject to a method statement that would consider requirements in relation to impacts on aquatic ecology (*CoCP Part A* Section 11).

b. Avoiding piling at night to ensure free windows of opportunity to allow fish to migrate past the site within each 24-hour period (*CoCP Part A* Section 6).

c. Undertaking noise measurements at prescribed points and intervals to ensure compliance with the *CoCP* (*CoCP Part A* Section 6).

d. Limiting allowable noise and vibration to leave part of the river cross-section passable at all times (*CoCP Part A* Section 6).

e. Where technically feasible, utilising low noise/vibration cofferdam or pile/pier installation techniques such as pressing or vibro-piling rather than impact/percussive piling. In the event that in-river percussive piling is needed, prior approval from the EA would be required (*CoCP Part A* Section 6).

f. When vibro-piling is undertaken, slowly increasing the power of the driving to enable fish to swim away before the full power of the pile driver is felt through the river (*CoCP Part A* Section 6).

g. The contractor would make every reasonable effort to remove all piles completely from the bed of the river. With the prior written agreement of the PLA the contractor would ensure any piles which prove impossible to fully extract on application of the confirmed minimum crane pull of 40 tonnes, are driven down, cut off or removed to a depth of a least 1 metre below the adjacent riverbed level unless advised otherwise (*CoCP Part A* Section 4).

h. Dewatering operations for cofferdams and in river structures need to consider fish rescue arrangements. To the extent that it is not dealt with in the application for development consent, prior written consent from the EA is required under the Salmon and Freshwater Fisheries Act, 1975, to net or trap fish, or introduce fish into a water course (*CoCP Part A* Section 8).

i. Avoidance of pollution of the river through measures that accord with the principles set out in industry guidelines, including the Environment Agency (EA) note PPG05: *Works in, near or liable to affect water courses* (Environment Agency, undated)[2] and Construction Industry Research and Information Association (CIRIA) report C532: *Control of water pollution from construction sites* (CIRIA, 2001)[3] (*CoCP Part A* Section 8).

j. For works where materials are being loaded and unloaded on the river, the contractor is required to establish suitable management arrangements and mitigation measures so as to prevent spillage of transferred materials. This includes design of conveyor systems, enclosures, conveyor belt scrapper locations and selection of other loading equipment. Monitoring methods and contingencies arrangements are to be included in the *River Transport Management Plan and Emergency Preparedness Plan* (*CoCP Part A* Section 8).

k. In constructing temporary cofferdams the contractor would avoid any mixing of fill material with the underlying substrate. This would be achieved by installing a membrane between the existing river bed and the back fill material (*CoCP Part A* Section 11).

l. Appropriate measures would be taken with regard to ‘in river’ works to minimise the release of suspended sediment and solids into the water column (*CoCP Part A* Section 8).

m. The lighting, to be specified in a *Lighting management plan*, would be designed to comply with relevant standards. This would consider the aquatic environment and avoid direct lighting of watercourses, where reasonably practical, to avoid inhibiting movements of photophobic species such as eel (*CoCP Part A* Section 4) (See para. 5.2.6 for *CoCP Part B* measures for site working hours relevant to lighting at Putney Embankment Foreshore).

5.2.6 The *CoCP Part B* at Putney Embankment Foreshore commits to the following measures that are of relevance to aquatic ecology:

a. A membrane would be installed between the existing river bed and temporary back fill material to prevent contamination of juvenile fish habitat. Areas of foreshore used for temporary works would be restored to similar condition and material prior to the works (*CoCP Part B* Section 11).

b. The site would adhere to standard hours, and continuous hours for the short duration of constructing the short connection tunnel (*CoCP Part B* Section 4).

c. The loading and unloading of barges would only be carried out during standard working hours (*CoCP Part B* Section 6).

Operation

5.2.7 The elements of the operation of the proposed development of relevance to aquatic ecology are set out below. Further information is provided in Section 3 of this volume.

5.2.8 Discharges from the Putney Bridge CSO would be intercepted at the Putney Embankment Foreshore site. Based on the base case (which includes permitted Tidal Thames sewage treatment works upgrades, and the Lee Tunnel scheme, as well as projected population increases) discharges (which have been modelled for 2021) during the Typical Year[i] from the Putney Bridge CSO are anticipated to be 71,000m^3 per annum over a total of 33 discharge events (or spills) by 2021. The discharge is predicted to reduce to 1,600m^3 per annum over one discharge event once the Thames Tideway Tunnel project is operational. This represents an approximately 98% decrease as a result of the Thames Tideway Tunnel project.

5.2.9 A permanent foreshore structure would be in place in the river and would give rise to effects from the construction phase of the project onwards. However, as it is a permanent structure, effects would be ongoing throughout its existence, and are therefore considered under the operational assessment.

5.2.10 Scour protection for the permanent foreshore structure and discharge apron would consist of buried rip-rap which would be overlaid with an appropriate substrate material.

Environmental design measures

5.2.11 Generic design principles of relevance to aquatic ecology at Putney Embankment Foreshore are as follows:

a. Where appropriate to context and practicable, fendering (horizontal or vertical) would be included on the foreshore structure, preferably in timber, in order to promote aquatic ecology.

b. Scour protection would be provided beneath any new outfall extending to below the low water line and along the line of the new river wall (to protect its foundation). The detailed design and extent of this would seek to avoid or minimise adverse effects on aquatic ecology.

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[i] The ‘Typical Year’ represents the most ‘typical’ 12 month period of rainfall observed between 1970 and 2011 and covers the period from October 1979 to September 1980.

c. Where practicable, at the base of the foreshore structure, measures such as low level habitat features would be provided to encourage retention of sediment to promote aquatic ecology.

d. Light pollution would be minimised within the sites by using capped, directional and cowled lighting units.

e. Lighting would balance the need to provide a safe environment with one that also responds to the need to reduce light pollution and promote biodiversity (terrestrial and aquatic).

f. No lighting would be proposed in the tidal Thames or directed required for navigational purposes.

g. There would be no lighting on the outside of the foreshore structures unless required for navigational purposes.

h. The river wall would be finished in natural stone with vertical timber fenders.

i. New lighting to the foreshore structure would be provided in accordance with the lighting principles.

5.2.12 In addition the footprint of the temporary and permanent works has been reduced in size compared to earlier design iterations. This reduces encroachment into the river thus minimising the hydraulic effects on the river.

5.3 Assessment methodology

Engagement

5.3.1 Volume 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of aquatic ecology are presented in Vol 7 Table 5.3.1.

Vol 7 Table 5.3.1 Aquatic ecology – stakeholder engagement for Putney Embankment Foreshore

Organisation	Comment	Response
Environment Agency (phase two consultation response - February 2012)	Noted that it is important that the temporary nature of the slipway is made clear to river users so that removal does take place. If the slipway were to remain as a permanent structure, then appropriate assessment of its impact must be made in the *Environmental Statement*.	The *Environmental Statement* assesses the slipway as a temporary structure.

Organisation	Comment	Response
Environment Agency (phase two consultation response - February 2012)	Noted that in this area dace and smelt could potentially use sub-tidal gravels as spawning substrate. Therefore the sensitivity and value may be slightly higher if subtidal habitat spawning potential is recognised.	The spawning potential has been noted and the value of the fish receptor raised from medium (borough) to medium-high (metropolitan).
	Noted that this site would result in fragmentation of foreshore habitat and reduce the marginal area that fish can use when moving upriver. Requested that this loss of foreshore connectivity should be considered. Noted that this was mentioned in consultation material but the value of the foreshore habitat does not seem to be linked to the sensitivity of aquatic receptors.	The effect of development on the foreshore on movements of fish has been assessed and is reported in the *Environmental Statement*. The habitat has been accorded a valuation in its own right.
	Noted that the sub-tidal area of gravel would offer suitable spawning substrate for smelt, dace and other rheophilic gravel spawning species, which should be addressed within the *Environmental Statement*.	The value of the site as a nursery area for juvenile fish has been noted in the *Environmental Statement*.
London Borough (LB) of Wandsworth (phase two consultation response – February 2012)	Noted that dredging may be detrimental to foreshore ecology and needs to be carried out in accordance with specific timings to avoid detriment to fish populations and in particular the movements of spawning and juvenile fish.	Dredging would not be required at the Putney Embankment Foreshore site.
	Works to strengthen the river bed to avoid scour should be informed by ecological survey in order to avoid damage to aquatic ecology.	Environmental design measures would ensure that effects on aquatic ecology would be minimised. The *Environmental Statement* considers the effects of scour on ecological receptors.

Organisation	Comment	Response
	Proposed vertical fenders on river walls are welcomed and horizontal ones should be explored.	Section 5.2 details environmental design measures to provide fendering (horizontal and/or vertical) on the foreshore structure where practical.
	Surveys should inform the amount and type of lighting during construction and operation.	The *CoCP Part A* (Section 4) details controls on lighting to minimise effects on aquatic ecology.
Environment Agency (Section 48 consultation response – October 2012)	Requested that the impact of dredging and moorings be assessed.	Dredging would not be required at the Putney Embankment Foreshore site.
	Plans show infilling of corners between new and existing river walls to prevent build up of rubbish. Alternative mitigation should be found rather than encroachment into the river.	The scheme includes provision for a potential extension of the platform to reduce accumulation of debris in the foreshore area between the existing river wall and the foreshore structures (see Design Principles). The need for this would be reviewed during operation.
	Noted that rip-rap removal around existing apron is an opportunity for enhancement.	The existing apron would be removed. However, scour protection for the proposed interception chamber is required at this location which precludes the opportunity for enhancement.

Baseline

5.3.2 The baseline methodology follows the methodology described in Vol 2 Section 5. There are no site specific variations for identifying the baseline conditions for this site.

5.3.3 The assessment is based on survey and desk study data. For habitats, mammals, fish, invertebrates and algae, desk study data has been obtained for the whole of the Tidal Thames. The data sets for fish, invertebrates and algae are based on fixed sampling locations at intervals through the Tidal Thames. Locations as close to Putney Embankment Foreshore as possible have been selected. Details of the background and desk study data sets are provided in Vol 2 Section 5.

5.3.4 Surveys for fish and invertebrates were undertaken during October 2010, with a second fish survey undertaken in May 2011, within the site and within a 100m radius of the site boundary. During these surveys, the intertidal habitats present were recorded. Surveys for juvenile fish were also undertaken at five sampling locations along the Tidal Thames six times between May and September 2011, with one of the locations being Putney Embankment Foreshore. Surveys for algae were undertaken at eight sampling locations in May 2012, comprising each of the foreshore sites, including Putney Embankment Foreshore. The survey comprised sampling of algae along a vertical transect of the river wall located within or as close to the site as possible.

Construction

5.3.5 The assessment methodology for the construction phase follows that described in Vol 2 Section 5. The assessment area is the zone which lies within a 100m radius of the boundary of the site. The assessment year for construction effects is Site Year 1, ie when construction would commence. There are no site specific variations for undertaking the construction assessment of this site.

5.3.6 Section 5.5 details the likely significant effects on aquatic ecology arising from the construction of the proposed development at the Putney Embankment Foreshore site. The effects of interception of all of the CSOs within the Thames Tideway Tunnel project on aquatic ecology receptors at a river wide level are considered in Vol 3 Project wide assessment.

5.3.7 No schemes from the site development schedule (Vol 7 Appendix N) are considered relevant to the aquatic ecology base case. All developments in the site development schedule are in-land, do not comprise in-river development, development adjacent to the river or development discharging into the river and therefore would not affect the aquatic ecology baseline. Similarly, there are no schemes listed in the site development schedule which would be under construction during Site Year 1 which would be in-river, adjacent to the river or discharging to the river. Therefore no cumulative impact assessment has been undertaken.

5.3.8 The assessment of construction effects also considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Operation

5.3.9 The assessment methodology for the operation phase follows that described in Vol 2 Section 5. The assessment area is as stated in para.

5.3.5. There are two assessment years for operational effects; Year 1 and Year 6. Year 1 is the year that the Thames Tideway Tunnel project would be brought into operation. Year 6 provides sufficient time after operation commences to allow the longer term effects on aquatic ecology to be assessed. There are no site specific variations for undertaking the operational assessment of this site.

5.3.10 Section 5.6 details the likely significant effects arising from the operation of the proposed development at the Putney Embankment Foreshore site. The effects of the interception of all of the CSOs within the Thames Tideway Tunnel project on aquatic ecology receptors at a river wide level are considered in Vol 3 Section 5.

5.3.11 No schemes from the site development schedule (Vol 7 Appendix N) are considered relevant to the aquatic ecology base case. All developments in the site development schedule are in-land, do not comprise in-river development, development adjacent to the river or development discharging into the river and therefore would not affect the aquatic ecology baseline. There are no schemes from the site development schedule that require a cumulative assessment. Therefore no cumulative impact assessment has been undertaken.

5.3.12 As with construction (see para. 5.3.8), the assessment of operational effects also considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Assumptions and limitations

5.3.13 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 5. Assumptions and limitations specific to this site are outlined below.

Assumptions

5.3.14 It has been assumed that:

a. The campsheds would be concrete structures.

b. It would be necessary to remove all alluvial and other deposits above the natural gravel within the temporary cofferdam and campsheds in order to establish a stable construction platform, as detailed in Section 5.2.

c. The area between the outer edge of the temporary cofferdam and the maximum extent of working area would be subject to disturbance and consolidation during construction from jack up barges and similar equipment, particularly during cofferdam installation.

d. Campsheds would be constructed using the method similar to that described in 5.2.2b for the temporary cofferdams. Sheet piles would be used to create the outer edge of the campshed. Soft material would be removed from within the sheet piled area and replaced with a more coarse material similar to the existing river bed in order to provide stability. Concrete would be placed into the sheet piled area on top of a geotextile membrane

e. No dredging would be required while the campsheds are in use.

f. Reinforcement of the foreshore beneath Putney Embankment for scour protection would be required.

g. The trigger level for implementing scour protection measures (para. 5.2.3) would be set to ensure that scour would not penetrate below the depth of the existing substrate (i.e. there would be no change in broad habitat type as a result of scour).

Limitations

5.3.15 There are no site specific limitations.

5.4 Baseline conditions

5.4.1 The following section sets out the baseline conditions for aquatic ecology within the assessment area. Future baseline conditions (base case) are also described.

Current baseline

5.4.2 The following section sets out the existing baseline applicable to this site. The section begins with a discussion of any statutory (i.e. with a basis in law) or non-statutory (i.e. designated only through policy) sites designated for their nature conservation value. It then addresses habitats, followed by the species receptors associated with those habitats, namely mammals, fish invertebrates and algae. This order is followed throughout the assessment sections.

Designations and habitats

5.4.3 This section sets out the effects on designations and habitats applicable at the site specific level. Designations and habitats applicable at the project wide scale are assessed in Vol 3 Section 5.

5.4.4 The Tidal Thames is part of the proposed Thames Estuary South East Marine Conservation Zone (MCZ no.5) the details of which were submitted to Government in early 2012. If adopted, it would be designated as a national statutory site under the Marine and Coastal Access Act 2009. The purpose of MCZs is to protect the full range of nationally important biodiversity, as well as certain rare and threatened species and habitats. Species include smelt (*Osmerus eperlanus*), European eel (*Anguilla anguilla*) and tentacled lagoon worm (*Alkmaria romijnii*) (Balanced Seas, 2011) [4]. The Tidal Thames offers important spawning and migratory habitat for smelt, and migratory habitat for European eel.

5.4.5 There are no other international or national statutory sites (i.e. Sites of Special Scientific Interest or Local Nature Reserves) designated for aquatic ecology within the assessment area.

5.4.6 Putney Embankment Foreshore falls within the non-statutory River Thames and Tidal Tributaries Site of Importance for Nature Conservation

(SINC Grade M)[ii]. The SINC is designated by the Greater London Authority and adopted by all boroughs which border the Thames. It recognises the range and quality of estuarine habitats including mudflat, shingle beach, reedbeds and the river channel. The SINC citation notes that over 120 species of fish have been recorded in the Tidal Thames, though many of these are only occasional visitors. The more common species include dace (*Leuciscus leuciscus*), bream (*Abramis brama*) and roach (*Rutilus rutilus*) in the freshwater reaches (described in para. 5.4.8), and sand-smelt (*Atherina presbyter*), flounder (*Platichtyhys flesus*) and Dover sole (*Solea solea*) in the estuarine reaches. Important migratory species include Twaite shad (*Alosa fallax*), European eel, smelt, salmon (*Salmo salar*) and sea trout (*Salmo trutta*). A number of nationally rare snails occur, including the swollen spire snail *Mercuria confusa*, as well as an important assemblage of wetland and wading birds.

5.4.7 The Tidal Thames is the subject of a *Habitat Action Plan* (*HAP*) within the *London Biodiversity Action Plan* (*BAP*) (Thames Estuary Partnership Biodiversity Action Group, undated)[5]. The Tidal Thames *HAP* identifies a number of habitats and species which characterise the estuary, such as gravel foreshore, mudflat and saltmarsh. A number of these habitats and species, including mudflat, are also the subject of action plans under the UK *BAP*.

5.4.8 The river is divided into three zones within the Tidal Thames *HAP*; freshwater, brackish and marine (Vol 3 Figure 5.4.1, see separate volume of figures). The brackish zone is equivalent to the category known as transitional water or estuaries under the Water Framework Directive (WFD). Further details of the WFD river zone classifications can be found in Vol 3 Section 5.

5.4.9 Putney Embankment Foreshore lies within the freshwater zone of the river, which means that the fish and invertebrate communities which occur within the river at this location consist of freshwater species and more freshwater tolerant marine species. Invertebrate diversity is generally higher than in the brackish zone but species must be able to withstand some variations in salinity and a stressful environment. Stress is caused by the fluctuating tidal conditions, which means that flora and fauna have to be able to tolerate wide variations in their physical environment.

5.4.10 During the survey of habitats within and immediately adjacent to the main and secondary sites, the intertidal habitat at Putney Embankment was recorded as consisting of a shingle foreshore. The site is located approximately 400m upstream of the nearest area of UK *BAP* priority habitat 'mudflats' according to a search for UK *BAP* Priority Habitats on the Natural England website Nature on the Map (Natural England, undated)[6]. These mudflats extend for over 1km downstream.

5.4.11 An assessment of the habitats undertaken during spring 2011 indicated that the substrate was a mixture of gravel (10-20mm), pebbles (40-

[ii] SINC (Grade M) = Site of Importance for Nature Conservation (Grade III of Metropolitan importance)

100mm) and infrequent cobble stones (150-250mm) overlying a compacted silt under-layer. UK *BAP* target habitats present included sublittoral sands and gravels.

5.4.12 The river in this location is confined by a constructed vertical river wall, and bridge abutments. There was no marginal vegetation and relatively little intertidal habitat during the site survey. Scattered vegetation was growing on the river wall, including communities of macro and microalgae.

5.4.13 A summary of habitat types present and other features of interest recorded during October 2010 and May 2011 surveys are presented in Vol 7 Table 5.4.1. The survey area is presented in Vol 7 Figure 5.4.1 (see separate volume of figures).

Vol 7 Table 5.4.1 Aquatic ecology – principal habitat, substrate and other features of interest at Putney Embankment Foreshore

UK *BAP* target habitats present and features of interest	Substrate present in intertidal zone (approximate % cover)	Substrate present in subtidal zone
Gravel foreshore Sublittoral sand and gravels River wall Pier (Putney Pier) CSO outfall Scattered trees (above river wall)	Pebbles and shingles (85%) Sand, cobbles, silt (15%)	Pebble, gravel Sand

Evaluation of habitats for Putney Embankment Foreshore

5.4.14 The value of the habitats for individual aquatic ecology receptors is described in the relevant baseline sections. For the purpose of this assessment the habitats are considered to be of medium-high (metropolitan) value as part of the River Thames and Tidal Tributaries SINC (Grade M).

Marine mammals

5.4.15 Records compiled by the Zoological Society of London (ZSL) for 2003-2011 indicate common seal (*Phoca vitulina*) have been observed in this area of the Thames.

Evaluation of marine mammals for Putney Embankment Foreshore

5.4.16 The site is considered to be of low-medium (local) value for marine mammals given the small number of records of seal, and the limited extent of intertidal habitat for species of seal to use as a haul out site.

Fish

5.4.17 In general, Tidal Thames fish populations are mobile and wide ranging. Although the abundance and diversity of fish at any one site may provide some indication of the habitat quality offered at that site it is important to consider the data within the context of sites throughout the Tidal Thames, since the factors influencing distribution are likely to be acting at this wider scale. To this end, the findings of the Thames Tideway Tunnel project site specific survey, relevant juvenile fish surveys and EA background data are presented in this section and are used to inform the evaluation of the site. Effects at the project wide scale are assessed in Vol 3 Section 5.

Baseline surveys

5.4.18 Two one day surveys were undertaken at this site; one in October 2010, and the second in May 2011. Full details of the methodology and rationale for the timing of surveys are presented in Vol 2 Section 5.

5.4.19 Fish are routinely categorised into 'guilds' according to their tolerance to salinity and habitat preference (Elliott and Taylor, 1989[7]; Elliott and Hemingway, 2002[8]), which can be defined as follows:

a. Freshwater – species which spend their complete lifecycle primarily in freshwater.

b. Estuarine resident – species which remain in the estuary for their complete lifecycle.

c. Diadromous – species which migrate through the estuary to spawn having spent most of their life at sea.

d. Marine juvenile – species which spawn at sea but spend part of their lifecycle in the estuary.

5.4.20 The survey recorded low fish abundance in the area of Putney Embankment Foreshore, with only 40 individuals captured in total. The range of species recorded and the number of individuals is presented in Vol 7 Table 5.4.2 . The low abundance of freshwater species at Putney Embankment such as roach, bream and dace is explained by the site location, which is towards the downstream end of the freshwater zone (Vol 3 Figure 5.4.1, see separate volume of figures), where salinity is relatively close to the tolerance threshold of freshwater species.

5.4.21 At Putney Embankment Foreshore, as with other sampling locations, fish numbers were altogether lower in the May samples than in October. Early spring represents the seasonally low period for fish biomass in the Tidal Thames. By early May many species have either already completed spawning migrations into the Tidal Thames and have returned to the estuary, or are undergoing some form of localised migration into stable freshwater habitats in preparation for spawning. Surveys in autumn generally show highest fish biomass due largely to the first season's growth amongst young of the year.

Vol 7 Table 5.4.2 Aquatic ecology – results of fish surveys at Putney Embankment Foreshore

Common name	Scientific name	Number of individuals		Guild
		Oct 2010	May 2011	
Flounder	*Platichthys*	19	0	Estuarine resident

Common name	Scientific name	Number of individuals		Guild
		Oct 2010	May 2011	
	flesus			
Smelt	*Osmerus eperlanus*	1	0	Diadromous
Eel	*Anguilla anguilla*	2	0	Diadromous
Common bream	*Abramis brama*	4	0	Freshwater
Dace	*Leuciscus leuciscus*	4	1	Freshwater
Roach	*Rutilus rutilus*	10	0	Freshwater

Juvenile fish surveys

5.4.22 The shallow river margins, which shift across the intertidal foreshore with the ebb and flood of the tides, provide an important migration route for juvenile fish along the estuarine corridor. The young of species such as eel (known as glass eels or elvers), flounder, dace and smelt rely upon access to these areas of lower water velocity to avoid being washed out by tides and to avoid predation by the larger fish that occur in deeper water. Young fish also feed predominantly amongst the intertidal habitat. Adult migrants of larger fish tend to use faster mid-channel routes.

5.4.23 Surveys for juvenile fish were undertaken at Putney Embankment Foreshore as part of a suite of five sites sampled six times between May and September 2011 as part of the project wide assessment. The site locations are presented in Vol 2 Figure 5.4.4 (see separate volume of figures). The aim of the surveys was to record juvenile fish migrations through the Tidal Thames to inform a study of the hydraulic effects of the temporary and permanent structures on fish migration. The extent of the surveys and details of the methodology are presented in Vol 2 Section 5. The data from the juvenile fish surveys at Putney Embankment Foreshore are shown in Vol 7 Table 5.4.3.

Vol 7 Table 5.4.3 Aquatic ecology – results of 2011 juvenile fish surveys at Putney Embankment Foreshore

Common name	Scientific name	Number of individuals					
		Survey 1 May	2 late May	3 June	4 July	5 Aug	6 Sept
Flounder	*Platichthys flesus*	813	3698	1301	26	7	0
Smelt	*Osmerus eperlanus*	2	3	1	0	0	0

Common name	Scientific name	Number of individuals					
		Survey 1 May	2 late May	3 June	4 July	5 Aug	6 Sept
Eel	*Anguilla anguilla*	10	10	4	1	1	0
Common bream	*Abramis brama*	0	0	0	1	0	0
Dace	*Leuciscus leuciscus*	74	30	177	21	2	2
Roach	*Rutilus rutilus*	5	18	67	19	11	3
Perch	*Perca fluviatilis*	36	52	33	3	0	0
Goby	*Pomatoschistus* spp.	1	0	5	283	851	995
Sea bass	*Dicentrarchus labrax*	0	0	97	72	67	28
10-spined stickleback	*Pungitius pungitius*	0	0	20	1	0	1
3-spined stickleback	*Gasterosteus aculeatus*	6	0	52	60	26	17
Barbel	*Barbus barbus*	0	0	1	0	0	0
Gudgeon	*Gobio gobio*	0	0	2	1	1	0
Stone loach	*Barbatula barbatula*	0	0	2	0	0	0
Sand smelt	*Atherina presbyter*	0	0	1	0	1	1
Chub	*Leuciscus cephalus*	0	0	0	0	0	1
Mullet	*Chelon labrosus*	0	0	0	0	0	14

5.4.24 Post-larval flounders dominated the catch from surveys one, two, and three, followed by dace and perch (*Perca fluviatilis*) during surveys one and two, and dace and roach in survey three. Flounder were caught in the shallow littoral zone, indicating early springtime colonisation from marine spawning sites. From surveys three to six, three-spined stickleback (*Gasterosteus aculeatus*) and sea bass (*Dicentrarchus labrax*) were numerous, whilst goby (*Pomatoschistus* sp.) numbers increased considerably from survey four onwards, peaking at 995 individuals in survey six. Perch, roach and flounder declined over surveys four to six. The survey results indicate that Putney Embankment Foreshore is of importance for juvenile fish as a nursery area, which is an area spatially segregated from adult habitats, providing refuges and a ready food supply for juveniles.

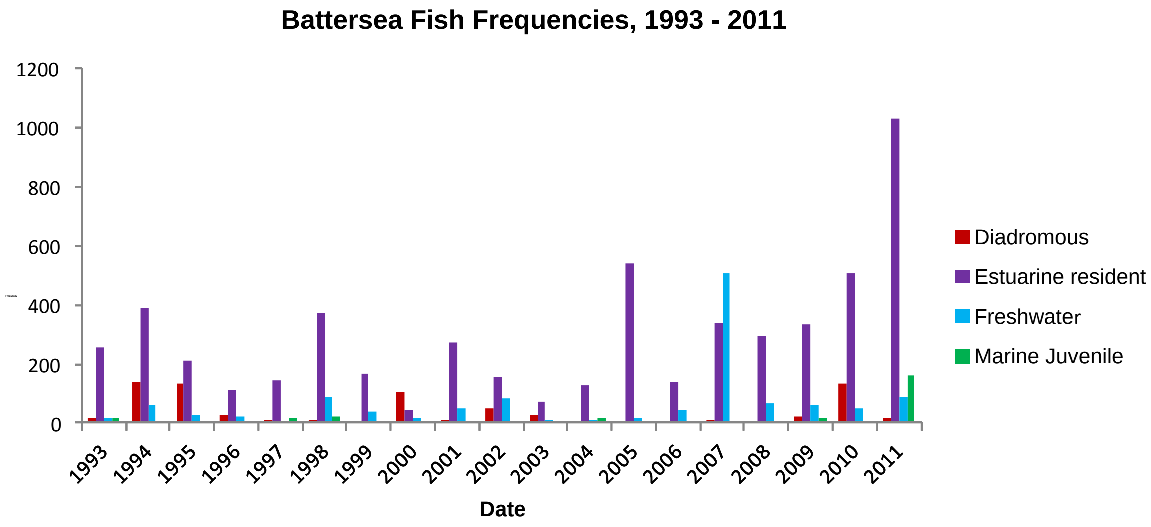
5.4.25 The site lies within the zone of the river known to offer spawning habitat for dace and immediately upstream of the zone of the river known to offer spawning habitat for smelt. The zone for dace extends from Richmond downstream to Battersea, and the zone for smelt from Wandsworth to Battersea (Colclough et al, 2002) , and the spawning habitat comprises 'clean' gravel (i.e. gravel substrates with little or no silt or other fine material overlying it) within the intertidal and subtidal. Although no direct evidence of spawning was recorded at the site, gravel habitats occur, particularly within the subtidal, and therefore the site has some potential as spawning habitat. The intertidal gravels are considered to be less suitable as spawning habitat since they are exposed for periods during the tidal cycle, and at this location they are regularly disturbed by boat traffic.

Environment Agency background data

5.4.26 The surveys described in paras. 5.4.18 to 5.4.24 provide up-to-date baseline information directly relevant to fish community composition at Putney Embankment Foreshore. EA records have also been used to provide a wider context for the fish community in the Tidal Thames. The EA carry out annual surveys of fish within the Tidal Thames, with data available from 1992-2011. Methodologies for the survey are provided in Vol 2 Section 5. There is an EA sampling site at Putney. The EA data at this location indicates that the most well represented species are dace, flounder, roach, sand-smelt and eels. EA data for the Putney site are, however, limited to 1992 and 1993. The EA annual data on abundance are in accordance with the findings of the October 2010 and May 2011 surveys, in that the site appears to have low value for fish species.

5.4.27 A more comprehensive survey dataset exists for Battersea, located 3km downstream, where EA surveys have been carried out every year from 1993 to 2011. Fifteen fish species have been recorded at Battersea. These show fairly consistent catches in trawls but some indication of increasing seine-net catches in recent years (Vol 7 Plate 5.4.1). Catches are dominated by estuarine resident fish such as common goby, flounder and sand smelt, freshwater species including dace, common bream, perch and roach, and migratory species including eel and smelt. Other migratory species such as salmon and sea trout must pass through the area but are present too infrequently to be detected by only one or two surveys per year. The high frequency of freshwater species recorded in 2007 may be as a result of very high rainfall during that year. High flows may have led to a greater number of freshwater fish being washed in to the Tidal Thames and lower salinity conditions which allowed them to survive.

Vol 7 Plate 5.4.1 Aquatic ecology – long-term EA total fish catches from Battersea site



Water quality and current fish baseline

5.4.28 Prior to the 1960s, water quality in the Tidal Thames was heavily degraded by raw sewage inputs caused by under-capacity of sewage treatment works (STWs). With the construction of new works (Wheeler, 1979)[9] the progressive improvement of fish populations from the 1960s onwards was recorded. The ecology of the Tidal Thames has undergone further improvement in recent decades, with some 125 fish species now recorded by the EA.

5.4.29 However, hypoxia events (see para. 5.1.3) arising from regular CSO spills and occasional discharges of untreated waste from STWs still occur. Discharges have the effect of depleting DO (measured in mg/l) by the biological breakdown of organic matter in the discharge. This is referred to as biochemical oxygen demand (BOD). Substantial fish mortalities begin to occur when DO levels drop beneath 4mg/l. An example of the effects of a hypoxia event occurred in June 2011, in which approximately 26,000 fish were killed across the Tidal Thames following a release of around 450,000 tonnes of untreated sewage. This incident is discussed in further detail in the project wide assessment (Vol 3 Section 5).

5.4.30 The Tideway Fish Risk Model (TFRM) was developed to evaluate DO standards for the Tidal Thames (Turnpenny *et al*, 2004)[10] as part of the *Thames Tideway Strategic Study (TTSS)*. The DO standards for the Tidal Thames comprise four threshold levels expressed as concentrations of DO in mg/l over specified tidal durations. Frequencies are set on the number of times per year each of these thresholds can be exceeded. Further details of the standards are presented in Vol 2 Section 14. Details of the TFRM are presented in Vol 2 Section 5 and Vol 3 Appendix C.3). The TFRM considers fish distribution and the effects of low DO oxygen conditions within defined 3km zones within the Tidal Thames. The zones are based on those used by the EA's automated water quality monitoring system (AQMS), for which DO data are collected continuously.

5.4.31 The model uses known hypoxia tolerance thresholds for seven species which are considered to represent the range of species which occur in the Tidal Thames. The model is based on the assumption that for most species of fish populations will be sustainable provided hypoxia related mortality does not exceed 10% of the total population. The model considers both adult and juvenile fish (known as ‘life stage cases’), since juveniles generally have a lower tolerance to hypoxia.

5.4.32 It is not possible to isolate the contribution of individual CSO discharges to hypoxia related fish mortalities in the Tidal Thames. This is because the TFRM provides outputs only at a population level. For example, DO conditions may be below a lethal threshold in one zone known to be used by a particular species of fish. However, provided conditions are above the threshold in other zones such that 90% of the population are unharmed then conditions are considered to be sustainable. The outputs are discussed in further detail in the project wide assessment (Vol 3 Section 5.6). However, TFRM results for the existing baseline suggest that a total of five of the seven species/life stage cases are expected to suffer unsustainable hypoxia related mortality in the Tidal Thames each year. Given that the indicator species used in the model act as surrogates for a wider range of ecosystem components, other sensitive taxa are also likely to be unsustainable under this water quality regime.

Evaluation of fish community for Putney Embankment Foreshore

5.4.33 The juvenile fish survey results (Vol 7 Table 5.4.3) demonstrate that the site has value as a nursery area. Given the predominantly gravel substrate and its location within the river, the site, and in particular the subtidal gravels, are considered to offer potential as spawning habitat for smelt. The Putney Embankment Foreshore site is considered to be of medium-high (metropolitan) value for fish due to the value of the site as a nursery area for juvenile fish as indicated in para. 5.4.24.

Invertebrates

5.4.34 Benthic invertebrates are used in the freshwater, estuarine and marine environments as biological indicators of water and sediment quality since their diversity, abundance and distribution reflects natural or man-made fluctuations in environmental conditions. Species diversity is influenced by factors such as substrate and salinity. However high species diversity (or numbers of species) at any given site generally indicates good water and/or sediment quality, whilst low diversity may indicate poor quality.

5.4.35 Invertebrate populations and particularly those which occur in the water column (pelagic) are influenced by conditions throughout the estuary. The strongest influences on invertebrate distribution and density tend to be physical factors such as salinity, and substrate type followed by water quality and local habitat conditions.

Baseline surveys

5.4.36 A single day survey was undertaken at Putney Embankment foreshore during October 2010. The area covered by the survey is the same as that described for the fish survey above (paras. 5.4.17 to 5.4.27) and illustrated in Vol 7 Figure 5.4.1 (see separate volume of figures). Details of the sampling methods used can be found in Vol 2 Section 5. Three intertidal and two subtidal samples were taken.

5.4.37 The invertebrates collected during the October 2010 field surveys are presented in Vol 7 Table 5.4.4 below. The Community Conservation Index (CCI) score (Chadd and Extence, 2004)[11] has been used to identify species of nature conservation importance. CCI classifies many groups of invertebrates of inland waters according to their scarcity and conservation value in Great Britain and relates closely to the Red Data Book (RDB) (Bratton, 1991[12];Shirt, 1987 [13]) by attributing a score between 1 and 10. The higher the CCI score the more scarce the species and/or greater its conservation value.

Vol 7 Table 5.4.4 Aquatic ecology – invertebrate fauna sampled at Putney Embankment Foreshore

Taxa	CCI Score	No. of individuals - subtidal samples		No. of individuals - Intertidal samples		
Sample numbers		**Air Lift1**	**Air Lift 2**	**Kick sample**	**Sweep Net 1**	**Sweep Net 2**
Theodoxus fluviatilis	3	38	20	2	4	8
Potamopyrgus antipodarum	1	45	40	0	1	90
Radix balthica	1	65	90	2	260	200
Sphaeridae	-	3	0	1	0	0
Sphaerium corneum	1	0	2	0	1	1
Pisidium spp.	-	0	0	0	0	0
Dreissena polymorpha	2	0	1	0	0	0
Oligochaeta	-	20	100	16	120	3000
Glossiphonia complanata	1	0	0	1	0	0
Erpobdella testacea	5	27	32	2	10	8
Crangon crangon	-	0	1	0	4	37
Eriocheir sinensis	-	1	0	1	1	0
Asellus aquaticus	1	1	0	0	0	0
Apocorophium lacustre	8	7	3	0	0	0
Gammarus sp	-	0	0	1	0	0

Taxa	CCI Score	No. of individuals - subtidal samples		No. of individuals - Intertidal samples		
Sample numbers		**Air Lift1**	**Air Lift 2**	**Kick sample**	**Sweep Net 1**	**Sweep Net 2**
Gammarus zaddachi	1	750	400	8	240	85
Tipulidae	-	0	0	0	0	0
Number of taxa	-	10	10	9	9	9

5.4.38 Putney Embankment Foreshore samples were characterised by relatively high diversity for the subtidal area. In addition to the typical pollution tolerant taxa, moderately pollution tolerant groups were abundant in both the subtidal and intertidal zones (*Theodoxus fluviatilis* (Neritidae), *Gammarus* and *Apocorophium*). The species generally considered most sensitive to organic pollution is the river neritid, *T. fluviatilis*. It was relatively abundant at Putney Embankment Foreshore in both intertidal and subtidal samples.

5.4.39 All of the taxa present are brackish species or animals that have a varying tolerance to different levels of salinity from estuarine to near freshwater. No obligate freshwater or marine animals were present. The brackish nature of the water is demonstrated by species such as *Gammarus zaddachi* (a brackish species of shrimp, rather than its more commonly occurring freshwater homologue *Gammarus pulex*) and *Crangon crangon* (shrimps, typical of estuarine and brackish conditions).

5.4.40 The only species of high nature conservation importance was the mudshrimp *Apocorophium lacustre* (CCI 8), a RDB species. It was present in subtidal samples at the site. EA data have shown *A. lacustre* to be common in the Tidal Thames and therefore the relative value of the invertebrate community is not considered to be of higher value in this instance.

5.4.41 Chinese mitten crab (*Eriocheir sinensis*), an invasive and non-indigenous species, was sampled at Putney Embankment Foreshore. Individual mitten crabs were captured at a number of sampling locations along the Tidal Thames. Mitten crabs can cause bank destabilisation and erosion, and also compete for food resources with other species. The former issue is less of a concern at this location, as much of the river bank comprises hard defences, but competition with other species could occur.

5.4.42 The zebra mussel (*Dreissena polymorpha*) was also identified. This species can establish in densities that crowd-out native invertebrates. It also colonises shells of native species, reducing the ability of the host to feed and burrow.

Environment Agency background data

5.4.43 Putney Embankment Foreshore is located 3km upstream of the EA sampling site at Battersea, which is the nearest invertebrate sampling location with recent data (2005-2010). The EA samples are taken using a number of techniques, including cores and kick sampling in the intertidal and day grab and core samples in the subtidal.

5.4.44 A total of 46 taxa were recorded at Battersea over the six year period in which samples were collected. The taxa Oligochaeta (worms), which thrives in organically polluted conditions, was relatively abundant, together with other pollution tolerant species such as the snail *Potamopyrgus antipodarum*. However, *G. zaddachi*, a moderately pollution-sensitive species was also highly abundant and *T. fluviatilis* (pollution sensitive river neritid) was present most years.

5.4.45 The basic invertebrate community structure surveyed in 2010 at Putney Embankment Foreshore was similar to EA samples from Battersea. Higher species richness recorded in some sample years at Battersea is likely to reflect the greater sampling frequency. For example, in 2005, 26 animal species were recorded at Battersea, but this was from a total of 14 samples across the year. Other differences, notably the absence of Chironomidae and lower abundance of *P.antipodarum* at Putney Embankment Foreshore are likely to reflect subtle differences in habitat, seasonal and sampling variation.

5.4.46 *A. lacustre*, the rare species of mud shrimp sampled at Putney Embankment Foreshore, appears to be similarly abundant at Battersea.

Water quality and current invertebrate baseline

5.4.47 The influence of water quality, and specifically CSO discharges was investigated through statistical analysis of the EA invertebrate background data, Thames Tideway Tunnel project baseline data, and EA water quality data. The analysis is presented in Vol 3 Appendix C.1. Although it was not possible to isolate trends over time at a site specific level, a number of observations were made that helps to identify the factors influencing invertebrate abundance and diversity. For example, certain species of Oligochaete worm, present at Putney Embankment Foreshore, are indicative of polluted conditions because they are able to tolerate the low DO conditions and multiply rapidly in the enriched sediments.

5.4.48 The analysis is described in further detail in Vol 3 Section 5.4. The following summary is relevant to the freshwater zone of the Tidal Thames in which the Putney Bridge Foreshore site is located.

5.4.49 The varying level of salinity and saline fluctuations appear to be a dominant factor determining the diversity and structure of benthic invertebrate assemblages. The analysis showed that, in general, samples in the brackish zone were less diverse compared with samples taken in the freshwater zone. This concurs with previous research into the invertebrate community of the Tidal Thames and other estuaries, which show diversity decreasing downstream as the saline influence increases (Bailey-Brock *et al*, 2002)[14] . This is generally attributed to the fact that relatively few invertebrates are adapted to large fluctuations in salinity. Other factors such as poor water quality and lack of habitat diversity, particularly in central London, are also likely to contribute.

5.4.50 Redundancy analysis[iii] (RDA) was used to compare the invertebrate dataset with water quality data for the period between 1992 and 2011. The analysis demonstrated the importance of environmental variables in determining the invertebrate communities in the Tidal Thames. It appears that dominance of either Gammaridae (sensitive to hypoxia) or Oligochaeta (more tolerant to hypoxia) is influenced by the DO concentrations and DO sags in the Thames, although other factors such as habitat are also highly important. Other invertebrate taxa also appeared to be affected by poor water quality (low DO) and/or saline intrusion, notably the insect group (mayflies), while other groups (essentially Polychaete and Oligochaete worms) were shown to be tolerant of these conditions.

Evaluation of invertebrate community for Putney Embankment Foreshore

5.4.51 The Putney Embankment Foreshore site is considered to be of medium (borough) importance due to the dominance of the invertebrate community by a limited range of pollution tolerant species. Whilst of limited conservation value, the invertebrate community enriches the borough habitat resource. Only a single species of conservation importance (*A. lacustre*) was recorded, and it is ubiquitous within the Tidal Thames.

Algae

5.4.52 Algae occurs in the Tidal Thames both in the water column and growing on the river wall and associated structures. The range of species which occur in the Tidal Thames reflect salinity, habitat and environmental conditions. As well as their intrinsic value, algal communities provide valuable habitat for invertebrates and juvenile fish. Algae are often used as an indicator of water quality, since nutrients associated with sewage promote the growth of certain species of algae. This assessment focuses on the algal communities which grow on the river wall and associated structures.

Baseline surveys

5.4.53 A single day survey was undertaken in May 2012 at Putney Embankment foreshore. All records are shown in Vol 7 Table 5.4.5.

Vol 7 Table 5.4.5 Aquatic ecology – marine algae sampled at Putney Embankment Foreshore

Species	2012 Survey observations	Species presence within the Thames Estuary
Blidingia minima	Occasionally present on the river wall.	Widespread and abundant.
Cladophora	Occasionally present on the	Widespread and

[iii] Redundancy analysis is a form of regression analysis which proves information on the influence of environmental variable on the composition/abundances of the invertebrate assemblages.

Species	2012 Survey observations	Species presence within the Thames Estuary
glomerata	river wall from high tide level to the base.	abundant.
Rhizoclonium riparium	Dominant on the river wall from high tide level to the base.	Common.
Ulva prolifera	Occasionally present on the river wall.	Common.
Vaucheria sp.	Occasionally present from high tide level to the base.	The *Vaucheria sp* recorded is most probably *Vaucheria compacta*, which occurs on the upper littoral levels on sea walls. Widespread in the tidal Thames.

Natural History Museum background data

5.4.54 Data was obtained from the Natural History Museum, London (NHM) that identifies records of marine algae received for the period from the early 1970s to 1999. Algae were recorded from a sampling location at Putney Embankment Foreshore, and the records are shown in Vol 7 Table 5.4.6.

Vol 7 Table 5.4.6 Aquatic ecology – marine algae sampled at Putney Embankment Foreshore between early 1970s and 1999

Species	Observations
Urospora penicilliformis	Upper littoral on sea walls and floating structures just above the water line. Widespread in the Tidal Thames.
Blidingia marginata	Upper littoral and supra-littoral, and floating structure just above the water-line. Widespread and abundant.
Blidingia minima	Upper littoral and supra-littoral, wood breakwaters and halophyte stems. Abundant in Tidal Thames.
Rhizoclonium riparium	Upper mid-littoral levels on sea walls and occasionally on floating structures above the water-line. Common in the estuary.

Water quality and algal communities

5.4.55 Algae depend on the nutrients nitrate and phosphate for growth. Although these nutrients occur naturally in water bodies, they are also present in sewage. Discharges of untreated sewage can result in elevated levels of nutrients which can lead to excessive growth of algae. As these algae die and decompose they use up oxygen in the water resulting in hypoxia (see para. 5.1.3). This process is known as eutrophication. Excessive levels of algae can disrupt other elements of the ecosystem by smothering them.

5.4.56 Studies of the pelagic algae (para. 5.4.52) of the Tidal Thames to inform its classification for the WFD have concluded that the estuary is not eutrophic due to strong tidal flows (English Nature, 2001)[15]. However, historically poor water quality has had a considerable negative influence on the algal communities of the Tidal Thames and the loss of pollution sensitive species. Improvements in sewage treatment since the 1960s have led to a gradual process of recovery (Tittley, 2009)[16], although pollution tolerant species such as the green algal species still dominate the community.

Evaluation of algal community for Putney Embankment Foreshore

5.4.57 None of the species recorded in Vol 7 Table 5.4.5 and Vol 7 Table 5.4.6 have protected or notable status (e.g. RDB species or UK or local *BAP* species). The algal populations are therefore given low-medium (local) value as only limited records of widespread species occur from this location.

Aquatic ecology receptor values and sensitivities

5.4.58 Using the baseline set out in paras. 5.4.1 to 5.4.57 the value accorded to each receptor considered in this assessment is set out in Vol 7 Table 5.4.7 below. The definitions of the receptor values and sensitivities used in this evaluation are set out in Vol 2 Section 3.7.

Vol 7 Table 5.4.7 Aquatic ecology – summary of receptors and their values/sensitivities during construction at Putney Embankment Foreshore

Receptor	Value/sensitivity
Foreshore habitat (intertidal and subtidal)	Medium-high (metropolitan) value
Mammals	Low-medium (local) value
Fish	Medium-high (metropolitan) value
Invertebrates	Medium (borough) value
Algae	Low-medium (local) value

Construction base case

5.4.59 The base case in Site Year 1 of construction would include the improvements at the five main sewage treatment works that discharge into the Tidal Thames (Mogden, Beckton, Crossness, Long Reach and Riverside), and the Lee Tunnel project. TFRM modelling (Vol 3 Appendix C.3) has shown that at a river wide level there will be a significant reduction in the occurrence of mass or population level fish mortalities with these schemes (i.e. hypoxia events which result in more than 10% mortality of fish populations). However, predictions for the base case show that, even with these schemes, unsustainable mortalities of salmon, the most sensitive species can be expected. Salmon is considered as acting as a surrogate for the more sensitive aspects of ecology, and thus taxa other than salmon may also be harmed under this condition. Given that CSOs within the Tidal Thames, including the Putney Bridge CSO, would continue to spill and no major changes in habitat quality are anticipated, the fish baseline for the Putney Embankment Foreshore site may therefore be expected to support a similar assemblage of species to the current baseline, with potentially a greater number of pollution sensitive species and life stages. Recovery due to water quality improvements will, however, be at an early stage.

5.4.60 The invertebrate analysis demonstrates that more pollution sensitive groups such as shrimps (Gammaridae) are subject to fluctuations in abundances during low DO periods. With the improvements associated with the Lee Tunnel scheme and sewage treatment works upgrades at Mogden, these fluctuations are likely to be reduced. Whilst there may be minor changes, increases in abundance and diversity will however be limited by the fact that even with the Lee Tunnel and STW improvements in place there are still predicted to be numerous failures of DO standards. Colonisation by DO sensitive taxa such as Corophiidae, Crangonidae and Gammaridae which would otherwise occur within the freshwater zone, including the Putney Embankment Foreshore site would continue to be suppressed. As for fish, recovery of the invertebrate communities would be at an early stage. The recovery in algal communities that has taken place since the 1960s is expected to continue under the base case, however the baseline conditions are not anticipated to significantly change from that described in Section 5.4. No changes in marine mammals are anticipated as they are relatively insensitive to point source sewage discharges.

5.4.61 As detailed in para 5.3.7 there are no other known developments which would change the base case. Furthermore, there is unlikely to be encroachment onto the tidal Thames foreshore for non-river dependent uses as this is restricted through *London Plan 2011*(GLA, 2012)[17] Policy 7.28 Restoration of the Blue Ribbon Network which states that development should 'protect the value of the foreshore of the Thames and tidal rivers'. The EA's *National Encroachment Policy for Tidal Rivers and Estuaries* (Environment Agency, 2005)[18] also presumes against developments riverward of the existing flood defences where these would, individually or cumulatively, change flows so that fisheries were affected or cause loss or damage to habitat. Therefore no change to current baseline from other developments is considered likely.

Operational base case

5.4.62 The river wide recovery in fish and invertebrate communities that will occur as a result of the Lee Tunnel and sewage treatment works upgrades will have advanced by Year 1 and Year 6 of operation due to the reduced number of hypoxia events. However as noted in para. 5.4.59 there will still be unsustainable mortalities of salmon, and possibly other sensitive taxa. Further, catchment modelling shows that the frequency, duration and volume of spills from the Putney Bridge CSO will continue to rise due to population growth, which will limit improvements for aquatic ecology receptors (spill frequency and volume as stated in para. 5.2.8; further details of projected spills are provided in Section 14 of this volume. Therefore recovery due to water quality improvements will be suppressed at Putney Embankment Foreshore. As a result there are unlikely to be major changes in habitat quality at the site level and pollution sensitive fish species, such as salmon will continue to be suppressed. Indeed, conditions in the immediate vicinity of the CSO may be less favourable for fish than the current baseline given the increase in frequency, volume and duration of CSO spills.

5.4.63 At a river wide scale invertebrate communities will be likely to include more pollution sensitive components as noted in para, 5.4.60, which will also be reflected to some degree at a site level. However, increased CSO spill frequency, durations and volumes will suppress recovery and may also be less favourable than current baseline conditions given the increase in frequency, volume and duration of CSO spills.

5.4.64 The recovery in algal communities that has taken place since the 1960s is expected to continue under the base case, however the baseline conditions are not anticipated to significantly change from that described in Section 5.4. No changes in marine mammals are anticipated as they are relatively insensitive to point source sewage discharges.

5.4.65 As stated in para. 5.4.61 there is unlikely to be encroachment onto the tidal Thames foreshore for non-river dependent uses. Therefore no change to the current baseline from other developments is considered likely.

5.5 Construction effects assessment

5.5.1 This section presents the findings of the construction phase assessment. It outlines the construction impacts arising from the proposed development and the likely significant effects on aquatic ecology receptors.

Construction impacts

Temporary landtake

5.5.2 There would be a total of approximately 3,435m^2 of temporary landtake from intertidal and subtidal habitats associated with the presence of the cofferdam, campsheds and a temporary slipway (of which approximately 450m^2 would be from subtidal habitat). This represents 0.015% of the River Thames and Tidal Tributaries SINC. Foreshore material from within the cofferdam would be removed and a geotextile membrane used to separate the underlying substrate from the imported granular fill material. The cofferdam would be in place for a total of three years, which is therefore the duration of this temporary impact.

5.5.3 Where scour protection is not required around the permanent structure (see para. 5.2.10), reinstatement would involve the removal of imported granular fill and the geotextile membrane and the placement of imported substrate in order to restore the area to a profile similar to the surrounding foreshore. The imported substrate material would replicate the existing foreshore particle size.

5.5.4 Given the uncertainty over the re-establishment of the habitat, the impact of temporary landtake is considered to be negative, however due to the small area involved in the context of the wider SINC designation it is accorded low magnitude. The probability of the impact occurring is considered to be certain.

Sediment disturbance and consolidation

5.5.5 It has been assumed that the area between the outer edge of the cofferdam and the maximum extent of working area would be subject to disturbance and consolidation due to the jack-up barge operation. At Putney this represents a total area of approximately 18,065m^2 (of which 8,430m^2 would be from intertidal and 9,635m^2 from subtidal habitats) outside the cofferdams which would be affected by construction activities during the site establishment phase. There is also likely to be consolidation and disturbance due to barge movements. At Putney Embankment there would be a peak monthly average of approximately four barge movements per day.

5.5.6 Impacts on the intertidal and subtidal habitats and associated flora and fauna are considered to be low negative, probable and temporary, due to the small area likely to be subject to regular consolidation and disturbance within the maximum working area boundary.

Change to scour and accretion patterns

5.5.7 The approach to addressing scour associated with the temporary structures consists of monitoring the structures and implementing mitigation only if trigger levels of scour are reached. Further details are provided in the *Scour monitoring and mitigation strategy* (Vol 3 Appendix L.4). No deposition currently occurs within the vicinity. With the temporary cofferdam structure there would be sediment accumulation immediately upstream and over a greater distance immediately downstream of the temporary works. Upstream and over a greater distance downstream there would also be some occasional accumulation of sediment.

5.5.8 Based on the assumption that scour associated with the temporary structures would not be permitted to penetrate beyond the existing substrate layer (para. 5.3.14g) impacts associated with temporary scour and accretion are considered to be are considered to be low negative, probable and temporary.

Change to flow velocity

5.5.9 The presence of the temporary cofferdam would result in alterations to the hydraulic regime and this has been modelled as described in para. 5.6.9. Hydraulic modelling shows that there would be an increase in maximum velocity of 3.5% on mean spring tides with normal fluvial flow. There would also be areas of low velocity water created adjacent to the works and in their wake on the opposite foreshore which would extend around 400m upriver of the works on flood tides and downriver on ebb tides. The impact on flow velocity is considered to be negligible.

Waterborne noise and vibration

5.5.10 There would be approximately 500m of sheet piling installed for the permanent and temporary cofferdams. Piles would be driven using vibro piling techniques, thus limiting the principal source of waterborne noise and vibration impacts. Further measures to limit noise and vibration impacts during the construction stage of the project have been incorporated into the *CoCP Part A* (Section 6). These are described in Section 5.2 above.

5.5.11 There would be additional sources of noise and vibration, including activities associated with construction of the shaft and vehicle and barge movements. Although background levels of noise and vibration within the Tidal Thames are likely to be moderately high due to existing boat movements, and ground-propagated noise from transport systems, the proximity of the works to the river and their scale means that underwater noise and vibration levels are likely to be elevated locally during construction. Noise and vibration have the potential to cause physical damage to fish, and disrupt behaviour and movement. However, in this case, given the piling techniques proposed and the extent of the works relative to the width of the channel this is considered to be a low negative impact, probable and temporary.

Spillage of light from construction compound into surrounding riverine habitats

5.5.12 Light spillage into the water column has the potential to cause disturbance to fish. During construction the site would be operated 24hrs for the tunnelling and secondary lining tunnel works. As stated in para. 5.2.5m the *CoCP Part A* (Section 4) indicates that lighting of the construction site would be managed via a *Lighting management plan*. It has been assumed that flood lighting or similar would be designed such that it would be directed into the site or shielded to minimise illumination of the water. The extent of light spillage is therefore anticipated to be very limited, and it would be of short duration, especially during the summer months. The impact is therefore considered to be negligible, probable and temporary.

Increase in suspended sediment loads

5.5.13 Construction of the campsheds, piling operations, and barge movements are likely to lead to localised increases in suspended sediment with the possibility for effects on local and downstream habitats. It is predicted that the cofferdam would impact on scour patterns while in place, which could cause the mobilisation of increased levels of suspended solids, and potentially contaminants, into the river.

5.5.14 During chemical analysis of sediment, one out of the three samples was found to contain elevated concentrations of lead (220 mg/kg) in comparison with the Probable Effects Level (112 mg/kg). However two thirds of the samples did not and there was considerable variation in concentrations indicating that the elevated concentration is localised. The majority of PAH compounds were recorded above the Probable Effects Level in at least one of the samples and in some cases, all three, indicating that these are less localised. These levels are all very typical of levels in the Tidal Thames. Excavation on the foreshore would be confined within a cofferdam which would effectively prevent release of contamination during sediment removal.

5.5.15 There would be small quantities of sediment liberated during cofferdam installation; however, these would be negligible compared to the 40,000 tonnes (or 20,000m^3 assuming an in-situ density of 2t per m^3) of sediment that are carried on a spring tide (HR Wallingford, 2006) [19]. In this context, the volumes produced by the construction works from piling or scour would not be detectable against natural fluctuations in sediments and would not have an impact on surface water resources (HR Wallingford, 2012)[20]. Impacts are considered to be low negative, probable and temporary.

5.5.16 Measures and safeguards to minimise the risk of accidental releases of silty or contaminated discharges to the Tidal Thames are included in the CoCP *Part A* (Section 8). These are described in Section 5.2 above. No impacts from polluted discharges are anticipated with these control measures and safeguards in place.

Construction effects

5.5.17 This section (paras. 5.5.18 to 5.5.47) describes the effects of these impacts on aquatic ecology receptors based on the significance criteria set out in Vol 2 Section 3.7. Only those impacts which are considered relevant to each receptor are assessed, in accordance with the methodology presented in Vol 2 Section 5.

Designations and habitats

Loss of intertidal and subtidal habitat due to temporary landtake

5.5.18 There would be a temporary loss of 2985m^2 of intertidal habitat and 450m^2 of subtidal habitat, coupled with localised losses due to scour. The habitats affected by temporary landtake are presented in Vol 7 Table 5.4.1 and include gravel foreshore, sublittoral sand and gravels, and river wall. These habitats which are considered to be of medium-high (metropolitan) importance are represented elsewhere across the Tidal Thames. The impact of temporary landtake is considered to be of low negative magnitude since the extent of the areas affected in the context of the overall size of the upper and middle Tidal Thames is small.

5.5.19 Where scour protection is not required around the permanent structure (see para. 5.2.10), reinstatement would involve the removal of imported granular fill and the geotextile membrane. Where soft material had been removed in order provide stable conditions within the cofferdam (see para. 5.2.2b) this would be replaced with an appropriate substrate material. The approach to reinstatement at each of the foreshore sites is presented in Vol 3 Appendix C.4. The objective would be to restore the area to a profile similar to the surrounding foreshore.

5.5.20 Subsequent excavation and removal of the granular fill material followed by reinstatement of substrate of comparable particulate material to the original substrate would facilitate recovery. This is expected to lead to establishment in the medium (1-5 years) or long term (+5 years). However, this does not affect the overall effect level. The overall effect is considered to be **minor adverse**.

Change in intertidal and subtidal habitat due to scour and accretion

5.5.21 The intertidal habitats at Putney Embankment Foreshore are dominated by pebbles and shingle with some sand, cobbles and site with subtidal habitat comprising pebbles, gravel and sand (Vol 7 Table 5.4.1). There may be some removal of the finer material in the areas subject to abutment and contraction scour, although based on the assumption that scour would not be permitted to develop beyond the depth of the existing broad habitat type, which is river gravel deposits. Changes are thus anticipated to be limited to minor and localised changes in the relative composition of the substrate types.

5.5.22 There would be an increase in the proportion of fine sediments in the vicinity of the site due to accretion. This may result in localised changes in the composition of the habitat as sediments accumulate on top of the coarser material. There is a risk that anoxic (i.e. low DO) conditions) can develop within accreted sediment with potentially adverse effects on sediment dwelling organisms.

5.5.23 Overall, the effect of scour and accretion is considered to be **minor adverse** given the medium-high (metropolitan) importance of the receptor and the low negative impact.

Disturbance and consolidation of intertidal and subtidal habitat

5.5.24 There would be disturbance and consolidation of approximately 17500m^2 outside the cofferdams during the site establishment phase due to the presence of a jack-up barge to install the temporary cofferdam. The jack-up barge may also be used to remove the piles once construction is complete. Habitats within this zone are expected to recover within the short term (less than 12 months) following site establishment. Coupled with the medium-high (metropolitan)value of the habitats the effect is considered to be **minor adverse** due to the low negative magnitude of the impact.

Marine mammals

Interference with the migrations of marine mammals within the Tidal Thames

5.5.25 Noise, vibration and other construction activity has the potential to disturb mammals and deter them from passing the site. However, given the low-medium (local) value of the receptor at this site, the low negative magnitude of noise and vibration impacts, the vibro piling methods proposed, the duration of the period when piling would be taking place, and the controls on underwater noise-generating activities described in the *CoCP Part A* (Section 6) (described in Section 5.2), this is considered to be a **negligible effect**.

Fish

Loss of feeding, resting and nursery habitat for fish due to temporary landtake

5.5.26 The subtidal gravel habitats may offer spawning habitat for smelt, and the site was found to provide a nursery area for juvenile fish during surveys undertaken in 2011. Loss of foreshore habitat is considered to be a low negative impact, which on a medium-high (metropolitan) receptor would result in a **minor adverse** effect.

Loss of feeding, resting and nursery habitat for fish due to sediment disturbance and consolidation

5.5.27 The area which would be subject to disturbance and consolidation outside the cofferdam lies in both the intertidal and subtidal zones. The foreshore was found to provide a nursery area for juvenile fish during surveys undertaken in 2011, and the subtidal offers potential spawning habitat for smelt. Given that recovery is likely to occur within the short term (less than 12 months) and given the medium-high (metropolitan) value of the receptor coupled with a low negative impact, the effect is considered to be **minor adverse**.

Change in feeding, resting and nursery habitat for fish due to scour and accretion

5.5.28 The limited depths of scour predicted at this site are not predicted to result in a change in the extent or nature of feeding, resting and nursery habitats. Increase levels of accretion may cause minor localised changes in the invertebrate community. However, this is not anticipated to limit the feeding opportunities for fish. The site lies within the zone in which dace are known to spawn and immediately upstream of the zone in which smelt are known to spawn, however the accretion would occur within the intertidal habitats, whilst it is the subtidal habitats that are key for spawning, thus minimising the risk of smothering spawning habitats due to sediment accretion. Effects are thus considered to be **minor adverse** due to the medium-high (metropolitan) value of the receptor and the low negative magnitude of the impact.

Potential disturbance due to illumination of the river

5.5.29 Although fish behaviour can be altered through lighting, the illumination associated with the 24 hour construction would be primarily land-side and directed away from the river. Illumination of the river is likely to be highly localised in extent. Since it is considered an impact of negligible magnitude on a receptor of medium-high (metropolitan) value would result in a **negligible** effect.

Interference with the migratory movements of fish

5.5.30 Ideally the river channel should provide an uninterrupted route for juvenile fish migrations for species such as eel as glass eels or elvers, dace, goby and flounder as they move through the estuary.

5.5.31 In general, encroachment of structures such as cofferdams into the river channel may affect the river hydraulics, particularly at high discharges associated with heavy fluvial inputs or spring tides. Changes in water velocity caused by constriction of the hydraulic channel may hinder movements of fish against the tide, including their ability to withstand, or hold station in the flow. Constriction of the hydraulic channel, reduction of the intertidal zone and increased water velocities might cause some fish to be lost, for example by forcing them into deeper water with increased predation risk. Formation of eddy currents in the wake of structures may temporarily entrap fish and delay progress of migrations. Persistently delaying the successful migrations of fish past individual sites may also interfere with key life stage events such as spawning through preventing fish from reaching spawning sites at appropriate times.

5.5.32 The river is heavily constricted by the existing river defences at Putney Embankment foreshore, such that velocities are already likely to affect the ability of juvenile fish of some species from holding station against the tide. The Individual Based Modelling (IBM) used to simulate the effects of the temporary and permanent structures on juvenile fish migration demonstrates that the temporary works should benefit upstream migration by presenting more opportunities for fish to shelter from adverse currents. Although the structure would cause juvenile fish to move into deeper water where predation risk is higher, the period of time in which they are exposed to this risk is sufficiently short that the study found it would have no effect on overall mortality rates when compared to base case. Detail of the study, including the modelling methods, are presented in Vol 3 Section 5.

5.5.33 Given the temporary nature of the works, and the fact that the minor adverse effects of fish being forced into deeper water would be offset by the minor beneficial effect anticipated through increased opportunities for shelter, the effects of the temporary structures on juvenile fish migrations are considered to be **negligible**.

Effects of waterborne noise and vibration on fish

5.5.34 The effects of waterborne noise and vibration on fish vary according to the proximity of the receptor to the source. Effects depend on distance from source, ranging from potential death at very close proximities, through injury, and behavioural disturbance with increasing distance from the source. The driving of sheet piles for the cofferdams would be undertaken using techniques that minimise the level of noise and vibration. However the period of piling would be sufficiently brief (assumed for the purposes of this assessment to be approximately 7 weeks for the permanent works and 6 weeks for the temporary cofferdam). Removal of the piles for the temporary cofferdam would take a similar length of time at the end of the construction period. Furthermore, a series of control measures relating to the timing and duration of piling operations have been included in the *CoCP Part A* (Section 4) (see Section 5.2 in this document).

5.5.35 The site offers potential to support spawning habitat, and during surveys undertaken in 2011, was found to have value for juvenile fish as a nursery area. Waterborne noise and vibration is considered to be a low negative impact, and given that the value of the receptor is medium-high (metropolitan), the overall effect is assessed as being **minor adverse**.

Reduction in water quality due to suspended sediment

5.5.36 Although the Tidal Thames is a sedimentary environment with high levels of suspended solids, construction activities such as piling and barge movements may generate levels of suspended sediment which may cause disorientation of fish.

5.5.37 Given the length of the temporary cofferdam perimeter, approximately 200m, there is the potential for re-suspended sediments from piling and barge movements to affect juvenile fish migrations, particularly when considered along with the hydraulic effects described in paras. 5.5.30 to 5.5.33. Adult fish are considered to be less likely to be affected as they are able to move away from the turbid water. Effects on juvenile fish are considered to be **minor adverse**, with regard to the low negative magnitude of impact, natural recovery of sediments anticipated and the medium-high (metropolitan) value of the receptor.

Invertebrates

Direct mortality of invertebrates due to temporary landtake, sediment disturbance and consolidation

5.5.38 There would be direct mortality of invertebrates within sediments removed or covered by the cofferdam, and due to consolidation and disturbance of sediment due the site establishment phase. The effect is considered to be **negligible** due to the medium (borough) value of the receptor and the low negative impact magnitude.

Loss of burrowing and feeding habitat for invertebrates due to temporary landtake

5.5.39 The area beneath the temporary cofferdams would also be lost as burrowing and feeding habitat for invertebrates during the entire construction period. Subsequent excavation and removal of the granular fill material followed by reinstatement of substrate of comparable particulate material to the original substrate would facilitate recovery.

5.5.40 Given the medium (borough) value of the receptor and the low negative impact of habitat loss, the overall effect is considered to be **negligible**, particularly given the relatively limited loss of a burrowing and feeding resource.

Loss of feeding and burrowing habitat for invertebrates due to sediment disturbance and consolidation

5.5.41 The area beneath the temporary cofferdam would be subject to heavy consolidation, and hence would be unavailable to burrowing invertebrates in the medium term (one to five years) following removal of the cofferdam. The temporary consolidation and disturbance to the habitat for burrowing invertebrates is considered to be a **negligible** effect. This is because the receptor is of medium (borough) value, the impact of sediment disturbance and consolidation is considered to be low, and the effects are considered likely to be reversed upon recovery of the habitat, which would occur in the short term (less than 12 months).

Change to burrowing and feeding habitat due to scour and accretion

5.5.42 Whilst there may be some losses of fine material in the localised areas where scour is predicted, this is not anticipated to result in a change in the invertebrate community. The increase in the proportion of fine material associated with accretion may favour certain benthic invertebrates including the sediment dwelling Oligochaeta and Polychaeta. Oligochaeta are already the dominant benthic invertebrate group at the site and the change in the proportion of fine sediments is unlikely to change the overall community composition.

5.5.43 Overall, the effects are considered to be **negligible** due to the low negative magnitude of the impact and the medium (borough) importance of the receptor.

Potential disturbance due to illumination of the river

5.5.44 The illumination associated with the 24 hour construction would be primarily land-side and directed away from the river. Although pelagic invertebrates can be affected by lighting much of the invertebrate interest of the area is benthic and unlikely to be affected by illumination,. Since it is considered an impact of negligible magnitude on a receptor of medium (borough) value, this would have a **negligible** effect.

Reduction in water quality due to suspended sediment

5.5.45 The predicted increases in suspended sediment due to general construction activity such as barging are not expected to affect invertebrate communities given the existing background levels within the Tidal Thames. However, high levels of suspended sediment which may occur as a result of a sudden scour event could give rise to localised reductions in DO and potentially, increases in the concentrations of contaminants.

5.5.46 The majority of the invertebrates present are not considered to be particularly sensitive to accretion or low DO conditions. These organisms are adapted to withstand tidal flows that bring about movements of degradable and non-degradable solids. The feeding mechanisms of animals that filter water might be affected (e.g. larger bivalves), but these are sparsely recorded in the Tidal Thames. Tube living animals such as Corophiidae might be more susceptible, but they are quite mobile and able to move away from sources of impact.

5.5.47 Effects are thus considered to be **negligible**, given the low negative magnitude of impact and medium (borough) value of the resource.

Algae

Loss of habitat due to temporary landtake

5.5.48 The construction of temporary cofferdams would mean that any algae would be lost from the area of river wall within the permanent and temporary cofferdams, as algae require regular inundation with water in order to survive. However, given the low value of the receptor and the fact that algae are likely to re-colonise rapidly following removal of the cofferdams, the effect is considered **negligible**.

Blanketing of areas and increase in water column turbidity due to suspended sediment

5.5.49 As stated in para. 5.5.36, the Tidal Thames is already a sedimentary environment with high levels of suspended solids. The generation of increased levels of suspended sediment from construction activities may cause smothering of marine algae.

5.5.50 Given the length and extent of cofferdam in contact with the tidal flow as described in para. 5.5.37, there is the possibility that re-suspended sediments may affect marine algae located on river walls immediately downstream. The value of the receptor is low-medium (local) and the impact considered low negative and therefore the effect is considered to be **negligible**.

Sensitivity test for programme delay

5.5.51 For the assessment of effects on aquatic ecology during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the assessment findings reported above (paras. 5.5.1 - 5.5.50). This is because there are no developments in the site development schedule (Vol 7 Appendix N) that would fall into the base case as a result of this delay and therefore the base case would remain as described in paras.5.4.59 - 5.4.61.

5.6 Operational effects assessment

5.6.1 This section presents the findings of the operational phase assessment. It outlines the operational impacts arising from the proposed development and the likely significant effects on aquatic ecology receptors.

Operational impacts

Permanent landtake

5.6.2 There would be approximately 1,675m^2 of permanent landtake (of which 740m^2 would be from intertidal habitat and 370m^2 would be from subtidal habitat associated with the permanent CSO outfall apron). The remaining 565m^2 would all be from intertidal habitat associated with the permanent foreshore structure, which would extend approximately 13m into the channel. Permanent landtake is certain and is considered to be a medium negative impact, due to the extent of landtake involved and the fact that the Putney Embankment Foreshore site falls within the non-statutory River Thames and Tidal Tributaries SINC (Grade M), and also includes areas of *BAP* habitat, including gravel foreshore and sublittoral sand and gravels.

Modification of habitat as a result of scour protection measures

5.6.3 As noted above the outfall at Putney Embankment Foreshore would include a CSO outfall apron to prevent residual discharges scouring the surrounding bed. Scour protection would also be provided around the perimeter of the permanent foreshore structure. Scour protection (including aprons) would comprise buried rip rap. A total area of up to 1,110m^2 is likely to be affected by scour protection at the Putney Embankment Foreshore site (of which 740m^2 would be from intertidal habitat and 370m^2 would be from subtidal habitat).

5.6.4 This is regarded as a low negative impact as habitat modification, rather than habitat loss, would result.

Change to scour patterns

5.6.5 The permanent foreshore structure would extend into the channel. Hydraulic modelling has shown that the permanent foreshore structure would impact on scour patterns.

5.6.6 Scour protection would be provided beneath the new outfall where it extends below the mean low water line, in the form of an outfall apron, and along the line of the new river wall (to protect its foundation). The detailed design and extent of this would seek to avoid or minimise adverse effects on aquatic ecology.

5.6.7 With the permanent structure in place, some sediment accumulation is predicted to occur immediately upstream of the permanent foreshore structure within the intertidal zone, with some occasional deposition predicted both immediately upstream and downstream of the permanent foreshore structure within the intertidal zone. These predicted areas of sediment and accumulation are illustrated in Vol 7 Section 14 (see Vol 7 Plate 14.6.1).

5.6.8 Impacts on the intertidal and subtidal habitats and associated flora and fauna are considered to be low negative, probable and permanent, due to the reduced area likely to be subject to scour following incorporation of scour protection. Impacts due to accretion are considered to be negligible, probable and permanent.

Change to flow velocity

5.6.9 The presence of the permanent foreshore structure would result in alterations to the hydraulic regime. On both mean and maximum spring tides, maximum velocities are predicted to increase by less than 1% on normal fluvial flows. There would be a zone of reduced velocities adjacent to the structure and in their wake along the right foreshore, although this would be smaller than with the temporary works. The impact is considered to be negligible.

Increases in dissolved oxygen concentrations in the vicinity of the CSO

5.6.10 The projected Typical Year 98% decrease in discharges compared against the base case (see para. 5.2.8) would result in improvements in DO concentrations at a local level and throughout the Tidal Thames. The Thames Tideway Tunnel project improvements would ensure compliance with the DO standards described in para. 5.4.30. These improvements are assessed at a river wide level in Vol 3 Section 5. The impact is considered to be medium positive due to the existing relatively large number and volume of spills from the Putney Bridge CSO, and impacts would be near certain and permanent.

Reduction in sediment nutrient levels

5.6.11 Elevated concentrations of nutrients (phosphate and nitrate) are likely to have accumulated in the sediments in proximity to the discharge point as a result of the faecal material and sewage derived litter discharged from the CSO. In addition to the directly toxic effects of elevated ammonia (particularly in low oxygen situations) increased nutrients in the sediment can reduce the natural limits on algal growth and enable more nitrogen/phosphate responsive species to outcompete other species reducing diversity. Interception of the CSO would lead to a gradual reduction in sediment nutrient levels. The impact is considered to be low positive, probable and permanent.

Reduced levels of sewage derived litter

5.6.12 Sewage derived litter from the CSO can be expected to reduce by approximately 98%, from approximately 18t to less than 0.5t, in the Typical Year with beneficial effects on aquatic ecology receptors. This is considered to be a low positive impact and would be near certain and permanent.

Operational effects

5.6.13 The following section describes the effects of these impacts on aquatic ecology receptors based on the significance criteria set out in Vol 2 Section 3.7. Only those impacts which are considered relevant to each receptor are assessed, in accordance with the methodology presented in Vol 2 Section 5.

5.6.14 Unless stated the effects described below apply to both Year 1 of operation and Year 6 of operation.

Designations and habitats

Permanent loss of intertidal habitats

5.6.15 There would be a permanent loss of approximately 565m^2 of intertidal habitat due to the permanent structure. A further 740m^2 of intertidal habitat and 370m^2 of subtidal habitat would be modified as a result of the scour protection measures and permanent apron. This would consist of buried rip-rap which would be overlaid with an appropriate substrate material. The effect is considered to be **moderate adverse** due to the magnitude of the impact (medium negative) and the medium-high (metropolitan) value of the receptor.

Change in intertidal and subtidal habitat due to accretion

5.6.16 The modelling results have predicted some changes in sediment accumulation and occasional deposition as a result of the permanent foreshore structure. Therefore overall the effect of accretion is considered to be **negligible**, given the medium-high (metropolitan) value of the receptor and negligible impact.

Improvements in habitat quality through changes in water quality

5.6.17 The predicted increases in DO concentrations and reductions in BOD would result in localised improvements in habitat quality. This may be characterised by increased levels of photosynthesis by microscopic algae at the interface with the sediment and within the water column, termed primary production. These algae form the basis of the estuarine food chain, providing a food source for fish and invertebrates. The gradual breakdown and removal of sewage derived litter associated with the sewage discharge would contribute to the recovery. However, habitats per se are relatively insensitive to alterations in DO concentrations, with reductions in sediment nutrient levels and sewage derived litter more important factors with regards to habitat quality improvements. Therefore the impact in this instance is considered to be of low positive magnitude, rather than medium positive. Combining the magnitude of change (low positive) with the medium-high (metropolitan) value of the resource, the effects are considered to **negligible** at Year 1 increasing to **minor beneficial** by Year 6.

Marine mammals

Increase in the number and/or change in the distribution of marine mammals

5.6.18 No changes are anticipated on marine mammals as a result of the water quality improvements associated with interception of a single CSO. This is because they are relatively insensitive to point source sewage discharges. Improvements in habitat quality due to the reduction in sewage derived litter may make the habitat more favourable, although the factor determining its use by seals relates predominantly to the lack of disturbance rather than water quality. Effects are considered **negligible** given the low-medium (local) value of the resource and low positive magnitude of impact.

Fish

Permanent loss of intertidal feeding and resting habitat for fish due to landtake

5.6.19 The subtidal gravel habitats may offer spawning habitat for smelt, and the site was found to provide a nursery area for juvenile fish during surveys undertaken in 2011. Loss of 565m^2 of intertidal foreshore habitat is considered to be a medium negative impact. Given that the value of the receptor is medium-high (metropolitan), and the magnitude of impact is medium, the effect on fish is considered to be **moderate adverse**.

Modification of intertidal feeding and subtidal habitat for fish

5.6.20 At Putney Embankment Foreshore, scour protection would occupy an area of approximately 1,110m^2. The rip-rap scour protection would consist of buried rip-rap which would be overlaid with an appropriate substrate material (see paras 5.6.20 to 5.6.21 for discussion of effects on fish associated with this). The rip rap scour protection areas may offer some benefits to juvenile fish by providing refuges from the current and from predators. In this respect it is analogous to artificial reef structures created in the marine environment to provide shelter for fish and increase the heterogeneity of otherwise uniform habitats (Grove, 1991)[21].

5.6.21 Similarly, the rip rap scour protection may offer shelter for pelagic invertebrates such as *Gammarus* which represent a food source for some fish species. It is unlikely to have potential as feeding habitat for benthic feeding fish except where accretion allows colonisation by invertebrates.

5.6.22 The effects on fish are considered to be **negligible.** This is because although the overall impact is low negative, the balance of positive and negative effects for fish gives rise to a negligible effect.

Change in feeding, resting and nursery habitat for fish due to accretion

5.6.23 The modelling results have predicted some changes in sediment accumulation and occasional deposition as a result of the permanent foreshore structure. Increase levels of accretion may cause minor localised changes in the invertebrate community. However, this is not anticipated to limit the feeding opportunities for fish. The site does lie within the zone in which dace are known to spawn and immediately upstream of the zone in which smelt are known to spawn, however increases in sediment accumulation are in the intertidal zone only and predominantly on the rip rap scour protection, whilst it is the subtidal zone that is key for spawning, and therefore there is no risk of smothering of spawning habitats due to sediment accretion. Therefore overall the effect of accretion is considered to be **negligible**, given the medium-high (metropolitan) value of the receptor and negligible impact.

Interference with migratory movements of fish

5.6.24 The Individual Based Modelling study shows that none of the three species (bass, eel and flounder) used to represent the range of species found in the Tidal Thames were significantly affected when comparing the base case and the proposed development. This is likely to be influenced by the permanent foreshore structure offering refuges for juvenile fish against adverse currents, and thus offsetting the slightly increased velocities resulting from the presence of permanent foreshore structures. The effect is therefore considered to be **negligible**, considering the medium-high (metropolitan) value of the receptor and negligible impact magnitude.

Reduction in the occurrence of dissolved oxygen related fish mortalities

5.6.25 Interception of the CSOs throughout the Tidal Thames would result in far fewer hypoxia events. The TFRM has been used to predict the change in the number of hypoxia events, and the results are reported in Vol 3 Section 5. In summary, all Tidal Thames fish populations would become sustainable (ie, less than 10% mortality as a result of hypoxia (Turnpenny *et al*, 2004[22]), compared with the current baseline in which there is a greater than 10% mortality due to hypoxia for four key species (smelt, dace, flounder and common goby).

5.6.26 Interception of the Putney Bridge CSO would contribute to Tidal Thames-wide improvements, but would also result in improvements in the local area. Given that the impact is considered to be medium positive, and the value of the receptors is medium-high (metropolitan), the effect is thus considered to be **moderate beneficial**.

Increase in the distribution of pollution sensitive fish species

5.6.27 The Tidal Thames currently supports a small number of rare fish species such as salmon, sea trout, twaite shad and river lamprey (*Lampetra fluviatilis*). A number of factors limit the colonisation of habitats by these species, including salinity, substrate type and current, but pollution is known to be an important factor in determining colonisation (Maitland and

Hatton Ellis, 2003)[23]. Improving water and sediment quality would facilitate the spread of those pollution sensitive species which are currently being impeded by poor water and sediment quality.

5.6.1 EA data and bespoke project surveys have indicated no records of rare fish species in the vicinity of Putney Embankment Foreshore although it lies immediately upstream of the zone known to support spawning habitat for smelt. Given that the impact is considered to be medium positive, and the value of the receptors is medium-high (metropolitan), the effect is thus considered to be **negligible** in the short term (Year 1), and **moderate beneficial** in the medium term (Year 6) since it would take time for fish species to colonise.

Improvement in the quality of foraging habitat

5.6.2 Intertidal habitat in the upper and middle Tidal Thames is used by juvenile fish for foraging. For example, juvenile flounder, bass and smelt migrate to the tidal limit in spring and early summer and then migrate downstream in search of suitable foraging habitat. As habitat quality improves as described in para. 5.6.17, and the invertebrate community becomes more diverse (para. 5.6.9 to 5.6.11) foraging opportunities for fish may increase. Given that the impact is considered to be medium positive, and the value of the receptors is medium-high (metropolitan), the effect is considered to be **negligible** in the short term (Year 1), increasing to **moderate beneficial** in Year 6 of operation as it would take time for communities to develop.

Invertebrates

Permanent loss of intertidal feeding and burrowing habitat for invertebrates due to landtake

5.6.3 The area beneath the permanent works would be lost as burrowing and feeding habitat for invertebrates. Given that the impact is considered to be medium negative, and the value of the receptors is medium (borough), the overall effect is considered to be **minor adverse**.

Modification of intertidal and subtidal habitats for invertebrates by scour protection

5.6.4 As for fish the degree to which the scour protection would change conditions for invertebrates depends on the nature of the existing substrate. Fine substrates are unlikely to accumulate extensively within the rip rap scour protection given the high flow velocities which are likely to occur in the vicinity of them. Benthic invertebrates may thus be excluded from these areas, except in sheltered pockets where accretion can occur.

5.6.5 Pelagic invertebrates such as *G. zaddachi* may be attracted to these areas in order to shelter from the current.

5.6.6 The overall effect on invertebrates is considered to be **minor adverse** given the low magnitude of impact and value of the receptor.

Change to burrowing and feeding habitat due to accretion

5.6.7 The modelling results have predicted no changes in sediment accumulation as a result of the permanent foreshore structure. The increase in the proportion of fine material associated with accretion may favour certain benthic invertebrates including the sediment dwelling Oligochaeta and Polychaeta. Oligochaeta are already the dominant benthic invertebrate group at the site and the change in the proportion of fine sediments is unlikely to change the overall community composition. Therefore overall the effect of accretion is considered to be **negligible**, given the medium (borough) value of the receptor and negligible impact.

Localised improvements in invertebrate diversity and abundance

5.6.8 Improvements in DO concentrations are likely to lead to an increase in the distribution of a range of species that are currently being suppressed by poor water quality conditions. Some of these improvements would occur under the base case due to the Lee Tunnel and sewage treatment works upgrades. However, even with these improvements in place there are still predicted to be a number of occasions during an average year when DO standards would be breached. Colonisation by DO sensitive taxa such as Corophiidae, Crangonidae and Gammaridae which would otherwise occur within the freshwater zone would continue to be suppressed.

5.6.9 Full compliance with the standards as a result of the Thames Tideway Tunnel project is expected to enable colonisation by these DO sensitive taxa. In the localised areas around CSO discharges gradual reductions in organic material associated with sewage would also allow for a transition from invertebrate communities dominated by small numbers of species to a more diverse and balanced community. For example, pollution sensitive estuarine taxa such as *Corophiidae, Crangonidae, Gammaridae, Sphaeromatidae, Nuculidae, Anthuridae*, and P*alaemonidae* may be expected to increase in abundance.

5.6.10 Improvements in water quality could theoretically selectively enhance colonisation by invasive, non-native species. However, studies on mitten crabs, for example, have determined that the species is able to tolerate poor water quality, but that improvement of water quality does not necessarily lead to an increased distribution (Veilleux and de Lafontaine, 2007) [24].

5.6.11 Given that the impact is considered to be medium positive, and the value of the receptors is medium (borough), the effect is considered to be at **negligible** at Year 1 and **minor beneficial** Year 6 of operation since it would take time for new species to colonise.

Increase in the distribution of pollution sensitive invertebrate species

5.6.12 The Tidal Thames currently supports a small number of rare invertebrate species, such as swollen spire snail and tentacled lagoon worm. A number of factors limit the colonisation of habitats by these species, including salinity, substrate type and current, but pollution is known to be an important factor in determining colonisation. Improving water and sediment quality would facilitate the spread of those pollution sensitive species which are currently being impeded by poor water and sediment quality.

5.6.13 EA data and bespoke project surveys have indicated no records of rare invertebrate species in the vicinity of Putney Embankment Foreshore (other than *A. lacustre* which, as discussed, although uncommon nationally, is common in the Tidal Thames). Given that the impact is considered to be medium positive, and the value of the receptors is medium (borough), the effect is thus considered to be **negligible** in Year 1, and **minor beneficial** in Year 6 as it would take time for species to colonise.

Algae

Permanent loss of original river wall

5.6.14 The algae that have previously been found on the river wall at the Putney Embankment Foreshore site can be expected to recolonise the new river wall (ie, the outer wall of the permanent structure) relatively quickly following the completion of construction (within 5 years). As none of these species are uncommon the effect is considered to be **negligible**, given the magnitude of impact and the low-medium (local) value of the receptor.

Changes in algal communities

5.6.15 The reduction in nutrient levels, both in the water column and the sediments in the vicinity of the discharge may cause local changes to the algal communities of the river wall. Whilst it is not possible to predict these changes precisely it is likely that the reduction in nutrients would contribute to the recovery of algal flora, with pollution sensitive species becoming a more common component of the community at the expense of more pollution tolerant species.

5.6.16 However, habitat availability would remain a key factor determining the diversity and abundance of algal communities and so the effects associated with the Thames Tideway Tunnel project are considered to be **negligible**, due to the low-medium (local) value of the receptor and low positive magnitude of impact.

Sensitivity test for programme delay

5.6.17 For the assessment of effects on aquatic ecology during operation, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the assessment findings reported above (paras. 5.6.1 - 5.6.16). This is because there are no developments in the site development schedule (Vol 7 Appendix N) that would fall into the base case as a result of this delay and therefore the base case would remain as described in paras. 5.4.62 - 5.4.65.

5.7 Cumulative effects assessment

5.7.1 As described in Section 5.3, during the construction phase there are no schemes within the site development schedule (Vol 7 Appendix N) that would have an impact on aquatic ecology receptors, and so no cumulative impacts with the proposed development would arise.

5.7.2 Similarly during the operational phase there are no schemes that could lead to a cumulative impact at Putney Embankment Foreshore.

5.7.3 Therefore the effects on aquatic ecology would remain as described in Section 5.5 and 5.6 above.

Sensitivity test for programme delay

5.7.4 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year, the cumulative effects assessment would remain unchanged. As described above in para. 5.7.1 - 5.7.3, there are no schemes anticipated to generate cumulative effects on aquatic ecology and this would remain the case with a programme delay of approximately one year.

5.8 Mitigation and compensation

5.8.1 The approach to mitigation has been informed by the ‘Mitigation and Compensation Hierarchy’ consulted on with the Thames Tideway Tunnel Biodiversity Working Group and EA Technical Working Group as a systematic and transparent decision-making process. The hierarchy is appended to Vol 2 Section 5 (Appendix C.3).

5.8.2 The hierarchy is sequential and seeks to avoid adverse environmental effects. The hierarchy of ‘avoid effect’, ‘minimise’, ‘control’ ‘compensate’, and ‘enhance’ has been strictly applied in this sequence. Vol 2 of the *Environmental Statement* describes how this hierarchy has been applied.

5.8.3 All *CoCP Part A and Part B* and embedded design measures of relevance to aquatic ecology are summarised in Section 5.2. No significant effects requiring mitigation are predicted during the construction stage.

5.8.4 During operation, the permanent loss of intertidal foreshore is considered to be a moderate adverse effect on designated sites and habitats, and fish. The footprint of the permanent structure has been minimised as far as possible to accommodate the necessary works therefore further mitigation is not possible.

5.8.5 During operation the permanent loss of intertidal foreshore at Putney Embankment Foreshore contributes to an overall loss of habitat arising from all of the foreshore sites. Compensation for this project-wide permanent loss of foreshore habitat is described in Vol 3 (see para. 5.8.7 and 5.9.2).

5.8.6 A monitoring programme to measure the recovery of aquatic ecology receptors throughout the Tidal Thames following interception of the CSO network would be implemented.

Compensation

5.8.7 Significant adverse effects would occur due to the permanent loss of intertidal and subtidal habitats, and intertidal feeding and resting habitat for fish. On site habitat compensation is not considered possible due to the limited availability of land to create new habitat within the boundary of the site. A package of off site measures which would compensate for significant adverse effects on habitats and fish has been developed and is reported in full in Vol 3 Section 5.8. It includes measures such as the creation of an intertidal terrace on the Bell Lane Creek, and the installation of fish passes on several structures which are currently inhibiting the migration of fish from the Tidal Thames into freshwater tributaries.

5.9 Residual effects assessment

Construction effects

5.9.1 As no further mitigation measures are proposed in addition to the *CoCP Part A* and *Part B* requirements, the residual construction effects remain as described in Section 5.5. All residual effects are presented in Section 5.10.

Operational effects

5.9.2 Compensation for the overall permanent habitat loss across the Thames Tideway Tunnel project is outlined in the project wide assessment (Vol 3 Section 5). At a project wide level the total habitat losses have been addressed through creation/ enhancement of sites along the route of the Thames Tideway Tunnel project to compensate for adverse effects on aquatic ecology. The loss of habitat at Putney Embankment Foreshore has been reported here without taking account of these compensation sites. This is to ensure that the local effects are presented. However, it is recognised that aquatic ecological resources are highly mobile and river-wide. Reference should therefore be made to the project wide assessment which includes the compensation sites to understand the total effects anticipated to result from the Thames Tideway Tunnel project.

5.9.3 As no other mitigation is required all other effects remain as reported in Section 5.6. Residual effects are reported in Section 5.10.

5.10 Assessment summary

Vol 7 Table 5.10.1 Aquatic ecology – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Designated sites and Habitats	Loss of intertidal and subtidal habitat due to temporary landtake.	Minor adverse	None	Minor adverse
	Change in intertidal and subtidal habitat due to scour and accretion	Minor adverse	None	Minor adverse
	Disturbance and consolidation of intertidal and subtidal habitat	Minor adverse	None	Minor adverse
Marine mammals	Interference with the migrations of marine mammals within the Tidal Thames.	Negligible	None	Negligible
Fish	Loss of feeding, resting and nursery habitat for fish due to temporary landtake	Minor adverse	None	Minor adverse
	Loss of feeding, resting and nursery habitat for fish due to sediment consolidation and disturbance.	Minor adverse	None	Minor adverse
	Interference with migratory movements of fish	Negligible	None	Negligible
	Effects of waterborne noise and vibration on fish	Minor adverse	None	Minor adverse
	Change in feeding, resting and nursery habitat for fish due to scour and accretion	Minor adverse	None	Minor adverse
	Potential disturbance due to illumination of the river	Negligible	None	Negligible
	Reduction in water column visibility due to	Minor adverse	None	Minor adverse.

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	suspended sediment.			
Invertebrates	Direct mortality of invertebrates due to temporary landtake and disturbance and consolidation of sediment.	Negligible	None	Negligible
	Loss of feeding/burrowing habitat for invertebrates due to temporary landtake	Negligible	None	Negligible.
	Loss of feeding/burrowing habitat for invertebrates due to sediment consolidation and disturbance.	Negligible	None	Negligible
	Change to burrowing and feeding habitat due to scour and accretion	Negligible	None	Negligible
	Potential disturbance due to illumination of the river	Negligible	None	Negligible
	Reduction in water column visibility due to suspended sediment.	Negligible	None	Negligible
Algae	Temporary landtake	Negligible	None	Negligible
	Blanketing of areas and increase in water column turbidity due to suspended sediment	Negligible	None	Negligible

Vol 7 Table 5.10.2 Aquatic ecology – summary of operational assessment

Receptor	Effect	Significance of effect		Mitigation	Significance of residual effect	Compensation
		Year 1	Year 6			
Designated sites and Habitats	Permanent loss of intertidal habitat	Moderate adverse	Moderate adverse	None	Moderate adverse (at the site level)	Compensation would be provided through a suite of off site habitat creation schemes which are described in the project wide volume (Vol 3 Section 5).
	Change in intertidal and subtidal habitat due to accretion	Negligible	Negligible	None	Negligible	None
	Improvements in habitat quality through changes in water quality	Negligible	Minor beneficial	None	Minor beneficial	None
Marine mammals	Increase in the number and/or change in the distribution of marine mammals.	Negligible	Negligible	None	Negligible	None
Fish	Permanent loss of intertidal feeding and resting habitat for fish due to landtake.	Moderate adverse	Moderate adverse	None	Moderate adverse (at the site level)	Compensation would be provided through a suite of off site

Receptor	Effect	Significance of effect		Mitigation	Significance of residual effect	Compensation
		Year 1	Year 6			
						habitat creation schemes which are described in the project wide volume (Vol 3 Section 5)
	Modification of intertidal feeding and subtidal habitat for fish	Negligible	Negligible	None	Negligible	None
	Change in feeding, resting and nursery habitat for fish due to accretion	Negligible	Negligible	None	Negligible	None
	Interference with migratory movements of fish due to blockage of the intertidal area by permanent structures.	Negligible	Negligible	None	Negligible	None
	Reduction in the occurrence of dissolved oxygen related fish mortalities.	Moderate beneficial	Moderate beneficial	None	Moderate beneficial	None
	Increase in the distribution of pollution sensitive fish species.	Negligible	Moderate beneficial	None	Moderate beneficial	None
	Improvement in the quality of foraging habitat	Negligible	Moderate beneficial	None	Moderate beneficial	None
Invertebrates	Permanent loss of intertidal feeding and burrowing habitat	Minor	Minor adverse	None	Minor adverse	None

Receptor	Effect	Significance of effect		Mitigation	Significance of residual effect	Compensation
		Year 1	Year 6			
	for invertebrates due to landtake.	adverse				
	Modification of intertidal and subtidal habitat for invertebrates by scour protection	Minor adverse	Minor adverse	None	Minor adverse	None
	Change to burrowing and feeding habitat due to accretion	Negligible	Negligible	None	Negligible	None
	Localised improvements in invertebrate diversity and abundance.	Negligible	Minor beneficial	None	Minor beneficial	None
	Increase in the distribution of pollution sensitive invertebrate species.	Negligible	Minor beneficial	None	Minor beneficial.	None
Algae	Permanent loss of original river wall	Negligible	Negligible	None	Negligible	None
	Changes in algal communities	Negligible	Negligible	None	Negligible	None

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 6: Ecology - terrestrial

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

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Thames Tideway Tunnel

Environmental Statement

Volume 7: Putney Embankment Foreshore site assessment

Section 6: Ecology – terrestrial

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6 Ecology – terrestrial

6.1 Introduction

6.1.1 This section presents the findings of the assessment of the likely significant effects of the proposed development on terrestrial ecology at the Putney Embankment Foreshore site.

6.1.2 The proposed development has the potential to affect terrestrial ecology due to:

a. site and vegetation clearance, and subsequent reinstatement and habitat creation

b. construction site activities

c. barge movements

d. a short period of 24 hour working associated with excavation of the connection tunnel.

6.1.3 Operational effects for terrestrial ecology for this site have been scoped out. This is on the basis that permanent operational lighting is minimal and would comply with the lighting design principles to minimise light spill, and maintenance works are limited to intermittent visits to site by maintenance personnel and vehicles. No significant operational effects are considered likely and for this reason only construction effects are assessed.

6.1.4 The following are not considered within the assessment:

a. contaminated runoff and atmospheric pollution, as these would be controlled through the implementation of the *Code of Construction Practice* (*CoCP*)[i]

b. designated sites relevant to terrestrial ecology. This is because those that lie within 250m of the site are isolated from it. No likely effects on these sites due to proposed construction works have been identified. However, the baseline includes details of the designated sites within 250m of the site (para. 6.4.2).

6.1.5 The assessment of the likely significant effects of the project on terrestrial ecology has considered the requirements of the *National Policy Statement (NPS) for Waste Water* (Defra, 2012)[1]. In line with these requirements, designations, species and habitats relevant to terrestrial ecology are identified and measures incorporated into the proposed development described. Based on assessment findings, measures to address likely significant adverse effects are identified. Vol 2 Section 6 provides further details on the methodology.

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[i] The Code of Construction Practice (CoCP) is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

6.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Vol 7 Putney Embankment Foreshore figures).

6.2 Proposed development relevant to terrestrial ecology

6.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to terrestrial ecology are set out below.

Construction

6.2.2 The following elements of the construction phase have the potential to affect terrestrial ecology receptors:

a. removal of one holly (*Ilex* sp.) tree and amenity grassland within Waterman's Green, and pruning of all other trees within the Limit of land to be acquired or used (LLAU)

b. construction works throughout the construction phase that would create noise and vibration, such as the use of construction machinery and vehicles, demolition and connection tunnel excavation. This includes noise and vibration during 24 hour working

c. artificial lighting of the site in evenings during winter, and continuously during the construction of the connection tunnel

d. construction of temporary and permanent structures within the foreshore at both the main site and the secondary site (the location of the temporary slipway), including scour protection

e. use of barges and the associated campsheds on the foreshore.

f. reinstatement of foreshore after completion of works and removal of temporary structures.

Code of Construction Practice

6.2.3 The *CoCP* sets out the standards, procedures and measures for managing and reducing construction effects. These measures would be implemented through a site specific *Construction environmental management plan* (*CEMP*), which would encompass an *Ecology and landscape management plan* (*ELMP*). The *ELMP* would include measures to protect and minimise impacts on sensitive ecological receptors such as designated sites, sensitive habitats (e.g. trees, scrub, watercourses, grassland), and notable species.

Part A

6.2.4 The *CoCP* Part A includes the following measures to reduce impacts on terrestrial ecology:

a. consultation with a suitably qualified ecologist in preparing the control measures within the *ELMP* and *CEMP*

b. a check of the site in advance of the works to identify any ecological constraints in addition to those discussed in this *Environmental Statement* (ES)

c. supervision of works by a suitably qualified ecologist

d. protection of trees

e. measures specific to bats such as the control of lighting, noise and vibration, and procedures to follow if a bat roost is present on site

f. measures to prevent harm to nesting birds and birds that are listed on Schedule 1 of the Wildlife and Countryside Act 1981 (WCA, 1981)

g. use of capped and cowled lighting that is directed away from sensitive ecological receptors

h. controls to minimise noise and vibration, including use of noise enclosures, careful plant selection and careful programming of works

i. controls for site drainage to minimise the potential for pollution of watercourses and contamination of sensitive habitats

j. controls to prevent spread of non-native invasive plants, where present.

Part B

6.2.5 The following site specific measures are contained in *CoCP Part B* (Section 11) for terrestrial ecology:

a. areas of foreshore used for temporary works would be restored at the end of works.

b. a tree root survey and subject root protection measures during cabling works would be implemented to protect trees. The extent of pruning of trees would be agreed with the local authority.

Environmental design measures

6.2.6 The following measures to mitigate adverse effects or provide biodiversity enhancements have been incorporated into the project design as detailed in the Design Principles:

a. installation of a brown roof on the electrical and control kiosk on Waterman’s Green

b. a replacement holly tree would be provided.

c. bat boxes for common pipistrelle and soprano pipistrelle bats would be attached to trees on and adjacent to the site, located to avoid disturbance during construction and from lighting.

6.3 Assessment methodology

Engagement

6.3.1 Vol 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of effects on terrestrial ecology are presented here in Vol 7 Table 6.3.1 below.

Vol 7 Table 6.3.1 Terrestrial ecology – stakeholder engagement

Organisation	Comment	Response
London Borough of Wandsworth (*scoping opinion* – May 2011)	Requested full justification as to why the operational phase has been scoped out for terrestrial ecology at the Putney Embankment Foreshore site.	Activities during the operational phase are limited to maintenance visits every one to six months by maintenance personnel during normal working hours. There may be greater activity once every ten years during normal working hours. This is considered unlikely to have a significant effect on any of the terrestrial ecology receptors at or adjacent to the site.
	River walls and their value in supporting ecology have not been fully considered; this could be addressed in both aquatic and terrestrial surveys to ascertain a baseline – any issues arising from this baseline can then be suitably accounted for in subsequent documents.	Algal surveys have been undertaken on the river wall and these are reported in the aquatic ecology assessment (Section 5 of this volume). The river wall as a terrestrial ecology receptor has not been considered in this assessment for this site as both sections of wall affected by the works mainly comprise concrete and have very low potential to support notable species.
London Borough of Wandsworth (phase two consultation – February 2012)	The *CoCP* and its effective implementation will be critical to minimising damage to wildlife and habitats. The proposals for biodiverse roofs on the permanent structures are welcomed.	These comments have been noted.
	The retention of existing trees is welcomed and it is recommended that protection is specified as needing to meet the appropriate British	A survey of the tree roots would be undertaken prior to trenching works commencing to ensure that tree roots are avoided wherever practicable. Tree protection

Organisation	Comment	Response
	Standards.	measures are included in the *CoCP* Part A (Section 11) (see para. 6.2.4 above)
	Consideration should be given to the inclusion of bat roosting opportunities on the external walls of the electrical and control kiosk.	Bat boxes would not be attached to the electrical and control kiosk. However, the opportunity for the provision of bat boxes has been included in the design principles and is subject to landowner approval.
London Borough of Wandsworth (Section 48 publicity consultation – October 2012)	Object to the loss of the holly tree without suitable or adequate mitigation.	The holly tree would be replaced.
	Object to trenching along Waterman's Green due to concerns for the safety and health of the trees here. Seek to ensure that ducting and cabling is not injurious to the trees here.	A survey of the tree roots would be undertaken prior to trenching works commencing to ensure that tree roots are avoided wherever practicable. Tree protection measures are included in the *CoCP* Part A (Section 11) (see para. 6.2.4 above)

Baseline

6.3.2 The baseline methodology follows the methodology described in Volume 2 Section 6. In summary, the following baseline data has been reported in this assessment:

a. desk study

b. a Phase 1 Habitat Survey undertaken on 24 November 2010

c. bat triggering surveys (remote recording surveys) undertaken over three nights between 17 and 19 May 2011

d. wintering bird surveys undertaken on 13 December 2010 and 20 January, 18 February, 19 March, 10 October and 9 November 2011.

Construction

6.3.3 The assessment methodology for the construction phase follows that described in Vol 2 Section 6. There are no site-specific variations for this site. All likely significant effects throughout the duration of the construction phase have been assessed.

6.3.4 The term significance is used within this volume to refer to project significance levels from negligible to major effects (adverse and beneficial). Adverse moderate or major effects are considered to be significant and require mitigation. Negligible and minor effects are not considered significant and therefore do not require mitigation. These significance criteria and their relationship with levels of significance are based on the Institute for Ecology and Environmental Management guidelines (IEEM, 2006)[2] is given in Vol 2 Section 6.

6.3.5 No effects on habitats are predicted beyond 10m of the site boundary. Therefore, the assessment area comprises the site and adjacent land within 10m of the site boundary.

6.3.6 The assessment considers bats, breeding birds and wintering birds within 100m of the site. This is considered to be a sufficient distance within the context of the urban environment to ensure that any significant effects on species, for example from disturbance as a result of construction lighting and noise, are assessed.

6.3.7 Section 6.5 details the likely significant effects arising from the construction at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on terrestrial ecology within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

6.3.8 The following developments identified in the site development schedule (Vol 7 Appendix N) would be complete and operational by Site Year 1 of construction and have the potential to change the terrestrial ecology baseline conditions in the assessment area. The resulting change in baseline conditions is discussed in para. 6.4.23. Therefore, these developments have been considered as part of the base case:

a. No. 2 Putney High Street located adjacent to the site, resulting in the creation of an opening in the river wall to provide access to Watermans Green for outdoor restaurant seating

b. No. 4-6 Putney High Street, located adjacent to the site, providing further openings in the river wall to access vaults.

6.3.9 No change to the base case conditions for terrestrial ecology are considered likely from any of the other developments identified in the site development schedule (Vol 7 Appendix N), due to the isolated location of these developments from the proposed development site, within the urban context.

6.3.10 A number of developments listed in Vol 7 Appendix N would be under construction during the construction phase of the Thames Tideway Tunnel project. However, again, these developments are isolated from the site. Therefore, no cumulative effects of construction activities are considered for Putney Embankment Foreshore site (Section 6.7).

6.3.11 The assessment of construction effects considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Assumptions and limitations

6.3.12 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 6. Site specific assumptions and limitations are detailed below.

Assumptions

6.3.13 It is assumed for the purposes of assessment that the current use of the Putney Embankment Foreshore site (described in Vol 7 Section 2) would continue as at present, aside from the development at 2 Putney High Street which partially falls within the site.

6.3.14 It is assumed that the tree protection measures outlined in para. 6.2.5 would be sufficient to prevent unintentional damage or loss of trees.

Limitations

6.3.15 No site-specific limitations have been identified for the Putney Embankment Foreshore site assessment.

6.4 Baseline conditions

6.4.1 The following section sets out the baseline conditions for terrestrial ecology receptors within and around the site, including their value. Future baseline conditions (base case) are also described. All figures referred to in this section are contained in the Vol 7 Putney Embankment Foreshore figures.

Current baseline

Designated sites

6.4.2 The following designated sites relevant to terrestrial ecology are within 250m of the site and are shown on Vol 9 Figure 6.4.1 (see separate volume of figures):

a. Fulham Palace and Bishop's Park Site of Importance for Nature Conservation (SINC Grade I of local importance[ii]) 160m to the north of the site on the opposite bank of the River Thames comprising parkland trees, grassland, scrub and waterbodies

b. the site is within and adjacent to the River Thames and Tidal Tributaries SINC (Grade M[iii]) and comprises foreshore habitat and river channel. Effects on this designated site are assessed in the aquatic ecology section 5 and is not considered further here.

Habitats

6.4.3 Habitats recorded within the survey area during the Phase 1 Habitat Survey are described in Vol 7 Table 6.4.1 and shown on the Phase 1 Habitat Survey map (Vol 7 Figure 6.4.2, see separate volume of figures).

[ii] SINC (Grade L) = Site of Importance for Nature Conservation (Grade I of local importance)

[iii] SINC (Grade M) = Site of Importance for Nature Conservation (Grade III of Metropolitan importance)

Vol 7 Table 6.4.1 Terrestrial ecology – Phase 1 Habitat Survey

Habitat type	Description
Buildings, hardstanding and boundary (river wall)	Residential properties are present in close proximity to the site. Hardstanding in the form of roads, footpaths and slipways are present on site. A stretch of river wall is also present on site.
Amenity grassland	There is a small strip of amenity grassland on site (Waterman's Green).
Scattered trees	There are a number of mature trees adjacent to the foreshore within the survey area. There are also trees along the Thames Path.
Running water and intertidal habitat	Most of the survey area lies within the River Thames in the intertidal zone. This habitat type is part of the aquatic ecology assessment (Section 5) and is not considered further in this assessment.

6.4.4 The buildings, hardstanding and river wall are not considered to comprise notable habitats and therefore are of negligible value.

6.4.5 The amenity grassland is species-poor, common and can be recreated. Its value is also limited by its small extent. This habitat is of negligible value.

6.4.6 The mature trees on and adjacent to the site are mostly ornamental non-native species, including London plane (*Platanus x acerifolia)*. They are not designated and are not listed on the local UK Biodiversity Action Plan (BAP). However, they offer some local biodiversity value. The trees adjacent to the site are considered to be of low (site) value.

Notable species

6.4.7 Survey results are set out in a notable species report, which is included in Vol 7 Appendix D.1. A summary of the results and an assessment of the value of species associated with the site are set out below.

Bats

6.4.8 During the Phase 1 Habitat Survey, potential foraging and commuting habitat was identified. The trees on site have the potential to support limited populations of invertebrates upon which bats could feed. Consequently the site and its immediate surrounds are considered to represent a potential foraging resource for bats. The stretch of river corridor which lies both within and adjacent to the site is also of potential importance to foraging and commuting bats. Therefore, remote recording surveys were undertaken.

6.4.9 All bats comprise European Protected Species (EPS) under the Conservation of Habitats and Species Regulations 2010. Seven of the 18 bat species that occur in England are listed as priority species on the UK BAP. Nine bat species are listed on the London BAP including common pipistrelle (*Pipisitrellus pipistrellus)*, and soprano pipistrelle (*Pipistrellus pigmaeus)*. These two species were both recorded on site. Detailed survey results are provided in Vol 7 Appendix D.1 and on Vol 7 Figure 6.4.3 (see separate volume of figures).

6.4.10 The results of the bat triggering surveys indicated that small numbers of soprano pipistrelle and common pipistrelle bats pass through the site. The activity on site indicates that low numbers of common pipistrelle and soprano pipistrelle bats are associated with the site. These bats are likely to be foraging around the trees on site and commuting along the River Thames.

6.4.11 The trees on site had negligible potential to support roosting bats as they had an absence of suitable roosting features such as holes and peeling bark. There were no records of bat passes during the surveys that were timed close to sunset or sunrise, when bats usually leave or return to their roost sites, indicating that the bat activity was unlikely to be associated with a roost on or near the site.

6.4.12 The common pipistrelle bat is the UK's most common bat species, and is a widespread species in Greater London. The soprano pipistrelle bat is also widespread and common across Greater London but has a smaller UK population than the common pipistrelle (London Bat Group, 2012)[3], (Harris et at., 1995)[4]. Both species are in decline mainly due to habitat loss.

6.4.13 With consideration given to the conservation status of both common pipistrelle and soprano pipistrelle, and the size of the populations using the site relative to their UK populations, the populations of these two species associated with the site and its immediate surrounds are both considered to be of low (site) value.

Breeding birds

6.4.14 During the Phase 1 Habitat Survey, the small number of scattered trees on site were identified as having some potential to support nesting birds. Due to the limited extent of this habitat however, it was not considered necessary to undertake a breeding bird survey.

6.4.15 The trees on and adjacent to the site are limited in extent and have the potential to support a small number of nesting birds, such as those recorded in the desk study (Vol 7 Appendix D.1). This could include UK BAP or local BAP bird species. The breeding bird resource associated with the site is considered to be of low (site) value.

Wintering birds

6.4.16 During the Phase 1 Habitat Survey, the foreshore habitat along the River Thames was considered to have potential to support wintering waterbirds, and therefore wintering bird surveys were undertaken. Details of the surveys are provided in Vol 7 Appendix D.1 and shown on Vol 7 Figure 6.4.4 (see separate volume of figures).

6.4.17 A total of 15 waterbird[iv] species were recorded on the foreshore on and adjacent to the site. Of these, seven species are of nature conservation importance and are included on the Birds of Conservation Concern (RSPB, 2009)[5] Red or Amber List[v] and/or UK and/or London BAP as priority species (Vol 7 Table 6.4.2):

a. on two occasions, small numbers of teal *(Anas crecca)* were observed foraging on the foreshore following the receding tide

b. mallard (*Anas platyrhynchos*), tufted duck (*Aythya fuligula*), black-headed gull (*Larus ridibundus*), common gull (*Larus canus*), lesser black-backed gull (*Larus fuscus*) and herring gull (*Larus argentatus*) were observed.

6.4.18 The records of waterbirds of nature conservation importance recorded on the foreshore were compared to counts at other sites published in the London Bird Report 2008 (London Natural History Society, 2011)[6]. High numbers of gulls were recorded on the foreshore on and adjacent to the site where the public were observed feeding the birds. This has skewed the data at this site, particularly for black-headed gull. The high numbers would occur at most sites along the Thames Tideway Tunnel project corridor where the public feed the gulls.

6.4.19 Taking into account the skewed data for black-headed gull, the populations on site are small relative to their London populations. Therefore, any population of any one individual species of conservation concern is considered to be of low-medium (local) value. All other bird species associated with the intertidal habitat, were recorded at low numbers relative to populations within the London Bird Report 2008. As such, they would not be considered to be of importance individually at more than low (site) level. However, as an assemblage of wintering birds, they appreciably enrich the local area. Therefore, the waterbird assemblage is considered to be of low-medium (local) value

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[iv] 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.

[v] 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.

Vol 7 Table 6.4.2 Terrestrial ecology – wintering birds of nature conservation importance

Common name	Scientific name	Nature conservation designation	Maximum counts	Value
Teal	*Anas crecca*	Amber List	Recorded on two survey visits, with a maximum count of 10 in December 2010 and 3 in January 2011.	Low-medium (local)
Mallard	*Anas platyrhynchos*	Amber List	Recorded on each visit, with a maximum count of 26 in November 2011 and numbers varying between 6 and 13 in other months.	Low-medium (local)
Tufted duck	*Aythya fuligula*	Amber List	Two were recorded on one survey visit during March 2011.	Low-medium (local)
Black-headed gull	*Larus ridibundus*	Amber List	Recorded on each survey visit, with a maximum count of 302 in January 2011 and numbers varying between 33 and 152 in other months.	Low-medium (local)
Common gull	*Larus canus*	Amber List	Recorded on three survey visits, with a maximum count of 9 in December 2010 and 1 and 3 in other months.	Low-medium (local)
Lesser black-backed gull	*Larus fuscus*	Amber List	Recorded on each survey visit, with a maximum count of 10 in March 2011 and numbers varying between 2 and 5 in other months.	Low-medium (local)
Herring gull	*Larus argentatus*	Red List and UK and London BAP Priority List	Recorded on each survey visit, with joint maximum counts of 20 in January and March 2011 and numbers varying between 6 and 19 in other months.	Low-medium (local)

Noise, vibration and lighting

6.4.20 As noise, vibration and lighting have the potential to disturb species on and adjacent to the site, baseline conditions are described here.

6.4.21 Current noise levels on site are high with road traffic noise from Putney Bridge Approach, Lower Richmond Road and Embankment, and other more distant roads around the site. Levels of vibration around the site are low (see Section 9 of this volume).

6.4.22 At night the site is lit by street lighting along Putney Bridge Approach, Lower Richmond Road and Embankment. Consequently, the baseline light levels at night are moderate to high.

Construction base case

6.4.23 Taking into account the developments described in para. 6.3.8 the base case would be slightly different as several trees would have been removed from Waterman's Green to facilitate the creation of the outdoor seating area associated with the restaurant at No. 2, Putney High St. Apart from this slight change, it is assumed the site would be maintained as it is at present and the conditions at Site Year 1 of construction would be the same as the current baseline conditions.

6.4.24 The noise and vibration base case is described in detail in Section 9 of this volume. Noise levels are likely to be similar to those currently present on and in close proximity to the site, with slight increases in noise experienced due to an anticipated increase in traffic levels adjacent to the site. The levels of lighting and vibration around the site are considered unlikely to change in the base case.

6.5 Construction effects assessment

Construction impacts

Habitat clearance and creation

6.5.1 Site clearance as part of construction works would result in the removal of one holly tree. This tree is of low (site) value and would be replaced with another tree at a location to be agreed with the local authority after completion of the proposed construction activities at this site. The remaining trees on and immediately adjacent to the site would be pruned at the start of construction. Tree protection measures would be put in place to minimise impacts on trees on and in close proximity to the site, as detailed in the *CoCP* Part A (Section 11). However, it is likely that some of these trees would be lost due to unavoidable damage to their root zones. These trees would be replaced.

6.5.2 A section of river wall and hardstanding of negligible ecological value would also be removed as part of the site clearance activities and replaced.

6.5.3 There would be a temporary loss of foreshore habitat for wintering birds during construction from the temporary in-river structures. A small area of foreshore would be permanently lost to the permanent foreshore structure and scour protection. The use of campsheds would also result in the temporary loss of habitat for wintering birds and bats on the foreshore of the River Thames. The foreshore would be reinstated following removal of the campsheds and temporary structures at the end of construction. A brown roof would be installed on the electrical and control kiosk on Waterman's Green, creating a small area of ephemeral short perennial habitat which would be of benefit to species such as birds and invertebrates. Bat boxes are also proposed, which would increase the availability of potential roosting opportunities for bats.

Movement, noise, vibration and lighting

6.5.4 Noise and vibration impacts are based upon the data and assessment in Section 9 of this volume. Noise and vibration is likely to increase during the construction period with most of the works taking place during the day. An increase in noise and vibration would be perceptible on the foreshore during works within the foreshore. This activity could disturb wintering birds. Noise and vibration from construction activities are unlikely to affect bats as the majority of the works would be undertaken during the day whilst bats fly through the site at night.

6.5.5 As vehicle movements along the Embankment and Lower Richmond Road are currently high, the movement of vehicles and site workers on site is unlikely to significantly increase the level of disturbance to birds adjacent to the site.

6.5.6 Construction would require there to be some lighting in the early morning and evening during the winter months to facilitate standard working hours. There would also be periods where lighting is required to facilitate 24 hour working. With measures in place, as described in the *CoCP* Part A (Section 4), the increase in lighting is likely to be minimal particularly as current light levels are considered to be high at this location. Therefore, it is considered unlikely that lighting would affect wintering birds on the foreshore and bats associated with the River Thames corridor.

6.5.7 The movement of construction workers and machinery on site could disturb birds adjacent to the site during construction.

Barging and associated activities

6.5.8 Although light spill would be minimised through measures in the *CoCP* Part A (Section 4), some increases in lighting are expected on the foreshore as a result of lighting of the barging facilities for navigational purposes. Therefore, some disturbance from lighting is anticipated on wintering birds and commuting bats.

6.5.9 The movement of barges in and out of the site is likely to cause disturbance to wintering birds on the foreshore adjacent to the site. Wash created by the movement of barges may also displace birds from the foreshore adjacent to the site.

Construction effects

Habitats

6.5.10 Replacement planting would ensure that tree removal, pruning and damage to the roots of trees on and adjacent to the site is unlikely to have a significant effect on the habitat resource in the long term. A small area of amenity grassland would be permanently lost (negligible value). The overall effect is considered to be probable, **negligible** and not significant.

6.5.11 The provision of a brown roof would provide a small area of ephemeral short perennial habitat that, although beneficial, would not appreciably enrich the local habitat resource. Therefore, the significance of the effect is considered to be probable, **negligible** and not significant.

Species

Bats

6.5.12 There would be temporary loss of foreshore during construction, and the permanent loss of a small area of foreshore to the permanent foreshore structure. However, the function of the River Thames as a commuting corridor for bats would be maintained. Therefore, it is considered unlikely that the temporary or permanent loss would result in a decline in bat populations and the effect is considered to be probable, **negligible** and not significant.

6.5.13 Small changes in light levels are considered unlikely to create a barrier to the movement of commuting bats. Common and soprano pipistrelle bats can tolerate relatively high light levels, up to 14 lux. There may be some minor changes in bat behaviour as bats are likely to commute over or around the foreshore works. The River Thames is a wide corridor at this point, and the function of this habitat would be maintained. It is considered unlikely that changes in light levels and minimal changes in commuting behaviour would have an effect on the local distribution and abundance of bat populations. Therefore, the effect is considered to be probable, **negligible** and not significant.

6.5.14 The provision of bat boxes would be beneficial for bats although the significance of the effect on bats cannot be predicted with any level of certainty as the number, location and type of bat box is to be agreed. Therefore, the significance of the effect on bats is considered to be probable, **negligible** and not significant.

Breeding birds

6.5.15 There would be temporary loss of a small area of breeding bird habitat from the removal of one tree and pruning of other trees on site during the construction works. Birds would be displaced to adjacent habitats but it is considered unlikely that this would result in a perceptible change to breeding bird populations. Therefore, the effect of habitat loss on breeding bird populations is considered to be probable, **negligible** and not significant.

6.5.16 Birds adjacent to the site are likely to habituate to changes in noise and vibration levels, and disturbance from lighting would be minimised through measures outlined in the *CoCP* Part A (Section 11). Some displacement of nesting birds from adjacent habitat, due to disturbance from lighting, noise and vibration, is considered unlikely to adversely affect breeding bird populations, as alternative habitat is available and the breeding bird resource associated with the site is small. The displacement effect would be reversed following cessation of the noise and vibration impacts following construction. Any small fluctuations in populations as a result of this disturbance are considered unlikely to be perceptible against background population fluctuations. Therefore, the effect of disturbance on breeding bird populations is considered to be probable, **negligible** and not significant.

Wintering birds

6.5.17 Works within the foreshore, including the temporary structures and campsheds, would result in the loss of foreshore habitat for wintering waterbirds during construction. The site is mainly frequented by several species of gull and low numbers of teal and mallard. It is considered likely that these species would be displaced to other areas of foreshore adjacent to the site. Following reinstatement of the foreshore, wintering waterbirds are likely to return to the site. The permanent loss of a small area of foreshore is unlikely to significantly reduce the overall resource for wintering birds given the large scale of foreshore habitat that would remain along the River Thames. No perceptible change in wintering bird populations associated with the site are anticipated as a result of changes to the foreshore habitat. Therefore, the effect on wintering bird populations at the site is considered to be probable, **negligible** and not significant.

6.5.18 There would be a temporary increase in noise and vibration levels associated with the construction work within the foreshore. Occasional displacement of birds is expected where sudden noises occur and when barges pass close by, with birds moving away from adjacent intertidal habitat temporarily and returning shortly after. This displacement and return of wintering birds has been observed on the foreshore at other sites on the River Thames, particularly where people walk along the foreshore. It is considered likely that any waterbirds present within the surrounding area would habituate to the increase in noise and vibration levels. Therefore, the effect on wintering bird populations associated with the site is considered to be probable, **negligible** and not significant.

6.5.19 Changes in light levels, with control measures in place, are considered to be small and are unlikely to affect wintering birds adjacent to the site. Therefore, the effect of disturbance on wintering bird populations is considered to be probable, **negligible** and not significant.

Sensitivity test for programme delay

6.5.20 For the assessment of effects on terrestrial ecology during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the assessment findings reported above (paras. 6.5.1 - 6.5.19). This is because there are no further developments in the site development schedule that would fall into the base case as a result of this delay and therefore the base case would remain as described in paras. 6.4.23 - 6.4.24.

6.6 Operational effects assessment

6.6.1 As stated in para. 6.1.3, operational activities are limited at this site and not likely to lead to significant operational effects.

6.7 Cumulative effects assessment

6.7.1 As stated in para. 6.3.10, proposed developments in the vicinity of the site that would be under construction during the construction phase of the Thames Tideway Tunnel project, are considered to be isolated from the site. Therefore, no cumulative effects on terrestrial ecology are anticipated.

Sensitivity test for programme delay

6.7.2 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year, the cumulative effects assessment would remain unchanged. As described above in para. 6.7.1, there are no schemes anticipated to generate cumulative effects on terrestrial ecology and this would remain the case with a programme delay of approximately one year.

6.8 Mitigation

6.8.1 All measures embedded in the design and the *CoCP* of relevance to terrestrial ecology are summarised in Section 6.2. As no significant adverse effects have been identified, no other mitigation measures for construction effects are proposed.

6.9 Residual effects assessment

6.9.1 As no mitigation measures are required, the residual construction effects remain as described in Section 6.5. All residual effects are presented in Section 6.10.

6.10 Assessment summary

Vol 7 Table 6.10.1 Terrestrial ecology – construction assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Habitats				
Trees, amenity grassland, hardstanding and river wall	No significant change in habitat quality and area on site as trees lost during construction would be replaced following completion of works. The hardstanding, amenity grassland and the river wall to be removed are of negligible ecological value.	Negligible	None	Negligible
Ephemeral short perennial	No significant change in the habitat resource as a result of the provision of a small area of ephemeral short perennial habitat on the brown roof.	Negligible	None	Negligible
Notable species				
Bats	No significant change in bat populations as a result of temporary and permanent loss of the foreshore on site as the function of the corridor as a commuting corridor for bats would be maintained.	Negligible	None	Negligible
	No significant changes in bat populations as a result of temporary lighting during construction.	Negligible	None	Negligible
	No significant change in bat populations as a result of the provision of bat boxes, as numbers, location and type are to be agreed.	Negligible	None	Negligible
Breeding	No significant change in bird populations due to temporary habitat loss on site as birds would be	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
birds	displaced to alternative habitat in the surrounding area.			
	No significant change in bird populations as result of low levels of disturbance from noise and vibration and lighting.	Negligible	None	Negligible
Wintering birds	No significant changes in wintering bird populations due to temporary and permanent changes to the foreshore habitat on site due to construction works within the foreshore, and the presence of a permanent operational structure within the foreshore.	Negligible	None	Negligible
	No significant changes in populations of wintering birds due to disturbance from noise and vibration from construction activities and the movement of barges.	Negligible	None	Negligible
	No significant changes in populations of wintering birds due to increases in light levels during construction activities.	Negligible	None	Negligible

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 7: Historic environment

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

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Thames Tideway Tunnel

Environmental Statement

Volume 7: Putney Embankment Foreshore site assessment

Section 7: Historic environment

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7 Historic environment

7.1 Introduction

7.1.1 This section presents the findings of the assessment of the likely significant effects of the proposed development on the historic environment at the Putney Embankment Foreshore site. The historic environment is defined in para. 4.10.2 of the NPS as including all aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora. For the purposes of this assessment, heritage assets comprise buried and above-ground archaeological remains, buildings, structures, monuments and heritage landscapes within and around the site. Effects during construction and operation are assessed with effects on buried assets presented first, followed by above-ground assets.

7.1.2 The construction assessment includes an assessment of the effects of ground movement (in this case ground settlement). As the ground movement would be generated by construction activity and any damage would be greatest for the period of construction, an assessment has not been undertaken of operational effects on above ground heritage assets from ground movement. An assessment of effects from ground movement resulting from the whole Thames Tideway Tunnel project is covered in Volume 3 Project wide effects.

7.1.3 Based on a review of the noise and vibration assessment (Section 9), it is concluded that there would be no significant noise or vibration effects requiring offsite mitigation to any listed building. Such effects are therefore not considered further in this assessment.

7.1.4 Once the proposed development is operational, scour protection around foreshore structures would prevent scour affecting heritage assets. In the deeper mid channel of the river, where contraction scour may occur, it is unlikely that archaeological remains would be present. The operational phase would not involve any activities below-ground aside from maintenance confined within the tunnel infrastructure. For these reasons, an assessment has not been undertaken of operational effects on buried assets.

7.1.5 A separate but related assessment of effects on townscape character and visual amenity is included in Section 11 Townscape and visual.

7.1.6 The assessment of the historic environment effects of the project has considered the requirements of the *National Policy Statement for Waste Water* (NPS). As such the assessment covers designated and non-designated assets, and a description of the significance of each heritage asset affected by the proposed development and the contribution of their setting to that significance. The assessment covers both above and below ground assets. The effect of the proposed development on the significance of heritage assets is clearly detailed in line with the requirements of the NPS. The role of the design process in helping to minimise effects on the historic environment is explained, and where appropriate, mitigation is proposed. Vol 2 Section 7 provides further details on the methodology.

7.1.7 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 7 Putney Embankment Foreshore Figures).

7.2 Proposed development relevant to the historic environment

7.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to the historic environment are set out below.

Construction

7.2.2 All below-ground works during construction are relevant to the assessment because they would potentially truncate or entirely remove any heritage assets within the footprint of the works. These are described below, firstly for the main site and then for the secondary site (for the temporary slipway). Those in the vicinity of the listed Putney Bridge would cause ground movement that could potentially induce damage to the listed bridge.

Main site

7.2.3 A stretch of the upper section of the existing late 19th century river wall and hand rails would be removed, along with localised temporary removal, prior to reinstatement, of the upper part of the existing late 19th century cobbled public drawdock / slipway, including a number of timber fenders along the edge of the slipway. The late 19th century outfall apron beneath the contemporary Grade II listed Putney Bridge would be removed (see Demolition and site clearance plan 1, separate volume of figures - Section 1). Metal grilles covering the two outfall sewers beneath Putney Bridge would also be removed, prior to construction of the interception chamber.

7.2.4 Site preparation would entail the diversion of an underground electricity supply cable crossing the western end of the cobbled slipway, with groundworks assumed, for the purposes of this assessment, to extend to a depth of approximately 1.5m. One tree within Waterman's Green would be removed as part of landscaping works (see Demolition and site clearance plans, separate volume of figures - Section 1).

7.2.5 A temporary cofferdam would be constructed within the main site. This would be located on the foreshore adjacent to Putney Embankment and beneath Putney Bridge, to provide a working area. The end of the cofferdam would abut the existing river walls and be sealed against river water ingress. A piling rig, located on a jackup barge positioned on the foreshore, would be used to construct the cofferdams. (see Construction phase 1 plan, separate volume of figures - Section 1). The majority of the 19th century slipway within the main site would be protected prior to the infilling of the cofferdam. Granite paving slabs may be removed from within a localised area of the slipway at the upper section to facilitate modification works to the river wall.

7.2.6 For structural reasons, soft material located adjacent to the perimeter of the temporary cofferdam and adjacent to the river wall would be removed. The soft material would include silt, peat and other materials. Within the footprint of the permanent cofferdam, all foreshore material would be removed. It is assumed for the assessment that the majority of foreshore material within the temporary cofferdam would remain *in situ*. Removal of the soft material would ensure that any settlement of the cofferdam fill material does not adversely affect the ties between the walls of the twin walled temporary cofferdam leading to structural difficulties, and to ensure sound foundations for permanent construction. The exact extent and depth of the foreshore deposits to be removed at each site would be informed by geotechnical investigations. Areas of removed material would be filled with gravel similar to the existing bed material. Cofferdam fill material would then be placed onto the foreshore on top of a geotextile layer, to a total average depth of 4.8m as assumed for the purposes of this assessment. Suitable sized plant would be utilised to reduce potential load impacts on the foreshore. A piling rig, located on a jack up barge positioned on the foreshore, would be used to construct the cofferdam. The cofferdam would be tied into the existing river wall using slots prepared in the river wall, except where the cofferdam abuts the listed abutment of Putney Bridge, where the cofferdam would not be fixed to the river wall (see Construction phase 1 plan, separate volume of figures - Section 1).

7.2.7 A campshed would be constructed on the foreshore to facilitate barge access. For the purposes of this assessment it is assumed up to 0.3m depth of alluvium and other soft foreshore material would be remove from within the campshed footprint prior to construction.

7.2.8 Upon removal of the temporary cofferdam, the fill and geotextile layer would be removed by suitably sized plant and the locally excavated areas on the foreshore bed would be reinstated with suitable material to match the pre-existing river bed conditions. The area of the foreshore where permanent scour protection is required would be excavated to a depth of approximately 1.5m by an excavator.

7.2.9 Within the temporary cofferdam, a permanent cofferdam would be constructed adjacent to the western end of the slipway, to form the edge of the permanent foreshore structure. Below-ground works within the permanent cofferdam footprint would include deep excavations for the construction of a combined sewer overflow (CSO) drop shaft; two valve chambers; a air treatment chamber; a ventilation chamber, ventilation ducts, and relocated storm overflows. A reinforced foreshore apron would be built adjacent to the permanent cofferdam to service the relocated Putney Bridge CSO (see Site works parameter plan, separate volume of figures - Section 1).

7.2.10 A deep interception chamber would be located beneath the southernmost arch of Putney Bridge at a similar formation level to that of the bridge abutment. A concrete hood would be built over the new interception chamber and tied into the bridge superstructure and abutment. For the purposes of this assessment it is assumed that any gaps between the chamber and the arch would be filled using mass concrete or a similar suitable binding material. A deep connection culvert from the CSO to the interception chamber would run beneath the foreshore within the footprint of the temporary cofferdam.

7.2.11 Above-ground ventilation structures would comprise two ventilation columns located on the permanent foreshore structure and bridge approach, respectively, as shown in the Site works parameter plan, (see separate volume of figures - Section 1). An electrical and control kiosk would be located on Waterman's Green along with associated ductwork. The foundations for the kiosk and the trenches for ductwork would extend to a depth of 1.5m, as assumed for the purposes of this assessment.

7.2.12 The construction activities which would give rise to effects on the historic character, appearance and setting of heritage assets are:

a. creation of the temporary cofferdam structures by piling rigs and other plant

b. establishment of hoardings around the boundary of the construction site

c. use of cranes and other plant during construction

d. provision of temporary structures, e.g. for on-site welfare facilities

7.2.13 Works to listed structures are shown on the following plans (see separate volume of figures - Section 1):

a. As existing listed structure interface – kiosk

b. Proposed listed structure interface – kiosk

c. Listed structure interface - interception chamber

d. Existing and proposed listed bollard location plan

Secondary site

7.2.14 At the temporary slipway site, areas of the eastern section of the existing slipway would be removed and localised modifications to the footway, river wall and street furniture carried out. A temporary slipway structure, constructed of prefabricated steel, would be constructed adjacent to Putney Embankment. Floating working platforms and a jack up barge would be used for piling operations. A campshed may be constructed on the foreshore to facilitate access by barge. For the purposes of this assessment the campshed is assumed to be present. It is assumed that up to 0.3m depth of alluvium and other soft deposits would be removed from within the footprint of the campshed prior to construction.

7.2.15 The temporary slipway would be removed following completion of construction works at the main site.

Code of Construction Practice

7.2.16 The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

7.2.17 Measures incorporated into the *Code of Construction Practice (CoCP)* Part A (Section 12) to protect heritage assets include:

a. The requirement for the contractor to prepare a site-specific *Heritage Management Plan* (HMP), indicating how the historic environment is to be protected. This may take form of both physical protection and working practices. It would also address any effects from third-party impacts, vibration, ground movement and dewatering.

b. Protective measures, such as temporary support, hoardings, barriers, screening and buffer zones around heritage assets, and archaeological mitigation areas within and adjacent to worksites.

c. Advance assessment to inform the types of plant and working methods for use where heritage assets are close to worksites, or attached to structures that form parts of worksites.

d. Where elements to be demolished are attached to listed structures being retained, they will be separated where practicable, prior to demolition, using non-vibratory techniques such as diamond sawing.

e. Care would be taken when jack-up barges; piling or borehole rigs; mechanical excavators or other plant is operating over areas of the river channel or foreshore known to be particularly archaeologically sensitive. In exceptional cases exclusion zones may apply. Safeguards may include appropriate methods for installing and operating plant, and the use of suitable foreshore protection.

f. Condition surveys to define ground movement and vibration limits for heritage assets potentially affected by the works - to include monitoring regimes and provision for cessation of works where feasible, should levels exceed the specified limits.

g. Procedures under EPP for the emergency repair of damage to listed buildings. Where there is damage that does not require emergency repair, repair will be affected as making good as part of the construction process. Final repairs to significant finishes will be 'like for like'.

h. Security procedures to prevent unauthorised access to heritage assets and archaeological investigations, and damage to or theft from them, including by the use of metal detectors.

i. Procedures in the event of the discovery of human remains.

j. Procedures under the Treasure Act Code of Conduct 1997, to address the discovery of any artefacts defined in the Treasure Act 1996.

7.2.18 Section 13 of the *CoCP* details the approach to third party impact and the asset protection process in relation to ground movement. This includes measures for the contractor to undertake a condition survey of the relevant infrastructure and buildings prior to commencing works that could impact them. The contractor would put in place protection measures during construction to minimise the impact to third-party infrastructure and buildings as a result of ground movement. Monitoring would be carried out prior to commencement of construction work to enable baseline values to be established and would continue until any significant ground movement due to the works, as shown by the monitoring, has effectively ceased. Post condition surveys would be carried out, as well as installation of instrumentation and monitoring to confirm that ground movements is as predicted and acceptable. An Emergency Planning and Response Plan would be developed in conjunction with the asset owner to include relevant contingency plans and trigger levels for action.

7.2.19 Site-specific measures incorporated in the *CoCP* Part B (Section 12) comprise:

a. The attachment of the cofferdam against the listed southern abutment of Putney Bridge would avoid cutting into the stonework facings of the abutment, unless agreed otherwise through a separate consent.

b. Hand railings along Waterman's Green would be protected and reinstated after the completion of construction activities.

c. The protection of the existing slipway during construction. Localised areas of cobbles would be removed, stored and reinstated to the existing conditions of the slipway as far as is possible.

d. The protection of the University Boat Race starting stone from accidental strike damage.

e. The removal, protection and reinstatement of listed bollards. These would be securely stored for the duration of the works.

f. The requirement for contractors working methods to minimise risk of accidentally striking the listed bridge. Protection barriers would be installed as required but not attached to the structure unless otherwise agreed.

7.2.20 All the measures detailed above form part of the proposed development subject to the assessment, and therefore impacts such as strike damage on heritage assets are considered unlikely to occur and are not assessed. However, site specific measures to mitigate effects on buried heritage, which would be detailed in *Site Specific Archaeological Written Scheme of Investigation (SSAWSI)*, in line with the *Overarching Archaeological Written Scheme of Investigation (OAWSI)* (Vol 2 Appendix E.2), would be subject to the findings of field evaluation, and are therefore reported as mitigation as detailed further in para. 7.8.5.

Operation

7.2.21 The operation of the proposed development at Putney Embankment Foreshore is described in Section 3 of this volume. The particular components of importance to this topic include the design of the public realm and the design and siting of the proposed ventilation structures and electrical and control kiosks (see Proposed landscape plan and Site works parameter plan, separate volume of figures - Section 1).

7.2.22 The operational design has been developed through close liaison with stakeholders, including the local authority and English Heritage, and in response to early iterations of the environmental impact assessment, through a series of design workshops, as well as in response to other design factors, such as operational requirements. The design process has therefore helped to minimise effects on the character, appearance and setting of heritage assets. Such design decisions are 'embedded' within the proposed development which has been assessed. Alternatives to the proposed development, including design iterations, are fully detailed in Section 3 of this volume.

Historic environment design measures

7.2.23 A high quality design in keeping with the character of the surrounding townscape has been proposed for the development of this site to minimise adverse effects on the historic character, appearance setting of heritage assets in accordance with the design principles set out in Vol 1 Appendix B. Generic design principles of relevance to the historic environment are:

a. All the principles for the integration of functional components relating to the site including those regarding materials, the use of signature designs and careful detailing because they would inform the appearance of the completed operational infrastructure at the site.

b. All the heritage design principles. These set out measures to safeguard significance and to develop designs and carry out works that are in accordance with established conservation principles and that also have regard to the interest of neighbouring heritage assets.

c. All the riparian and in-river structure principles regarding appearance and functionality that apply to the site.

d. All the landscape principles relating to the quality of soft and hard landscaping, materials and public accessibility that apply to the site.

e. All the lighting design principles regarding heritage and sensitive settings that apply to the site. These include matters relating to safety, the aesthetic effect of the lighting and the quality of fittings.

7.2.24 The following site-specific design principles are also relevant:

a. In order to minimise the visual and physical impact on the listed bridge, the top of the interception chamber would sit below the springing point of the bridge arch and be as small as possible. Furthermore the face of the interception chamber would be set back from the main bridge elevations as far as possible to maintain the architectural integrity of the existing bridge.

b. The interception chamber would be finished in high quality, fair-faced concrete that complements the existing finish of the bridge.

c. The design and materials of the facades of the main Waterman’s Green kiosk would match the existing bridge abutment wall. The design and layout of the main Waterman’s Green Kiosk would accommodate the continued use of an existing ventilation louvre located within the abutment wall.

d. The main Waterman’s Green kiosk would be as narrow in depth as possible to maximise space on Waterman’s Green.

e. The kiosk on the foreshore structure would be positioned to mark the western junction with the existing embankment and mediate the level change between the pavement and the foreshore structure. It would be finished in such a way that positively contributes to the public ream with the inclusion of historic interpretive information about the area and maritime events. Any public art at this site would be procured in close collaboration with the local authority's Arts Team.

f. The design of the interception ventilation column (positioned on the listed bridge) would be appropriate to the listed structure and in keeping with the character of surrounding street furniture.

g. The layout of the permanent works would minimise the visual and physical effects on the existing slipway and avoid the need for alterations. Any slipway materials that are disturbed by the works would be removed with care, stored and reinstated to the existing standard. The works would not prejudice the possibility of widening the slipway in the future by others.

h. The river wall of the permanent foreshore structure would be finished in natural stone with vertical timber fenders on the outer face and horizontal fenders on the upstream and downstream faces.

i. The listed bollards would be carefully removed, stored and reinstated. They would be relocated in the vicinity of their current positions in keeping with the revised layout and access requirements.

j. The foreshore structure would sit on the starting line of the University Boat Race. The University Boat Race stone would be retained in its current position. A physical marker would run from the stone to the new river wall. The marker would have a detailed treatment and could feature as a work of public art.

k. The Holly tree that would be removed from Waterman's Green during construction would be replaced with another tree at a location to be agreed with the local authority.

7.3 Assessment methodology

Engagement

7.3.1 Vol 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of the historic environment are presented here. Throughout the environmental impact assessment (EIA) there has been regular liaison with English Heritage and other stakeholders. Vol 7 Table 7.3.1 below summarises the comments raised by consultees and how each comment has been addressed.

7.3.2 As the design evolved, and in response to consultations especially with the London Borough of Wandsworth and English Heritage, several changes were made. The varied form of the existing structures along Putney Embankment and the sensitivity of the setting of Putney Bridge and the integrity of the Putney slipway were all important considerations. These factors have meant that in successive design iterations the proposed CSO drop shaft structure has moved further away from the slipway and the listed bridge, to its current proposed location between the slipway and Putney Pier. Here it would also take advantage of the historic associations of the University Boat Race Stone, being located in a location relating to a number of river events, thus adding to the area's historic focus as a centre of riverside leisure, which it has held since the late Victorian and Edwardian periods.

7.3.3 Materials have also been an important consideration. Timber fendering is proposed for the foreshore structure to reflect the materials of the slipway and other in-river bank structures. The river walls are mostly of mass concrete and the wall on Waterman's Green is of Cornish granite. The former material is therefore proposed for permanent foreshore structure and the latter for the electrical and control kiosk on Waterman's Green.

7.3.4 Concerns over the appearance of the interception chamber, attached to the listed bridge's southern abutment, have guided the design towards minimising its visual impact. Thus the structure would sit below the springing level of the bridge arches, set back from the outer edges of the bridge abutments. The attachment of the proposed structure to the abutment was also designed to minimise the amount of listed fabric to be removed.

Vol 7 Table 7.3.1 Historic environment – consultation response

Organisation and date	Comment	Response
English Heritage Scoping opinion (January 2011)	The site falls within an archaeological priority area and conservation area. The site will require a desk-based assessment of archaeology and an impact assessment in respect of conservation areas in order to determine appropriate mitigation.	A desk-based assessment has been carried out for the *Environmental Statement*. It takes into account the location of the site within an archaeological priority area and conservation area, and proposes appropriate measures to mitigate adverse effects.
Wandsworth Historical Society Phase two consultation response (January 2012)	A reassessment of the overall archaeological potential of the site is required. The baseline information contained within the report needs to be updated with finds/features recorded by the Wandsworth Historical Society for a full assessment of potential and significance.	Additional baseline material provided by the Wandsworth Historical Society, including the location and description of finds, features and past investigations within the assessment area, has been incorporated into the assessment.

Organisation and date	Comment	Response
Minutes of meeting with English Heritage (1st February 2012)	English Heritage confirmed acceptability of moving the foreshore structure further from the slipway.	This is noted and welcomed.
English Heritage Phase two consultation response (February 2012)	EH considers that this site can be rendered acceptable for the proposed scheme subject to significant mitigation being undertaken.	Appropriate mitigation is presented in Section 7.8, in addition to those measures embedded in the proposed development design (as detailed in Section 7.2)
	EH requests further details of the interception chamber to cap the existing outfall beneath Putney Bridge, as the impact on the bridge and its setting is not entirely clear from the information supplied.	The assessment presented in the *Environmental Statement* identifies the effects of the interception chamber on Putney Bridge and its setting.
	EH accepts the relocation of the Grade II listed bollards and welcomes their proposed restoration	This has been noted in the *Environmental Statement*.
	Several key data sources have not yet been consulted, and consequently the significance of the archaeology is severely underrated.	Additional baseline information has been included. Based on available sources of information, particularly geological and modern bathymetric data, and professional judgement, it is considered likely that the foreshore within the site has been substantially eroded. Based on this assumption, a low potential for pre-medieval remains is predicted in the *Environmental Statement*. However, field evaluation, which would inform final mitigation

Organisation and date	Comment	Response
		design, would be undertaken to confirm this.
	The area identified for the proposed temporary slipway has not been subject to archaeological assessment.	The effect of constructing the temporary slipway is assessed in the *Environmental Statement.*
	English Heritage considers that the scope of archaeological fieldwork should be expanded to include topographical survey, foreshore survey and buried terrain modelling to inform appropriate mitigation measures.	The *Environmental Statement* details a range of field evaluation methods which may be employed, and mitigation measures which would be implemented as appropriate, subject to the results of field evaluation. The suggested modelling and survey could form part of this.
	EH notes the recognition of the potential effect from altered scouring patterns, and considers that this needs to be fully understood in order to provide such mitigation measures as are necessary and possible.	The *Environmental Statement* assesses the effect of altered scour patterns on archaeology
	EH requires an expansion of the scope of proposed fieldwork, for example to include geotechnical investigations and field evaluation.	The *Environmental Statement* details a range of field evaluation methods which may be employed, including geotechnical investigation.
	EH note that the relationship between the Grade II* listed St Mary's Church and the River Thames is already affected by traffic congestion, and additional congestion is	St Mary's Church is included as a receptor in the traffic and transport assessment (Section 12).

Organisation and date	Comment	Response
	likely to create an impact on the historic environment at this location.	
LB Wandsworth Phase two consultation response (February 2012)	The promontory structure would harm the character and appearance of this part of the Putney Embankment Conservation Area.	The *Environmental Statement* assesses the likely significant effects of the proposals on the character and appearance of the conservation area.
	The new river wall would have an uncomfortable relationship to the historic slipway.	The *Environmental Statement* assesses the likely significant effects of the proposals on the historic slipway, and the setting of other assets nearby. Since phase two consultation the structure has been moved further from the slipway.
	Localised demolition of the historic slipway should be avoided.	The historic slipway would be reinstated as existing as far as possible, at the end of the construction phase.
English Heritage Meeting to discuss field evaluation (April 2012)	There is a greater potential for archaeological resources westwards of Putney Bridge. There is a high density of prehistoric finds in the area of the site. Test pitting would be required to determine potential.	Archaeological evaluation, including test pitting, if appropriate would be targeted in areas of the site where overall archaeological potential is less well known, eg, the area upstream from Putney Bridge. The approach to mitigation is set out in Section 7.8.
English Heritage Section 48 publicity comments(October 2012)	English Heritage would welcome an explanation of why, in the assessment for this site, the historic environment impacts on some	Where these differences exist, the *ES* includes an explanation in the assessment for each asset.

Organisation and date	Comment	Response
	heritage assets differ from the townscape impacts.	
	English Heritage would welcome confirmation that there will be minor adverse impacts upon the setting of named heritage assets.	All heritage assets within the Zone of Theoretical Visibility which could be subject to likely significant effects have been assessed. Putney Bridge and a number of named buildings in the Putney Embankment Conservation Area would experience a moderate adverse impact from the construction phase. Minor adverse effects have been predicted from the operational phase.
	English Heritage considers that the impacts upon St Mary's Church need to be acknowledged.	The *ES* assesses the effects of the proposals upon the setting of St Mary's Church.
LB of Wandsworth Section 48 publicity comments (October 2012)	LB of Wandsworth noted that the revised proposals represent a significant improvement over the previous designs in terms of reducing the impact on the Grade II listed bridge and historic slipway.	Noted.

Baseline

7.3.5 The baseline methodology follows the methodology described in Vol 2. It should be noted that whilst most topics within the ES use the term 'value' to define the sensitivity of environmental receptors within the baseline, the historic environment assessment uses 'asset significance' as per the terminology used within the NPS. Distinction is made between the significance of the resource, i.e. asset significance, and the significance of the environmental effect throughout the following assessment.

7.3.6 Baseline conditions for above and buried assets are described within a combined 200m-radius area around the centre points of the main site and secondary site, which is considered through professional judgement to be most appropriate to characterise the heritage potential of the site.

7.3.7 The assessment area for effects on the historic character and setting of above-ground heritage assets has been defined using professional judgement by identifying heritage assets within the Zone of Theoretical Visibility (ZTV) generated as part of the townscape and visual assessment (see Section 11), whose settings have the potential to be significantly affected by the proposed development. The setting of these assets is then described in the baseline. Where appropriate this assessment area extends beyond the 200m radius baseline area. In addition, 'Views of Heritage Value' (VHV) considered important for understanding the historic character and setting of heritage assets have been identified where appropriate. These are drawn from the Putney Embankment Conservation Area Appraisal & Management Strategy (LB Wandsworth, 2010), and from professional judgement based on observation and understanding of historic context and architectural purpose and design.

7.3.8 A site visit to the main site was carried out in March 2011 to identify assets on or adjacent to the site. Further site visits to the secondary site were carried out in January 2012 to identify any visible buried assets, and above-ground assets for inclusion within the assessment of effects on setting.

Construction

7.3.9 The assessment methodology for the construction phase follows that described in Vol 2. There are no site-specific variations for undertaking the construction assessment of this site.

7.3.10 In terms of physical effects on above or buried assets, likely significant effects could arise throughout the construction phase. Effects arising from all stages of the construction period are therefore assessed. The construction assessment area for such effects is defined by the site boundary.

7.3.11 In terms of effects on the character and setting of above-ground heritage assets, while there would be effects throughout the construction period the peak construction phase is Site Year 2, when the shaft would be under construction and cranes would be present at the site. This has been used as the assessment year for effects on the character and setting of heritage assets. It should be noted that in some instances, the townscape and visual assessments may differ to the historic environment assessments despite the receptors being largely coincident. This is due to the different value / sensitivity that may be attributed to a receptor and also due to consideration of different factors when assessing the magnitude of change and significance of effect (the reasoning is explained in the assessment for each receptor as required). The construction assessment area is as described in para. 7.3.7.

7.3.12 Section 7.5 details the likely significant effects arising from the construction at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on the historic environment within the assessment area for this site as the nearest sites (Barn Elms to the west and Carnwarth Road Riverside to the northeast) are too distant from Putney Embankment Foreshore site to have significant effects on the setting of the relevant heritage assets. Therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

7.3.13 In terms of the assessment of effects on above-ground and buried heritage assets located within the site, the development of underground vaults at No. 2 Putney High Street as part of a café, and the formation of arched openings in the listed river wall for each vault to Nos. 4 and 6 Putney High Street (as listed in the development schedule (Vol 7 Appendix N), which partially fall within the Putney Embankment Foreshore site LLAU, are considered in the base case. Whilst the baseline within the baseline area beyond the site may change as a result of any archaeological excavation and recording carried out as part of a standard programme of mitigation for other developments, such information is unlikely to significantly change the current understanding of the historic environment of the site. Aside from changes due to other developments, archaeological remains are a static resource, which have reached equilibrium with their environment and do not change (ie, decay or grow) unless their environment changes as a result of human or natural intervention. At this site ongoing fluvial erosion is changing the archaeological baseline within the foreshore. However, the rate of erosion is not known so the base case within the foreshore is assumed to be as per the baseline.

7.3.14 The development of underground vaults at Nos. 2 and 4-6 Putney High Street has also been considered as part of the construction base case for the assessment of effects on historic character, appearance and setting in the construction phase. None of the other schemes included in the development schedule (Vol 7 Appendix N) would change the existing baseline in terms of historic character and setting of above-ground assets given the distance of these schemes from the site and the presence of intervening structures.

7.3.15 Neither of the schemes included in the site development schedule (Vol 7 Appendix N) would have a significant physical cumulative effect on buried or above-ground heritage assets within the site. This is because there are no assets common to the Putney Embankment Foreshore site and those schemes listed in the development schedule. Therefore no assessment of cumulative effects has been undertaken for physical effects on assets in the construction phase. In terms of the assessment of cumulative effects on the character, setting and appearance of heritage assets, neither of the schemes identified in Vol 7 Appendix N would be under construction during Year 2 of construction, the assessment year for this part of the assessment. Therefore no assessment of cumulative effects has been undertaken

7.3.16 The assessment of construction effects on the character, setting and appearance of heritage assets also considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year, for example due to changes in schemes which form part of the base case or cumulative assessment. In the case of buried heritage, as described above, whilst the baseline within the baseline area beyond the site may change as a result of any archaeological excavation and recording carried out as part of a standard programme of mitigation for other developments, such information is unlikely to significantly change the current understanding of the historic environment of the site. Therefore a delay to the Thames Tideway Tunnel project, with a consequent change in other schemes which may have been developed by the time of Thames Tideway Tunnel construction, would not lead to any change in the archaeological baseline and therefore no change in the assessment of effects on these assets.

Operation

7.3.17 The assessment methodology for the operational phase follows that described in Vol 2. There are no site-specific variations for undertaking the operational assessment of this site which is based on an assessment in Year 1 of operation, when the development's full effect upon its surroundings would be evident. As with the construction assessment, it should be noted that in some instances the townscape and visual assessments may differ to the historic environment assessments of the operational phase, despite the receptors being largely coincident. This is due to the different value / sensitivity that may be attributed to a receptor and also due to consideration of different factors when assessing the magnitude of change and significance of effect (the reasoning is explained in relation to each receptor where appropriate). The operational assessment area is as described in para. 7.3.7 above.

7.3.18 As stated in para. 7.3.12 there are no other Thames Tideway Tunnel project sites which could give rise to additional effects on the assessment of the historic environment at this site. Therefore no other Thames Tideway Tunnel project sites are considered.

7.3.19 The following schemes from the site development schedule (Vol 7 Appendix N) have been considered as part of the base case for the assessment of effects on historic character, appearance and setting in the operation phase due to their proximity to the Thames Tideway Tunnel project site:

a. No. 2 Putney High Street, development of vaults beneath Lower Richmond Road with an opening in the river wall to provide access onto Watermans Green.

b. Nos 4-6 Putney High Street, formation of glazed arched opening in listed river wall for each of the two vaults.

7.3.20 None of the other schemes included in the development schedule (Vol 7 Appendix N) would change the existing baseline in terms of historic character and setting of above-ground assets given the distance of these schemes from the site and the presence of intervening structures.

7.3.21 As all of the schemes detailed in the development schedule would be complete and operational by the operational phase assessment year, no assessment has been made of cumulative effects on the historic character or setting of above-ground heritage assets.

7.3.22 The assessment of operational effects on the character, setting and appearance of heritage assets also considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year, for example due to changes in schemes which form part of the base case or cumulative assessment.

Assumptions and limitations

7.3.23 The assumptions and limitations associated with this assessment are presented in Vol 2. Site-specific assumptions and limitations are detailed below.

Assumptions

7.3.24 The assessment of effects on buried heritage assets is based on the shaft and other below-ground structures being located anywhere within the zones identified on the permanent works plan for these structures (see Site works parameter plan, separate volume of figures - Section 1). For this site the assessment is not sensitive to variations in location within these zones because the desk-based assessment has not identified any buried heritage assets of particularly high significance within the site, which would warrant preservation *in situ* and because any significant heritage assets would have been archaeologically excavated and recorded after insertion of the temporary cofferdam.

7.3.25 A number of assumptions have been made regarding the likely depth of temporary construction works (eg, site strip, footings for plant and accommodation), based on professional knowledge of construction projects. Whilst the precise nature of construction effects on buried heritage would vary if the depths varied, the mitigation proposed to address any effects would remain as stated, as would the residual effects. These assumptions are detailed in Section 7.2.

7.3.26 Vol 2 details assumptions made regarding the predicted impact of compression of potential archaeological assets within the foreshore from temporary cofferdam fill material. For the purposes of this assessment it has been assumed that where archaeological remains within the foreshore could contain voids, and/or are made of porous/organic material (timber structures/objects such as wattle, fishtraps, and peat), the compression predicted to occur is likely to cause some damage. Where such remains could be solid, non-porous or inorganic without voids, such as metal, stone, flint or brick, the compression is generally unlikely to lead to damage.

7.3.27 The assessment of effects on the historic character and setting of above-ground heritage assets is similarly based on the proposed above-ground structures being located anywhere within the zones identified for these structures. For this site the assessment is not sensitive to variations in location within these zones because of the open character of the townscape near the river.

7.3.28 Assumptions relating to the assessment of effects arising from ground movement are detailed in the project wide assessment in Vol 3 Section 7.

Limitations

7.3.29 A limitation of the assessment is that no intrusive archaeological investigation has been carried out on the site in the past (although several investigations have been carried out within the baseline area). Nevertheless the assessment is considered to be robust and in accordance with best practice.

7.3.30 There has also been little research into the effects of compression of buried heritage assets within foreshore alluvium from fill material placed on top of such deposits. Professional judgement has been used to estimate the likely impacts on different archaeological remains within the foreshore, and the assessment is considered to be robust.

7.4 Baseline conditions

7.4.1 The following section sets out the baseline conditions for the historic environment within and around the site. Future baseline conditions (base case), which would remain as per the baseline, are also described. The section comprises seven sub-sections:

a. a description of historic environment features within the 200m baseline area

b. a description of statutorily designated assets within the site and baseline area. Locally designated assets and known burial grounds are included, where relevant, as described in Volume 2

c. a description of the site location, topography and geology

d. a summary of past archaeological investigation, providing an indication of how well the area is understood archaeologically

e. a chronological summary of the archaeological and historical background of the site and its environs

f. a statement of significance for buried heritage assets, including buried heritage setting, taking account of factors affecting survival

g. a statement of significance for above-ground assets within and around the site, describing the features which contribute to their significance, including their historic character, appearance and setting.

Current baseline

Historic environment features

7.4.2 The historic environment features map (Vol 7 Figure 7.4.1, see separate volume of figures) shows the location of known above-ground and buried historic environment features within the combined 200m-radius baseline area, compiled from the baseline sources set out in the methodology in Vol 2. These have been allocated a unique historic environment assessment reference number (HEA 1, 2, etc), which are listed in the gazetteer in Vol 7 Appendix E.1. It should be noted that the baseline for the assessment of effects on the character, appearance and setting of heritage assets, is informed by professional judgement and the ZTV, with assets described in the 'Statement of significance: above-ground heritage assets' later in this section at paras 7.4.40 - 7.4.62.

Designated assets

International and national designations

7.4.3 The eastern edge of the main site lies beneath the Grade II listed Putney Bridge (HEA 1A), and includes the southern bridgehead. Some elements of the listed bridge structure are therefore incorporated within the site boundary; in particular two iron caged sewer outlets below the bridge form part of the granite abutment wall which emanates from the bridge westwards, between the pavement and the slipway.

7.4.4 Within the southern edge of the main site and within the bridge approach retaining wall is a stone staircase leading down from the Lower Richmond Road/Putney Bridge Approach, to former subterranean public lavatories (HEA 1D). The lavatories may be associated with the structure of the Grade II listed Putney Bridge and may extend into the boundary of the site, although their below-ground extent is unclear as it was not possible to gain access as part of the site walkover survey.

7.4.5 Recent illegal damage and drilling into the north side of the Putney Bridge approach retaining wall revealed brick vaults (HEA 1G) running from the river wall below the Lower Richmond Road. The vaults are considered likely to be part of the original listed bridge construction although it was not possible to gain access during the site walkover survey. The brick vaults are potentially a heritage asset and lie within the site boundary.

7.4.6 There are a number of listed buildings in the baseline area. Those closest to the main site comprise a group of five Grade II listed bollards at the western side of the site (HEA 43), the Grade II* St Mary's Church (HEA 41) 20m to the southeast and the Grade II listed White Lion Hotel (HEA 42), 40m to the south. Those closest to the temporary slipway site comprise the Grade II listed Winchester House/Putney Constitutional Club (HEA 58), 30m to the northeast; and Grade II listed 37, 39 and 41 Lower Richmond Road (HEA 59), 60m to the south.

7.4.7 There are no internationally designated heritage assets near the site.

Local authority designations

7.4.8 The site lies within an archaeological priority area as designated by Wandsworth Council. Remains from all periods are likely to be centred landward of Putney Embankment, to the south and southwest of the site, which was the focus of historic settlement; most notably of an extensive Roman settlement. This is due to the proximity of the current High Street and its immediate vicinity to ancient river crossings between the Putney and Hammersmith riverbanks. The site also lies within the Putney Embankment Conservation Area. The conservation area is characterised by its riverside location, boathouses, former wharf and some of the oldest existing buildings in Putney, combined with the deliberate landscaping of the area in the 1890s (Wandsworth Conservation and Design Group, 2010)[1].

7.4.9 Locally listed buildings close to the site comprise the Star and Garter Hotel (HEA 52) and Star and Garter Mansions (HEA 53) on Lower Richmond Road, both approximately 60m to the northwest of the main site. These buildings are both within the Putney Embankment Conservation Area and their significance and any impacts upon their settings are considered within the assessment of the conservation area.

Known burial grounds

7.4.10 There are no known burial grounds within the site or adjacent to it.

Site location, topography and geology

7.4.11 The ground slopes gently down to the northeast, towards the Thames embankment from 106.9m ATD (above Tunnel Datum) on Putney High Street, to approximately 106.2m ATD immediately to the southwest of the main site. The slipway within the main site slopes west to east from 104.8m to 101.1m ATD. Ground levels also slope downwards to the northeast at the temporary slipway site, from 108.0m to 104.3m ATD. Along the foreshore, ground levels slope down from 100.0–101.0m to 98.0–99.7m ATD.

7.4.12 The site is located on a narrow strip of shallow alluvium and gravel on the southern side of the Thames floodplain, between two significant tributaries, the Beverly Brook, 700m to the northwest, and the River Wandle, 1.3km to the southeast. The Kempton Park gravel terrace slopes down towards the site from Upper Richmond Road, 1.4km to the south, with a break in slope 30m to the south of the site where it merges with the Shepperton gravels.

7.4.13 Modern bathymetric data shows the current ground level of the gravel foreshore/riverbed within the main site at approximately 100.0m ATD. This is comparable to the levels of gravel across the foreshore between Putney Bridge and the Beverley Brook, approximately 700m to the west of the main site, observed in nearby boreholes. Levels of London Clay lie at approximately 94.0–95.0m ATD. By contrast, levels of London Clay beneath Putney Bridge are significantly higher (approximately 101.8m ATD). This indicates an area of higher topography in the immediate vicinity of Putney Bridge (between the marshy confluences of the Beverly Brook and the River Wandle with the Thames), providing ideal conditions for a river crossing from the prehistoric period onwards.

7.4.14 Although four borehole logs are located within or adjacent to the site, two are antiquated, whilst the other two are located within the Embankment. The logs do provide evidence of the levels of gravels and London Clay; however, they are not considered representative of the site, the majority of which lies directly on the foreshore. They are also likely to reflect man made impacts resulting from the construction of the 18th century Chelsea aqueduct and 19th century Putney Embankment.

7.4.15 The lack of alluvium indicated by current ground levels and limited available borehole data suggests alluvial deposits of archaeological interest are not likely to survive on the foreshore in the site. Alluvial deposits may have been removed either as a result of localised truncation from past construction activity, or through natural fluvial erosion. Similarly, the ground levels on the foreshore (comprised of gravels) within the temporary slipway site are comparable to levels from a borehole at the Beverley Brook mouth (where higher deposits of alluvium survive), suggesting that alluvial deposits have also been scoured from this part of the foreshore. It has therefore been assumed for the purposes of this assessment that the foreshore within both the main site and the temporary slipway site has been substantially eroded. However, further archaeological evaluation would be needed to clarify the geology of the site (see Section 7.8). The site topography and geology is discussed in more detail in Vol 7 Appendix E.2.

Past archaeological investigations

7.4.16 Numerous archaeological investigations have been carried out on the site, including foreshore surveys since the 1970s. Most recently (2011), surveys have been carried out by the Thames Discovery Programme (TDP), which have recorded foreshore structures to the east of Putney Bridge, including a brick abutment for the original Putney Bridge (HEA 1V). The remains of post-medieval flood defences were also identified.

7.4.17 The majority of past investigations carried out landward of Putney Embankment, to the south of the main site, were undertaken by the Wandsworth Historical Society (WHS) in the 1960s and 1970s. As well as prehistoric and post-medieval remains, these investigations uncovered extensive evidence of Roman activity and settlement, including road surfaces, ditches, building foundations, stakeholes and postholes, cremation burials, coins and large amounts of pottery. An extensive Roman road network was also identified. Datable finds, including coins and pottery, suggest that the Roman settlement endured for several centuries, surviving until the early 5th century. Further details of past archaeological investigations carried out within the site and baseline area are included in Vol 7 Appendix E.3.

Archaeological and historical background of the site

7.4.18 The following section presents a chronological summary of the archaeological and historical background of the site. Further detail is included in Vol 7 Appendix E.4.

7.4.19 Throughout the prehistoric period (700,000 BC–AD 43), the fertile and well-drained gravel terrace would have provided an ideal environment for farming and settlement. The Thames would have provided a reliable source of food and water and, as Putney was the only site between the Strand and Richmond where dryland gravel terraces reached the foreshore, on both sides of the river conditions were also suitable for a river crossing. Several (mainly residual) finds dating from the Lower Palaeolithic to the Iron Age have also been discovered within the baseline area, particularly along the foreshore and within the Thames channel, with notable Neolithic settlement remains to the southwest of the main site. Finds related to hunting and domestic activity, including pottery, flint-knapping, tools, and weapons, suggest activity and settlement from the

Neolithic (and possibly Mesolithic) to the Iron Age period. Bronze Age and Iron Age wooden posts uncovered along the opposite Hammersmith foreshore (HEA 21 and 54) suggest a river crossing in the vicinity of the present Putney Bridge. A human skull (HEA 45), dating to the mid-Iron Age was also recovered from the foreshore at very low tide, possibly from archaeological deposits subject to fluvial erosion to the east of Putney Bridge.

7.4.20 The fertile gravel terrace soils beside the River Thames and the non-tidal nature of the river would have provided ideal conditions for settlement in the Roman period (AD 43–410). Numerous Roman finds and remains of activity have been uncovered by the WHS, including parts of an extensive road network which would have facilitated communication and trade. This network is likely to have extended across the Thames. A previous investigation at Thames Place, approximately 35m to the southeast of the temporary slipway site, identified a road running southwest to northeast towards the foreshore (HEA 7) on an alignment with a Roman road on the opposite side of the river at Hammersmith. The settlement was probably fairly extensive and grew up around the crossing point, to the west of the present bridge.

7.4.21 Two main areas within the baseline area have been subject to several past investigations carried out by the WHS. The first area is concentrated either side of Putney High Street, south of the main site. A road and ditch dated to the 1st century AD were discovered at the Hippodrome Theatre (HEA 22), approximately 90m to the southwest of the main site. The remains of a hut with stakeholes and rubbish pits, and a possible iron working area including the remains of furnaces and iron objects, were discovered at Felsham Road (HEA 31), approximately 140m to the southwest. Late Roman pottery and coins dating to the 370s to 390s were recovered from 2–4 Richmond Road (HEA 3), approximately 85m to the southwest.

7.4.22 The second area is concentrated along Waterman Street and Bemish Road, to the south of the foreshore between the main site and the temporary slipway site. Past investigations revealed a cemetery at Bemish Road (HEA 62), and a cremation burial at ‘Point Common’, approximately 35m to the southeast of the temporary slipway site. Roman road sections, ditches, postholes and floor surfaces, as well as pottery were also discovered in the vicinity. A number of isolated Roman remains have also been recovered landward of Putney Embankment and on the foreshore to the east of the site. These mainly comprise coins and pottery assemblages, including a 2nd century Samian bowl (HEA 81) recovered from the foreshore approximately 90m to the east of the main site.

7.4.23 The name “Putney” is derived from the Anglo-Saxon place name indicating a ‘landing place’. It is likely that an early medieval (AD410–1066) settlement, largely engaged in fishing and farming, was present along the riverfront and potentially within the area of the site. Pottery and coins discovered at Waterman Street, approximately 65m and 120m to the west and southwest (HEA 24 and 31), and The Platt (HEA 28), approximately 130m to the southwest, possibly date to this period.

7.4.24 The later medieval (AD 1066–1485) settlement of Putney was probably similar to that of the early 17th century, when the site was used as a ferry point, comprising wharves and a landing place for boats, to the west of houses and shops along Putney High Street and around the 13th century St Mary's Church (HEA 41), 20m to the southeast of the site. It is possible that there was an earlier wooden bridge across the Thames in the latter half of this period, in the area of the current bridge. Later medieval coins, a sword, and several pilgrim badges (many dedicated to the Virgin Mary; HEA 79) were also discovered approximately 30m to the east of the site, opposite St. Mary's Church, and these finds may reflect the ferry crossing point. Several medieval ditches were also recorded as part of past investigations landward of Putney Embankment.

7.4.25 In the post-medieval period (AD 1485–present), Putney was situated on an important thoroughfare between London and Westminster on to Richmond, Kingston and the west of England following the construction of a wooden bridge in 1727–1729. The River Thames was a major route for communication and trade and the site was used as a landing or mooring place for boats, to the west of the settled area of buildings clustered along the High Street.

7.4.26 Early maps from the 17th, 18th and 19th centuries show the site as undeveloped foreshore adjacent to the river wall. In 1882–1886, Sir Joseph Bazalgette constructed Putney Bridge (Grade II listed). It replaced the earlier wooden bridge and formed part of the new sewerage system, with sewer outfall gates (HEA 1K) beneath its southernmost pier. The current cobbled slipway down to the river within the main site (HEA 1F) was also constructed around this time, as part of a recreational area focused on local rowing clubs. This included a wide promenade planted with trees and a urinal between the river wall and the slipway. The secondary site continued to lie within an undeveloped section of the foreshore between two slipways.

7.4.27 Both the main site and secondary site have changed little since the early 20th century. The western part of the main site currently comprises an undeveloped section of the Thames foreshore, including a cobble stone slipway (HEA 1F) and, at the western edge of the site boundary, a 20th century pier (HEA 2B). The eastern part of the site includes the southern approach to Putney Bridge, under which the low level Bazalgette sewer to Deptford runs. Subterranean toilets occupy an area within and adjacent to the southeastern boundary of the site. The secondary site comprises a mainly undeveloped section of the Thames foreshore, although a concrete boat slipway (perhaps originally of cobble stones and constructed in the late 19th century) is located in its southwestern boundary.

7.4.28 Numerous archaeological remains dated to this period have been identified within the main site. These include structural remains from the construction of the 1729 Putney Old Bridge, including part of the bridgehead (HEA 1V), to the east of the current bridge, and metal piles (HEA 1L) of the 1856 Chelsea Waterworks iron viaduct across the River Thames. Other features include 19th century steps with a commemorative stone marking the construction of the current Putney Bridge, leading to the foreshore adjacent to the western side of the bridge (HEA 1H). The remains of a cofferdam used in the construction of the present bridge (HEA 1J) have also been identified beneath the bridge approach. Surfaces of consolidated chalk, probably former barge beds, were discovered adjacent to the eastern side of the bridge approach (HEA 1M and 1O). Timber piles (HEA 2A), forming a flood defence/river wall, are located immediately behind the present embankment and slipway.

Statement of significance: buried heritage assets on the site

Introduction

7.4.29 The following section discusses past impacts on the site which are likely to have compromised asset survival (generally from late 19th and 20th century developments, for example, building foundations), identified primarily from historic maps, the site walkover survey, and information on the likely depth of deposits.

7.4.30 In accordance with the *National Policy Statement for Waste Water* (Defra, 2012)[2], *National Planning Policy Framework* (DCLG, 2012)[3] and *PPS5 Planning Practice Guide* (DCLG, 2012)[4] (which remains extant) and national planning policy guidance, this is followed by a statement on the likely potential for and significance of buried heritage assets within the site, derived from current understanding of the baseline conditions, past impacts, and professional judgement.

Factors affecting survival

7.4.31 The archaeological survival potential of the site is considered low for palaeoenvironmental and *in situ* prehistoric to early medieval remains (ie, finds discovered within their original historic context) due to probable natural fluvial erosion of the foreshore caused by the River Thames. A further factor is that construction of the 19th century embankment on the west side of the bridge may mean that the site lies further into what was then the river than on the east side of the bridge. Available bathymetric and geotechnical borehole information suggests that alluvial deposits of archaeological interest would have been entirely removed from the riverward parts of the site west of the bridge (in contrast to the eastern side where there is better survival potential); however this conclusion is tentative due to a lack of recent geotechnical data and would be clarified through subsequent field evaluation before the start of construction to inform required mitigation. Survival potential is low to moderate for later medieval remains and high for post-medieval remains, particularly 18th–19th century remains associated with the construction of the former and current Putney Bridge. Other factors affecting survival include:

a. The construction of the present Putney Bridge in 1882–1886 would have removed any earlier remains from within the footprints of former cofferdams and platforms used in its construction. These works are likely to have extended across a significant section of the foreshore within the site to the west of the current Putney Bridge.

b. Subterranean toilets and vaults associated with the construction of the bridge lie adjacent to the embankment (partially within the site boundary). The foundations of these structures may have truncated or entirely removed any earlier archaeological remains.

c. The foundations of the late 19th century slipways in the main site and the temporary slipway site would have caused localised truncation either from deep strip footings or localised piling.

7.4.32 Taking into account the impacts above, the archaeological survival potential of the site is generally considered to be low for remains earlier than post-medieval.

Asset potential and significance

7.4.33 The following statement of asset significance takes into account the levels of natural geology and the level and nature of later disturbance and truncation.

Palaeoenvironmental

7.4.34 The site has a low potential to contain palaeoenvironmental remains due to the anticipated reduced foreshore survival discussed in para. 7.4.15 and 7.4.31 above. The site is therefore considered to have a low potential to preserve palaeoenvironmental remains. Such remains, if present, would be of low asset significance, as derived from their evidential value.

Prehistoric

7.4.35 The site has a low potential to contain remains dated to the prehistoric period due to the anticipated reduced foreshore survival discussed in paras. 7.4.15 and 7.4.31 above. Although a single Palaeolithic flint flake was discovered within the site, this is probably residual (ie, deposited outside of its original context), and the potential for further prehistoric finds is considered to be low. Isolated residual artefacts, if present, would be of low asset significance, derived from the evidential value of such remains.

Roman

7.4.36 The site has a low potential to contain Roman remains. Archaeological evidence in the vicinity suggests an extensive settlement existed to the south and southwest of the main site; however, this was located on the higher and drier gravel terrace rather than the foreshore. It is possible that remains related to an earlier river crossing, such as a trackway, or residual artefacts, may survive on the site, although the survival potential is considered low due to probable fluvial scouring, as noted above. Remains, if present, would be of low asset significance for isolated, residual artefacts, and moderate or high for the remains of waterfront structures or a trackway. This would be derived from the evidential value of such remains.

Early medieval

7.4.37 The site has a low potential to contain early medieval remains. The early medieval settlement to the south of the foreshore was probably largely engaged in fishing and farming, and it is possible that residual artefacts relating to fishing, and an earlier river crossing, in the vicinity of the current Putney Bridge, may be discovered. However, the potential for this is considered to be low due to probable scouring by the Thames. Remains would be of low asset significance (isolated artefacts) or medium asset significance (riverfront structures). This would be derived from the evidential and historical value of such remains.

Later medieval

7.4.38 The site has a moderate potential to contain later medieval remains. Putney was a flourishing settlement with a probable river crossing in the vicinity of the current Putney Bridge. It is likely that the riverfront adjacent to the site was developed with revetments, wharves and associated buildings. Medieval pottery, although likely to be residual, has been recovered from within the site, and scattered remains dating to this period have been made in the vicinity, to the south of the embankment and to the foreshore west of Putney Bridge. Isolated residual artefacts would be of low significance. Remains of revetments or other riverfront structures (none were visible on the site walkover inspection) would be of low or medium significance, depending on the nature and degree of preservation. This would be derived from the evidential and historical value of such remains.

Post-medieval

7.4.39 The site has a high potential to contain remains dated to the post-medieval period. These are likely to include barge beds, flood defences and 18th–19th century remains associated with the construction of Putney Bridge, several of which were identified during the walkover survey. Isolated pottery and building materials are also likely to be present on the foreshore. The remains of revetments or other riverfront structures would be of low or medium significance, whilst construction debris and residual, isolated artefacts would be of low asset significance, depending on the nature and degree of preservation. There is also a high potential for the remains of post-medieval buildings on the landward side of the riverwall, of low asset significance. This would be derived from the evidential and historical value of such remains.

Statement of significance: above-ground heritage assets

Introduction

7.4.40 In accordance with the *National Policy Statement for Waste Water* and the associated guidance, the following section provides a statement of the likely significance of heritage assets based on professional and expert judgement. The significance of assets is a reflection of their value or importance, derived from their perceived historical, evidential, aesthetic and communal value. These terms are defined in Vol 2.

7.4.41 It also describes the significance, historic character, appearance and setting of conservation areas and settings of listed buildings within the construction and operational Zones of Theoretical Visibility (ZTV) where their historic character, appearance or settings may be affected by the proposed development. Such assets are shown in Vol 7 Figure 7.4.2 (see separate volume of figures). This figure also shows the construction and operational ZTVs and Views of Heritage Value (VHV) which illustrate important views to and from heritage assets. There are no other heritage assets in the assessment area whose settings would be significantly adversely affected by the proposed development.

Within the site

Putney Embankment Conservation Area

7.4.42 The site lies within the Putney Embankment Conservation Area as designated by Wandsworth Borough Council, which covers the Embankment, Putney High Street and Putney Bridge. The conservation area is divided into smaller areas, and the historic environment of each area is considered to be individual in its character. The site falls mainly within Area 3 (Lower Richmond Road), with part in Area 2 (Putney High Street) as described by the Putney Embankment Conservation Area Appraisal and Management Strategy document. Area 3 is described as having buildings of outstanding quality, rich in architecture and of diverse ages, with the overall density of buildings being low, providing a sense of space and “attractive wide open vistas.” The conservation area is a heritage asset of high significance, derived from its aesthetic, evidential, historical and communal values.

7.4.43 The Putney Embankment Conservation Area Appraisal describes the Lower Richmond Road Character Area as being of architectural quality, including Putney Bridge (HEA 40), a number of undesignated 19th century mansion flats, the locally listed Star and Garter mansions hotel and (HEA 52, 53) and the undesignated Bricklayers Arms. A modern restaurant development lies adjacent to the proposed development site along Lower Richmond Road, offering a narrow separation between it and the historic buildings beyond (see Vol 7 Plate 7.4.1). The embankment is lined with mature trees and hand rails. The Grade II* Listed St Mary’s Church (HEA 41), set back from the line of the embankment, lies within the adjacent Church Square and Putney Wharf Character Area, and forms part of the setting of this length of the Embankment. The modern buildings to the rear of St Mary’s Church detract from the historic character of this part of the Putney Embankment Conservation Area.

7.4.44 Views in and out of the Putney Embankment Conservation Area are dominated by the river and Putney Bridge. The view along the Embankment westwards from Putney Bridge has traditionally been one that artists and local photographers have sought to capture, the essence of which is the combination of the stature of the Star & Garter, the curve of the river and line of the Embankment, and the low grouping of boathouses that line the slipway, with distant views of Barn Elms beyond, as illustrated in View of Heritage Value 1 and Vol 7 Plate 7.4.1. The proposed development site, including the existing stone-set slipway and wing walls of Putney Bridge, lie at the fore of this view, and make a significant contribution to the composition as a whole (see Vol 7 Plate 7.4.2). Views from the Putney Embankment Conservation Area include the Bishops Park Conservation Area and its associated designated heritage assets on the opposite bank of the river. This is illustrated in View of Heritage Value 2 and Vol 7 Plate 7.4.2.

7.4.45 Given the high significance of the area, the heritage resource may be considered an assemblage rather than a series of separate heritage assets, whereby one asset forms the setting or context of another. The setting of the Embankment Wall is therefore defined by its relationship with Putney Bridge to the fore and the buildings fronting Lower Richmond Road to the rear. The site also forms part of significant views from and hence the setting of the Bishop's Park Conservation Area. Setting therefore makes a high contribution to the significance of both individual heritage assets and their overall group value and is subsequently sensitive to adverse change. The site's prominent location along the river means that it is an important part of the setting of the Putney Embankment Conservation Area.

Vol 7 Plate 7.4.1 Historic environment – view south at low tide towards Lower Richmond Road Character Area from Putney Bridge

Putney Bridge

7.4.46 The site lies adjacent to, and extends beneath the Grade II listed Putney Bridge (HEA 1A), built by Joseph Bazalgette in 1884 to replace a former aqueduct and the older wooden Putney Bridge, to the east. Some elements of the earlier bridge lie within the southeastern part of the site below the existing bridge. Also within the site is a commemorative stone, dated to 1884, set within the abutment of Bazalgette's bridge. The bridge is a heritage asset of high historical and evidential value. The commemorative stone is part of the listed structure of the bridge and is also an asset of high significance.

7.4.47 Beneath Putney Bridge are two Bazalgette sewer outlets and an associated sewer apron (HEA 1K), the outlets covered by protective iron grilles with domed tops. The outlets are incorporated within the listed bridge abutment and form an integral component to the design of the bridge. They are positioned centrally on the western side of the original bridge abutment, this having been extended with a later phase of construction which included widening and the inclusion of the current eastern carriageway. On the river side of the sewer outlets is a timber and stone sewer apron designed to carry waste from the outfalls into the river at low tide. This appears on original plans of the Bazalgette works on the site. The grilles and the associated apron have evidential and historic value as independent features but are also an integral part of the Grade II listed Putney Bridge structure, and are therefore assets of high significance.

7.4.48 Putney Bridge's western retaining wall curves around and continues along the Lower Richmond Road and runs within the southern edge of the site, joining up to the brick wall and railings described above (HEA 1E). The retaining wall has a gated opening leading down to subterranean toilets (HEA 1D; described below). The wall itself may have been an early 20th century modification as it appears in its present form for the first time on the 1913 OS map and prior to this on the 1894 OS map it is of a different shape in plan. Despite the possibility of it being an early 20th century modification, the bridge's western retaining wall can be considered part of the Grade II structure and therefore an asset of high significance.

7.4.49 The setting of Grade II listed Putney Bridge, the most visually prominent heritage asset within the area, is defined by its relationship with the river and the line of the Embankment Wall. This includes the Embankment Wall westwards towards the pier jetty, including the buildings along Lower Richmond Road, as shown in Viewpoint 2.7 detailed in Section 11 Townscape and Visual. The Embankment Wall, including the site, therefore forms an important part of the setting of Putney Bridge. The bridge's relationship with Bishop's Park is also important. St Mary's Church (HEA 41) also forms part of the setting of the bridge to the southeast. This is illustrated in View of Heritage Value 3 (see Vol 7 Figure 7.4.2, separate volume of figures), Vol 7 Plate 7.4.2 and Viewpoint 2.1 detailed in Section 11 Townscape and Visual.

Vol 7 Plate 7.4.2 Historic environment – view east at low tide from Putney Pier alongside Putney Embankment towards southern end of Putney Bridge

Putney Embankment

7.4.50 Within the site is a late 19th–early 20th century brick-built cobbled slipway (HEA 1F). On the southern side of the slipway is a brick wall approximately 70m long. This supports iron railings, which continue half the length of the slipway, where they are replaced by modern steel railings. The brick wall and iron railings are likely to be late 19th century to early 20th century in date and form part of the slipway. They are mentioned in the Putney Embankment Conservation Area Appraisal as a surviving example of an antiquated boundary treatment. The slipway is an element of a draw dock, where boats were drawn up on the foreshore and unloaded with the aid of carts which were pulled up the sloping ramp of the slipway by horses.

7.4.51 The slipway contributes positively to the character of the conservation area and it also lies adjacent to the traditional starting point of the Oxford and Cambridge Boat Race, which has run from Putney Bridge to Mortlake since 1829. It is considered a heritage asset of high significance for its evidential and historic value as a late 19th century structure. The significance also derives from its historical and communal value as a place directly connected to boat races of the past with a specific meaning for the crews and spectators, for whom it figures in their collective experience and memory.

7.4.52 Running along and just outside of the western edge of the site is a set of Grade II listed bollards (HEA 43) dating to c.1910 or earlier. These are assets of high significance which are included within the conservation area and contribute to its character and significance.

7.4.53 The existing 19th century river wall to the west pre-dates the Bazalgette alterations. It is an angled embankment wall of stone slabs capped with modern moulded stone. It is an asset of medium significance.

7.4.54 Located within the southern edge of the site is a Port of London Authority marker (HEA 1Q) which is set into the brick riverside wall and records the high water level of the 1928 flood, the last catastrophic flooding event in London. Other markers from the same flooding event are found at Greenwich. This is therefore a heritage asset with evidential, historical and group value and of medium significance.

7.4.55 Within the southern edge of the site and within the retaining wall is a stone staircase leading down from the Lower Richmond Road/Bridge Approach to a former subterranean public lavatories (HEA 1D). The lavatories may be associated with the structure of the Grade II listed bridge, although they are not shown on the OS 2nd edition 25” map of 1894. Their below-ground extent is unclear and may extend into the southern boundary of the site. The OS 3rd edition 25” map of 1913 shows a staircase, and label for a lavatory and urinal, with the underground structure reflected in a bulge in the embankment retaining wall on the bridge’s western side. Recent drilling into the north side of the retaining wall reveals brick arched vaults below the Lower Richmond Road (HEA 1G). It is possible that the vaults and the subterranean toilets are interconnected and form a complex of rooms beneath the bridge approach on Lower Richmond Road. The exact determination of their significance is uncertain, as their extent, date of construction and relationship to the Grade II listed Bridge is uncertain, although it is likely that they are at least of medium significance and lie just within the site boundary.

7.4.56 Also within the site is a recess in the river wall, adjacent to Putney Bridge, which may indicate the location of former river stairs (HEA 1H). These are of historical and evidential value and are of low significance.

7.4.57 The University Boat Race stone (HEA 1Z) on the embankment at the northwestern end of the main site marks the starting line of the Oxford and Cambridge Boat Race that was first held in 1829. The stone is unlisted, and is considered to be of medium significance for its historical and communal value, along with its group value with the other Boat Race Stone at Mortlake. The stone would be protected from accidental damage under the proposed development.

7.4.58 Putney Pier (HEA 2B) lies at the northwestern edge of the main site. It consists of four earthfast timber structures connected by modern walkways. The pier first appears in this location on the Ordnance Survey 1st edition map of 1862. It appears to have been rebuilt or modified in the early 20th century. It is of medium significance for historical and evidential value. Vol 7 Plate 7.4.3 illustrates the information above.

Vol 7 Plate 7.4.3 Historic environment – view west from Putney Bridge towards the slipway and Embankment Wall, with Lower Richmond Road to left

Within the assessment area

St Mary's Church

7.4.59 The tower of the Grade II* listed St Mary's Church (HEA 41), built in the 15th century with early 16th and 17th century additions and restored in the 1860s, is a prominent monument on the Putney Embankment. It forms a strong element of the river frontage to the east of Putney Bridge, particularly when viewed from the bridge and the opposite bank of the River Thames. It is less prominent when views from the west along Putney Embankment, where it is partly screened by mature vegetation and intervening buildings. Its overall setting has been diminished by the presence of modern commercial development to the south. Setting therefore makes a moderate contribution to the high significance of the church, although much of the site, to the west of the bridge, makes little contribution to its setting. This is illustrated in View of Heritage Value 4 and Vol 7 Plate 7.4.4.

Bishops Park Conservation Area and associated designated heritage assets

7.4.60 Bishops Park Conservation Area lies on the north side of the River Thames opposite the site. The boundary of the conservation area incorporates the separately designated Bishops Park Grade II Registered Park and Garden, the scheduled Fulham Palace Moated Site and the Grade II* Listed All Saints Church both of which are assets of high significance.

7.4.61 The river frontage of the Bishops Park Conservation Area, which includes the Bishops Park Registered Park and Garden, is characterised by the line of the Embankment Wall and a mixture of mature trees, shrub planting, flower beds and lawns separated by a network of paths. The setting of the conservation area includes views across the River Thames towards Putney Bridge and the Putney Embankment Conservation Area, including the proposed development site. This is illustrated in View of Heritage Value 5, Vol 7 Plate 7.4.4 and Viewpoints 2.14 and 2.15 detailed in Section 11Townscape and visual. The contribution of its setting to the significance of both the conservation area and registered park and garden is therefore high. The Fulham Palace Moated Site Scheduled Monument (high significance) and Grade II* Listed All Saints Church are largely screened from the river frontage by the presence of intervening planting and buildings, although its tower remains prominent, having group value with St Mary's Church on the opposite bank of the river. The site does not therefore form part of the setting of these assets within the conservation area.

Vol 7 Plate 7.4.4 Historic environment – view south from Bishops Park Conservation Area towards Putney Embankment Conservation Area. The tower of St Mary's Church stands in the centre of the plate

Putney Bridge Conservation Area

7.4.62 Putney Bridge Conservation Area is centred on the northern end of Putney Bridge and Putney Bridge Approach on the opposite bank of the River Thames. It is of high significance. There are prominent views from both the river frontage and along the road to Putney Bridge. Except for the part of the site around the southern end of Putney Bridge, the site is largely screened in views from the Conservation Area by the intervening presence of Putney Bridge itself. At low tide the foreshore area adjacent to Putney Bridge abutment appears as a large bank of mud set high against the embankment. This is illustrated in View of Heritage Value 6 and Vol 7 Plate 7.4.5 below. Due to its open aspect to the river, the setting of the Putney Bridge Conservation Area forms one of the main components of its overall significance, but the contribution of the site to its setting is very modest, since most of it is screened by the intervening Putney Bridge and it is some distance away.

Vol 7 Plate 7.4.5 Historic environment – view southwest from Putney Bridge Conservation Area towards Putney Bridge

Construction base case

7.4.63 As detailed in para. 7.3.13, whilst ongoing fluvial erosion is changing the archaeological baseline within the foreshore, since the rate of erosion is not known, the base case is assumed to be as per the baseline for the purposes of this assessment.

7.4.64 As detailed in para. 7.3.14, two non-Thames Tideway Tunnel projects at No. 2 Putney High Street, and at Nos. 4–6 Putney High Street, as listed in the development schedule (Vol 7 Appendix N), have been considered in terms of the base case. These developments would involve the removal of localised sections of the listed bridge abutment wing wall within the site, to the west of Putney Bridge, to facilitate access to a café terrace within Waterman's Green. The development would extend into the area of underground vaults located just within the site boundary. Although a localised physical change would occur to the abutment wall of the bridge, a heritage asset of high significance, its significance would not change as a result of this development. The vaults are considered to be heritage assets of at least medium significance. It is assumed for the purposes of this assessment that there would be no physical change to the vaults that would result in their asset significance being reduced.

7.4.65 Works to the wall have the potential to generate structural movement. It is assumed that any movement damage arising from this work to the wall on Watermans Green would be repaired, as it would be part of the public face of the new development. Similarly it is assumed that the construction methods used for demolition and creation of the openings within the wall would not generate physical damage or that any damage would be repaired as part of the development.

7.4.66 The base case for assessing the construction effects on above and below-ground heritage assets within the site would therefore be the same as the baseline. No other developments identified in the schedule would lead to any loss of or change in the heritage assets within the Thames Tideway Tunnel project site.

7.4.67 As outlined in para. 7.3.13, the base case in Site Year 2 of construction for the assessment of construction effects on the historic character and setting of heritage assets takes into account the developments at No. 2 and Nos. 4-6 Putney High Street. However, the presence of the schemes would result in only a modest change to the surrounding historic character, and would not significantly alter the baseline as described in Section 7.4.

Operational base case

7.4.68 In determining the base case in Year 1 of operation for the assessment of operational effects on the historic character and setting of heritage assets, account has been taken of the development of Nos. 2 and 4-6 Putney High Street, as described in para. 7.3.13. However, the presence of the schemes would result in only a modest change to the surrounding historic character, and it would not significantly alter the baseline as described in Section 7.4.

7.5 Construction effects assessment

Buried heritage assets

7.5.1 Effects of construction works are described in the following section in the sequence in which they would occur, with the individual impacts from each phase described. The effects on heritage assets are summarised in Section 7.10, by chronological period.

Site preparation

7.5.2 The diversion of an electricity supply cable within made ground at the western end of the main site is unlikely to impact on buried remains, given the depths of recent made ground and truncation which are likely to have resulted from the construction of Putney Embankment and the carriageway. The effect on heritage assets would therefore be **negligible**.

Construction of cofferdams, foreshore apron, campsheds, and permanent scour protection, and modifications to the river wall and slipways

7.5.3 A number of construction activities are proposed which would constitute a high magnitude of impact on any archaeological remains present, reducing the significance of any affected assets to negligible.

7.5.4 Multi-period archaeological remains are potentially located within the foreshore alluvium and possibly cut into the underlying gravels. These would be removed within the footprint of the proposed localised excavation of soft material (ie alluvium) down to the gravels, within the footprint of the permanent cofferdam, and adjacent to the perimeter of the temporary cofferdam and river wall (see assumptions in para. 7.3.26). Such material would also be removed from within the footprint of campsheds to a depth of 0.3m. The excavations would remove any archaeological remains (primarily post-medieval) which may be present, and comprise a high magnitude of impact to any affected assets within the excavation areas.

7.5.5 The movement of small plant machinery used to lay the geotextile layer across the cofferdam footprint prior to infilling, and used to remove the geotextile layer subsequently, would have an impact upon any archaeological remains on the surface of the foreshore and within the upper part of the alluvium, within the cofferdam footprint, through rutting and compaction, resulting in a localised high magnitude of impact.

7.5.6 The placement of temporary cofferdam fill material is predicted to have a high magnitude of impact due to compression of any remaining buried heritage assets within the foreshore alluvium and gravels which are not removed from within the cofferdam, where these are hollow (e.g. pottery vessels, hulked boats), and/or are made of porous/organic material (timber structures/objects such as wattle, fishtraps, and peat). Where remains are solid, non-porous or inorganic without voids, such as metal, stone, flint or brick, there is unlikely to be an impact.

7.5.7 A jackup barge would be used to insert the sheet pile walls and would affect any buried heritage assets within the footprint of its supports. The removal of the eastern section of the temporary slipway, modifications to the river wall, localised demolition of sections of the slipway at the main site (including the removal of timber fenders driven into the foreshore) and the removal of the outfall slipway beneath Putney Bridge would potentially locally truncate or remove archaeological remains (if present) within the foreshore or made ground. Piles for the temporary slipway structure would also affect remains within each pile footprint.

7.5.8 Excavation to a depth of 1.5m within the footprint of the area of permanent scour protection would remove any surviving buried heritage assets within the foreshore alluvium to this depth.

7.5.9 These activities would constitute a high magnitude of impact. The environmental effect would vary depending upon the heritage significance of the assets removed or compressed. Effects on each asset are predicted as follows:

a. There is a low potential for palaeoenvironmental remains of low asset significance. The removal of such remains would constitute a **minor adverse** effect.

b. There is a low potential for redeposited prehistoric remains of low asset significance. The removal of such remains would constitute a **minor adverse** effect.

c. There is a low potential for redeposited Roman remains of low asset significance. The removal of such remains would constitute a **minor adverse** effect, depending on the significance of the remains.

d. There is a low potential for Roman *in situ* remains (eg, waterfront structures and a trackway) of medium or high asset significance. The removal of such remains, if present, would constitute a **major adverse** effect.

e. There is a low potential for redeposited early medieval remains of low asset significance (for isolated artefacts). The removal of such remains would constitute **minor adverse** effect.

f. There is a low potential for *in situ* early medieval remains revetments or riverside structures of medium asset significance. The removal of such remains, if present, would constitute a **major adverse** effect.

g. There is a moderate potential for redeposited later medieval artefacts of low asset significance. Where such remains are removed, there would be a **minor adverse** effect.

h. There is a low to moderate potential for *in situ* later medieval waterfront remains, including revetment, hulks and riverfront structures. Such remains would be of low or medium asset significance and their removal would lead to **minor or moderate adverse** effect, depending on the significance of the remains, respectively.

i. There is a high potential for redeposited post-medieval construction debris and isolated artefacts of low asset significance. The removal of such remains would constitute a **minor adverse** effect.

j. There is a high potential for *in situ* post-medieval barge beds, flood defences and remains associated with the construction of the 18th and 19th century Putney Bridges and the Chelsea Waterworks aqueduct, some of which were observed during the site visit. They are of medium asset significance. Removal of such remains would constitute a **moderate adverse** effect.

Scour around temporary structures

7.5.10 Scour around the temporary cofferdams and campsheds, excluding protected areas, could have an impact upon any archaeological remains in the vicinity. The significance of any assets affected could be reduced which would constitute a high magnitude of impact for these assets. The significance of effect on heritage assets would be as that described in para. 7.5.9 above.

Construction of the CSO drop shaft, culverts and chambers

7.5.11 The construction of the CSO drop shaft, culverts, the interception chamber beneath Putney Bridge, valve chambers, air treatment chamber, ventilation chamber, ventilation duct and storm overflows would entirely remove any remaining surviving archaeological remains within their footprint, not previously removed as part of the cofferdam construction. The significance of effect on heritage assets would be as that of the cofferdams described in para. 7.5.9 above.

Ventilation columns and electrical and control kiosk

7.5.12 Above-ground ventilation structures would comprise ventilation columns located at the southwestern and/or southeastern corners of the bridge approach, including the pavements. An electrical and control kiosk (control cabinet) would be located on Waterman's Green along with associated ductwork. The foundations for the ventilation columns, kiosk and the trenches for ductwork would extend to a depth of 1.5m, as assumed for the purposes of this assessment. This is unlikely to impact on buried remains, given the depths of recent made ground and truncation which are likely to have resulted from the construction of Putney Embankment and the carriageway. Therefore no effect is predicted.

Above-ground heritage assets

Physical effects on above-ground heritage assets

7.5.13 The sewer outfalls (HEA 1K) and their associated outfall slipway (apron) beneath the Grade II listed Putney Bridge (HEA 1A) (high asset significance) would be removed by the insertion of the interception chamber. These works comprise a high magnitude of impact. Due to the high asset significance of the sewer outfalls, this would result in a **major adverse** effect.

7.5.14 The construction of narrow ventilation columns and the interception chamber hood on the southern side of the Grade II listed Putney Bridge (high asset significance) would have a localised physical impact, of low magnitude on the fabric of the structure. This would result in a **minor adverse** effect.

7.5.15 There would be an effect on Grade II listed Putney Bridge due to ground movement resulting from construction works and Sprayed Concrete Lining tunnelling. The bridge would experience a maximum vertical movement beneath two piers of less than 8mm and 9mm, respectively. The horizontal settlement would not cause significant damage to the bridge structure. The third pier of the bridge and the Putney abutment would experience less than 1mm of settlement. More pronounced vertical and radial movements are concentrated at pier one and two, and the intermediate spans, which would experience hogging (upward curving). Cracking would therefore be predicted to occur in the intermediate and abutment spans of the bridge; this would consist of minor cracking of the joints of the voussoirs[i] of the barrel arch, but would not affect the structural integrity of the bridge. This would constitute a low magnitude of change, and therefore there would give rise to a **minor adverse** effect on the bridge.

7.5.16 The Grade II listed bollards within the western boundary of the site (HEA 43) (high asset significance) would be temporarily removed, and stored to facilitate site access. They would be reinstated following construction. Temporary removal of the bollards is deemed to be a high magnitude of impact. Due to the high asset significance of the bollards, the temporary impact prior to reinstatement, taking into account the measures within the *CoCP* Part B (Section 12) for their protection during storage, would be a **moderate adverse** effect.

7.5.17 There would be a moderate magnitude impact to the upper section of the 19th century cobbled slipway (HEA 1F) arising from permanent localised modifications and the temporary removal of localised areas of paving. Although unlisted, this is an asset of high significance, and the temporary impact prior to reinstatement would be a **moderate adverse** effect.

7.5.18 Localised removal of existing granite paving of the 19th century slipway within the temporary slipway site would represent a low magnitude change to this asset of medium asset significance, and would result in a **minor adverse effect**.

7.5.19 The cofferdams would be inserted into slots cut into the 19th century river wall. This would represent a localised impact of low magnitude to an asset of medium significance, and would result in a **minor adverse** effect.

7.5.20 No other above-ground assets would be physically impacted by construction works.

Effects on the historic character and setting of above-ground heritage assets

7.5.21 The NPS recognises in paragraph 1.4.4 that nationally significant infrastructure projects are likely to take place in mature urban environments, with adverse construction effects on historic environment receptors likely to arise. Construction works similar to those proposed are commonplace in London, and therefore the following assessment should be viewed in this context. It should also be noted that construction effects are temporary in nature and, as assessed, relate to the peak construction phase. Effects during other phases of works are likely to be lower due to reduced levels of plant being required and a reduced intensity of construction activity.

Putney Embankment Conservation Area and associated designated heritage assets

7.5.22 The scale and extent of the construction works would detract from the character of, and views to, the Lower Richmond Road Character Area

[i] A wedge-shaped element, typically a stone, used in building an arch or vault.

within the Putney Embankment Conservation Area. The presence of cranes, hoardings, and temporary cofferdams on the foreshore would affect the setting of the buildings along Lower Richmond Road and the Embankment, including a number of heritage assets such as the Star & Garter Hotel and Mansions, and to a lesser extent Winchester House and Putney Constitutional Club, and Nos. 37, 39 and 41 Lower Richmond Road. The boathouses, Embankment wall, and Putney Pier would also experience some change to their settings. The works would detract from views to and from the Putney Embankment Conservation Area. Given the high significance of the Putney Embankment Conservation Area, the overall magnitude of change relative to the asset as a whole would be medium, resulting in a **moderate adverse** effect.

7.5.23 The separate townscape and visual assessment (Section 11) concludes that the works would have a major adverse effect upon the conservation area. The difference between the two assessments derives from their different methodologies: one considers the effect of the change to the character on the heritage value of the conservation area as a whole; whereas the other considers the effect on the townscape character of the area, which includes non-heritage factors.

Putney Bridge

7.5.24 The construction works would detract from both views west to the Embankment Wall from Putney Bridge and views east along the Embankment towards Putney Bridge. However, as the majority of the setting of the bridge would be unaffected, the magnitude of change would be medium. Given the high significance of Putney Bridge, the magnitude of change would be medium adverse, resulting in a **moderate adverse** effect.

7.5.25 The separate townscape and visual assessment (Section 11) concludes that the works would have a major adverse effect on the bridge. The difference between the two assessments derives from their different methodologies: one considers the effect of the change to setting on the heritage value of the bridge; whereas the other considers the effect upon the nature of a representative view southwest from the bridge, and includes non-heritage factors.

St Mary’s Church

7.5.26 The construction works would detract from views to and from St Mary’s Church when viewed from the west, north and east. However, the northwest view would be limited by the intervening presence of Putney Bridge. The installation of the ventilation shaft to the north west of the church would also temporarily detract from views. Nonetheless, as the majority of the works would be located to the west of the bridge and the large scale modern development surrounding the church already detracts from its setting, the relative magnitude of change would be low. Given the high significance of St Mary’s Church, this would result in a **minor adverse** effect.

Bishops Park Conservation Area and associated designated heritage assets

7.5.27 The construction works would be visible in views from the river frontage of the Bishops Park Conservation Area and Registered Park and Garden, detracting from views across the river towards the Embankment wall and Putney Bridge, although the effect would be diminished by the distance between them. The works would only be visible from a small part of the Conservation Area. There would be no effect on the setting of the Fulham Palace Moated Site Scheduled Monument or All Saints Church within the conservation area, given that the site does not contribute to the setting of these assets. The magnitude of change would be low, and given the high significance of Bishops Park Conservation Area and Registered Park and Garden this would result in a **minor adverse** effect.

7.5.28 The separate townscape and visual assessment (Section 11) concludes that the works would have a major adverse effect upon the townscape character of Bishops Park. The difference between the two assessments derives from their different methodologies: the historic environment assessment considers the effect of the change to setting upon the heritage value of the entire Bishops Park Conservation Area; whereas the other considers the effect upon the townscape character of Bishops Park only, which is a considerably smaller area, and includes non-heritage factors.

Putney Bridge Conservation Area

7.5.29 The construction works would be largely screened from the setting of Putney Bridge Conservation Area, which is located on the opposite bank of the river, due to the intervening presence of Putney Bridge. However, the presence of cranes would detract slightly from views towards the southern end of the bridge. Given the high significance of Putney Bridge, the magnitude of change would be low, resulting in a **minor adverse** effect.

Sensitivity test for programme delays

7.5.30 There would be no change to the assessment of the construction phase in the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year. This is because all scheduled projects would already be complete and operational.

7.6 Operational effects assessment

Above-ground heritage assets

Effects on the historic character and setting of above-ground heritage assets

Putney Embankment Conservation Area and associated designated heritage assets

7.6.1 The proposed development would introduce new elements within the Putney Embankment Conservation Area, resulting in a low magnitude of change to the historic character of the Lower Richmond Road Character Area. Given its height and scale, the foreshore structure would not detract from the setting of the buildings along Lower Richmond Road, including the Star & Garter Hotel and Mansions, Winchester House and Putney Constitutional Club, and Nos. 37, 39 and 41 Lower Richmond Road. The foreshore structure would stand near to Putney Pier, enhancing its present setting and that of the Embankment Wall by virtue of its design but slightly altering the view to and from Putney Bridge. In views from the west, the foreshore structure would be screened by Putney Pier. The ventilation column would be part screened by existing riverside trees in views within the conservation area, reducing the effect on views towards the prominent Star & Garter building within the conservation area. The effect upon the settings of the boathouses would be slight.

7.6.2 The narrow ventilation column at the southern end of Putney Bridge would be visible in views along the bridge, but would be largely screened from views along the Embankment wall by the presence of intervening vegetation. Whilst the ventilation column would present a new feature within views to and within the Putney Embankment Conservation Area, the magnitude of change would be low.

7.6.3 Overall, the high significance of Putney Embankment Conservation Area, combined with the low magnitude of change, would result in a **minor adverse** effect.

Putney Bridge

7.6.4 The foreshore structure would change the physical line of the Embankment wall, and so have a low magnitude adverse affect upon the setting of the southern end of Putney Bridge. However, this would not significantly detract from river views along the Embankment wall. The electric and control kiosk alongside the Embankment wall would be built using materials to match the existing stonework. The scale of the structure in relation to the Embankment wall and use of appropriate materials means that it would be barely visible in views to or from Putney Bridge, in contrast to the consented scheme for No. 2 Putney High Street which includes a new glazed opening through the granite wall east of the kiosk location. The connecting structure on the bridge abutment would be visible in views of the bridge. Its effect would be minimised by its curved profile and the fact that it would appear beneath the arch springing and set back from the east and west faces of the arches. The high significance of Putney Bridge, combined with the low overall magnitude of change, would result in a **minor adverse** effect.

St Mary’s Church

7.6.5 The installation of the proposed ventilation column near to the Grade II* listed church would introduce a new element to its setting. However, given the design of the structure, it would not significantly adversely affect the setting of the church. The ventilation column would not be perceptible in views from Putney Bridge, Putney Embankment or from across the River Thames. The high significance of St Mary’s Church, combined with the low magnitude of change, would result in a **minor adverse** effect.

Bishops Park Conservation Area and associated designated heritage assets

7.6.6 The foreshore structure and ventilation column would be visible in views from the Bishops Park Conservation Area and Registered Park and Garden, which form part of its setting. However, given the scale of the structure, use of materials and its position at the same level as the existing Embankment wall, it would not significantly detract from the setting of the conservation area. The proposed development would similarly not detract from views to the Bishops Park Conservation Area from the Putney Embankment Conservation Area, which also form part of its setting. There would be no effect on the setting of the Fulham Palace Moated Site Scheduled Monument or All Saints Church because the site does not contribute to the setting of these assets. The overall magnitude of change would be low, resulting in a **minor adverse** effect on these assets of high significance.

Putney Bridge Conservation Area

7.6.7 The view from the Putney Bridge Conservation Area to the site would be largely screened from the site by the intervening presence of Putney Bridge. The magnitude of change would be negligible, resulting in a **minor adverse** effect.

Sensitivity test for programme delays

7.6.8 There would be no change to the assessment of the operational phase in the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year. This is because all developments detailed in the development schedule (Vol 7 Appendix N) would already be complete and operational.

7.7 Cumulative effects assessment

7.7.1 As detailed in para. 7.3.15 and 7.3.21 above, no schemes in the site development schedule (Vol 7 Appendix N) have been identified within 1km of the site which are relevant for inclusion in the cumulative assessment. Therefore no assessment of cumulative effects has been undertaken for the construction or operational phases.

Sensitivity test for programme delays

7.7.2 There would be no change to the cumulative effects assessment of either the construction or operational phases in the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year. This is because all scheduled projects would already be complete and operational.

7.8 Mitigation

7.8.1 As per the NPS, (para 4.10.19), a documentary record of a heritage asset is not as valuable as retaining the heritage asset, and it should not be a factor in the decision as to whether or not development consent is given. Nevertheless, it is the most appropriate form of mitigation available and in

EIA terms serves to reduce the significance of the adverse effect, as has been agreed with English Heritage.

Buried heritage assets

7.8.2 Based on this assessment, no heritage assets of high significance are anticipated that would merit a mitigation strategy of permanent preservation *in situ*. It is therefore considered that the minor to major environmental effects of the proposed development could be successfully mitigated by a suitable programme of archaeological investigation before and/or during construction, to achieve preservation by record (through advancing understanding of asset significance).

7.8.3 Mitigation requirements would be informed by selective site-based assessment. This could include a variety of techniques, such as geotechnical investigation, geoarchaeological deposit modelling, foreshore monitoring and survey, archaeological test pits and trial trenches. This evaluation would enable a more targeted and precise mitigation strategy to be developed for the site in advance of construction. Both evaluation and mitigation would be carried out in accordance with a scope of works *(Site Specific Archaeological Written Scheme of Investigation [SSAWSI])*, as detailed in para. 7.8.5 below.

7.8.4 Subject to the findings of any subsequent field evaluation and the detailed construction methodology employed by the contractor, mitigation of the adverse effects upon archaeological remains within the site would include the following as appropriate:

a. An archaeological watching brief during site preparation and construction to mitigate impacts upon remains of low asset significance on the landward side of the existing river wall.

b. Targeted archaeological excavation within the footprints of the proposed temporary cofferdam. The precise approach would depend on the detailed construction methodology and the results of field evaluation.

c. For works taking place below low water on the outside of the cofferdams (such as construction of the campsheds) conventional archaeological investigation may not be feasible. In such an eventuality other techniques would be employed, such as monitoring and scanning the material as it is removed.

7.8.5 Both evaluation and mitigation would be carried out in accordance with a scope of works *(Site Specific Archaeological Written Scheme of Investigation [SSAWSI])*, based on the principles in the *Overarching Archaeological Written Scheme of Investigation (OAWSI)*, to ensure that the scope and method of fieldwork are appropriate. The *SSAWSI* would be submitted in accordance with the application for development consent (the ‘application’) requirement.

7.8.6 Construction phase scour around the temporary cofferdams would be mitigated through a programme of monitoring and the provision of scour protection if required, as detailed in the *CoCP* Part A (Section 12).

Above-ground heritage assets

7.8.7 The proposed mitigation strategy for any above-ground heritage assets which would be removed or truncated or their environment altered would comprise a programme of standing structure survey and photographic recording, to ensure that a record of these assets is made. Assets of differing significance would require different levels of standing structure survey and recording as detailed in English Heritage specifications (English Heritage, 2006)[5]:

a. The bridge abutment, sewer outfalls and outfall apron (HEA 1K; high asset significance) beneath Putney Bridge would require a Level 3 programme of standing structure survey and recording, with additional archival and documentary research.

b. The Grade II listed bollards (HEA 3; high asset significance) would be subject to English Heritage Level 2 Standing structure recording and photographic survey and protection prior to reinstatement.

c. Modifications to the river wall, cobbled slipway, and the localised removal of the granite paving of the 19th century slipway within the temporary site would require a programme of standing structure survey and photographic recording, equivalent to Level 2 of English Heritage specifications.

7.8.8 Mitigation would be required for the predicted ground movement. It is proposed that the bridge would be monitored to control measures that would be applied to limit the degree of volume loss to the soils beneath and adjacent to the bridge foundations. The monitoring would also give early and prior warning of significant movements. In accordance with the *CoCP* (Section 12), should significant damage occur to the structure during the works there would be emergency repairs to the bridge. Damage to its significance that would not require emergency repairs would be repaired using appropriate conservation techniques following the conclusion of works and abatement of ground movement in the area of the bridge.

7.8.9 All measures embedded in the proposed development and *CoCP* of relevance to the assessment of effects on the historic character and setting of above-ground heritage assets during construction are summarised in Section 7.2. Beyond these measures, no mitigation during construction is possible due to the highly visible nature of the construction activities.

7.8.10 As no significant adverse effects are predicted during operation, no mitigation is required.

7.9 Residual effects assessment

Construction effects

7.9.1 With the mitigation described above in place, the residual construction effects on buried heritage assets would be **negligible**. All residual effects are presented in Section 7.10.

7.9.2 In the case of ground movement effects to Grade II listed Putney Bridge, the proposed mitigation would reinstate the significance of the asset, although it is possible that like for like replacement of damaged elements, and areas of crack repair may remain visible. Therefore the residual effect would be **negligible**.

7.9.3 The physical impact of removal of the sewer outfalls and apron (HEA 1K) beneath the Grade II listed Putney Bridge would be partially mitigated by a programme of structure recording and photographic survey to form preservation by record. The residual effect would be **minor adverse**. Adverse effects would not be entirely removed as a survey record would not replace the permanent visual loss of these features and their association with the Grade II listed bridge.

7.9.4 The relocation of the Grade II listed bollards (HEA 43) would result in a **minor adverse** residual effect. The adverse effect would not be entirely removed by a survey record as their previous context and historical association with the slipway would remain altered.

7.9.5 With the mitigation described above in place, the residual physical effects on all other above-ground heritage assets would be **negligible**. All residual effects are presented in Section 7.10.

7.9.6 As no mitigation measures are possible for significant adverse effects on the historic character, appearance and setting of above-ground heritage assets beyond those embedded in the *CoCP* and proposed development design, the residual construction effects on the setting of heritage assets remain as described in Section 7.6. All residual effects are presented in Section 7.10.

Operational effects

7.9.7 As no mitigation measures are required for effects on the historic character, appearance and setting of above-ground heritage assets, the residual operational effects on the setting of heritage assets remain as described in Section 7.6. All residual effects are presented in Section 7.10.

7.10 Assessment summary

Vol 7 Table 7.10.1 Historic environment – summary of construction assessment

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
Buried heritage assets				
Low potential for palaeoenvironmental remains (Low asset significance)	Asset affected by the construction of cofferdams, foreshore apron, campsheds and permanent scour protection, and modifications to the river wall and slipways. Asset removed from within the footprints of the interception shaft and connection culvert. Impact from scour around temporary cofferdams. Asset significance reduced to negligible.	Minor adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdams and foreshore ground works. Monitoring of scour during construction and provision of scour protection if required and agreed with statutory consultees.	Negligible
Low potential for isolated prehistoric remains (Low asset significance)	Assets affected by the construction cofferdams, foreshore apron, campsheds and permanent scour protection, and modifications to the river wall and slipways. Assets removed from within the footprints of the interception shaft and connection culvert. Assets removed by scour around	Minor adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdams and foreshore ground works. Monitoring of scour during construction and provision of scour protection if required and agreed with statutory	Negligible

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
	temporary cofferdams. Asset significance reduced to negligible.		consultees.	
Low potential for isolated Roman remains (Low asset significance)	Assets affected by the construction of cofferdams, foreshore apron, campsheds and permanent scour protection, and modifications to the river wall and slipways. Assets removed from within the footprints of the interception shaft and connection culvert. Assets removed by scour around temporary cofferdams. Asset significance reduced to negligible.	Minor adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdams and foreshore ground works. Monitoring of scour during construction and provision of scour protection if required and agreed with statutory consultees.	Negligible

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
Low potential for Roman waterfront features or track ways (Medium or high asset significance)	Assets affected by the construction of cofferdams, foreshore apron, campsheds and permanent scour protection, and modifications to the river wall and slipways Assets removed from within the footprints of the interception shaft and connection culvert. Assets removed by scour around temporary cofferdams. Asset significance reduced to negligible.	Major adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdams and foreshore ground works. Monitoring of scour during construction and provision of scour protection if required and agreed with statutory consultees.	Negligible
Low potential for isolated early medieval remains (Low asset significance)	Assets affected by the construction of cofferdams, foreshore apron, campsheds and permanent scour protection, and modifications to the river wall and slipways. Assets removed from within the footprints of the interception shaft and connection culvert. Assets removed by scour around temporary cofferdams. Asset significance reduced to negligible.	Minor adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdams and foreshore ground works. Monitoring of scour during construction and provision of scour protection if required and agreed with statutory consultees.	Negligible
Low potential for early medieval revetments/riverside	Assets affected by the construction of cofferdams, foreshore apron, campsheds and permanent scour	Major adverse	Targeted archaeological investigation and recording, including environmental	Negligible

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
structures (medium asset significance)	protection, and modifications to the river wall and slipways. Assets removed from within the footprints of the interception shaft and connection culvert. Assets removed by scour around temporary cofferdams. Asset significance reduced to negligible.		sampling, within the area of the temporary cofferdams and foreshore ground works. Monitoring of scour during construction and provision of scour protection if required and agreed with statutory consultees.	
Moderate potential for isolated later medieval artefacts (Low asset significance)	Assets affected by the construction of cofferdams, foreshore apron, campsheds and permanent scour protection, and modifications to the river wall and slipways. Assets removed from within the footprints of the interception shaft and connection culvert. Assets removed by scour around temporary cofferdams. Asset significance reduced to negligible.	Minor adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdams and foreshore ground works. Monitoring of scour during construction and provision of scour protection if required and agreed with statutory consultees.	Negligible
Low to moderate potential for later medieval revetments and riverfront structures (Low or medium asset	Assets affected by the construction of cofferdams, foreshore apron, campsheds and permanent scour protection, and modifications to the river wall and slipways. Assets removed from within the	Minor to moderate adverse (depending on asset significance)	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdams and foreshore ground works.	Negligible

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
significance)	footprints of the interception shaft and connection culvert. Assets removed by scour around temporary cofferdams. Asset significance reduced to negligible.		Monitoring of scour during construction and provision of scour protection if required and agreed with statutory consultees.	
High potential for post-medieval construction debris and isolated artefacts (Low asset significance)	Assets affected by the construction of cofferdams, foreshore apron, campsheds and permanent scour protection, and modifications to the river wall and slipways. Assets removed from within the footprints of the interception shaft and connection culvert. Assets removed by scour around temporary cofferdams. Asset significance reduced to negligible.	Minor adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdams and foreshore ground works. Monitoring of scour during construction and provision of scour protection if required and agreed with statutory consultees.	Negligible
High potential for post-medieval waterfront remains, including barge beds, flood defences and remains associated with the construction of Putney Bridge (Medium asset	Assets affected by the construction of cofferdams, foreshore apron, campsheds and permanent scour protection, and modifications to the river wall and slipways. Assets removed from within the footprints of the interception shaft and connection culvert. Assets removed by scour around	Moderate adverse	Targeted archaeological investigation and recording, including environmental sampling, within the area of the temporary cofferdams and foreshore ground works. Monitoring of scour during construction and provision of scour protection if required and	Negligible

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
significance)	temporary cofferdams. Asset significance reduced to negligible.		agreed with statutory consultees.	
Above-ground heritage assets				
Bridge abutment, Bazalgette sewer outfalls, and outfall apron associated with Putney Bridge (High asset significance)	Removal of the existing sewer outfalls and apron for the construction of the interception chamber.	Major adverse	Partial mitigation by an English Heritage Level 3 Standing structure recording and photographic survey.	Minor adverse
Putney Bridge (High asset significance)	Construction of narrow ventilation column and concrete interception chamber hood leading to localised physical impact on fabric of bridge.	Minor adverse	No mitigation required further to that embodied within the proposed design and *Design Principles* report.	Minor adverse
	The construction works would have a medium magnitude adverse effect upon the setting of Putney Bridge.	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the *CoCP* and environmental design principles	Moderate adverse

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
	Ground movement resulting from construction works having a localised impact on spans 1, 2 and 3 of the bridge	Minor adverse	The bridge would be monitored throughout the works. Volume loss control would be implemented, emergency repairs would be effected where needed, and other repairs to damage would take place following completion of the works, using standard conservation techniques.	Negligible
Listed bollards (High asset significance)	Temporary removal and storage (to protect during construction) and relocation of the listed bollards.	Temporary moderate adverse	Physical impact of temporary removal would be partially mitigated by an English Heritage Level 2 Standing structure recording and photographic survey.	Minor adverse
19th century cobbled slipway within the main site (High asset significance)	Temporary localised removal at upper part of slipway (to subsequently be sensitively reinstated).	Temporary moderate adverse	Physical impact of removal could be partially mitigated by an English Heritage Level 2 Standing structure recording and photographic survey.	Negligible
Slipway within the temporary site (High asset significance)	Localised removal of existing granite paving.	Minor adverse	Physical impact of removal could be partially mitigated by an English Heritage Level 2 Standing structure recording and photographic survey.	Negligible
19th century river wall	Impact from slots for cofferdams.	Minor adverse	Physical impact of removal	Negligible

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
(High asset significance)			could be partially mitigated by an English Heritage Level 2 Standing structure recording and photographic survey.	
Putney Embankment Conservation Area and associated heritage assets (High asset significance)	The construction works would have an adverse effect upon the historic character and appearance of the eastern part of the Putney Embankment Conservation Area, and the settings of the heritage assets within it, which would be of a medium magnitude in relation to the conservation area as a whole.	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the *CoCP* and environmental design principles	Moderate adverse
St Mary's Church (High asset significance)	The construction works would have a low magnitude adverse effect upon the setting of the church.	Minor adverse	No mitigation required further to that embodied within the proposed design and the *CoCP* and environmental design principles	Minor adverse
Bishops Park Conservation Area and associated designated heritage assets (High asset significance)	The construction works would have a low magnitude adverse effect upon the setting of this group of heritage assets, and upon views to the Putney Embankment from the Bishops Park Conservation Area. Wider views from these assets would not be affected.	Minor adverse	No mitigation required further to that embodied within the proposed design and the *CoCP* and environmental design principles	Minor adverse
Putney Bridge	The construction works would have	Minor adverse	No mitigation required further to	Minor adverse

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
Conservation Area (High asset significance)	a low magnitude adverse effect upon the setting of and views towards the asset, since although the distance from the site and intervening Putney Bridge would limit views, the cranes would be partially visible.		that embodied within the proposed design and the *CoCP* and environmental design principles	

Vol 7 Table 7.10.2 Historic environment – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Putney Embankment Conservation Area and associated heritage assets (High asset significance)	The proposed development would introduce new elements of appropriate scale within the Putney Embankment Conservation Area, resulting in a low magnitude adverse change to the character of this part of the conservation area and the setting of the heritage assets within it.	Minor adverse	No mitigation required further to that embodied within the proposed design and environmental design principles	Minor adverse
Putney Bridge (High asset significance)	The ventilation column, and kiosk on Waterman's Green, and interception structure beneath the arch, would result in a low magnitude adverse change to the character of the bridge. While the foreshore drop shaft structure would offer improved views towards the bridge, it would alter the character of the river wall and also have a low	Minor adverse	No mitigation required further to that embodied within the proposed design and environmental design principles	Minor adverse

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	magnitude adverse effect upon the bridge's setting.			
St Mary's Church (High asset significance)	The ventilation column would have a low magnitude adverse effect upon the setting of the church, and would not affect wider views.	Minor adverse	No mitigation required further to that embodied within the proposed design and the *CoCP* and environmental design principles	Minor adverse
Bishops Park Conservation Area and associated designated heritage assets (High asset significance)	The scale and design of the proposed development would have a low magnitude adverse effect upon the setting of Bishops Park Conservation Area and Registered Park and Garden, and views towards the site	Minor adverse	No mitigation required further to that embodied within the proposed design and environmental design principles	Minor adverse
Putney Bridge Conservation Area (High asset significance)	Views from the Putney Bridge Conservation Area to the site would be largely screened by the presence of Putney Bridge, presenting a negligible magnitude of change to the asset's setting.	Minor adverse	No mitigation required further to that embodied within the proposed design and environmental design principles	Minor adverse

References

[1] Wandsworth Conservation and Design Group. *Putney Embankment Conservation Area Appraisal and Management Strategy* (2010). Accessed 03 February 2011.

[2] Department of Environment, Food and Rural Affairs*. National Policy Statement for Waste Water* (2012)

[3] Communities and Local Government. *National Planning Policy Framework* (March 2012)

[4] Department of Communities and Local Government, English Heritage & Department for Culture, Media and Sport. *PPS5 Planning for the Historic Environment: Historic Environment Planning Practice Guide* (March 2010)

[5] English Heritage. *Understanding historic buildings: a guide to good recording practice*. Swindon (2006).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 8: Land quality

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

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January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 7: Putney Embankment Foreshore site assessment

Section 8: Land quality

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8 Land quality

8.1 Introduction

8.1.1 This section presents the findings of the assessment of the likely significant land quality effects of the proposed development at the Putney Embankment Foreshore site.

8.1.2 The scope of the land quality assessment is to:

a. describe the condition of the site in terms of contaminant history and likely presence and magnitude of soil/sediment and liquid contamination (such as groundwater or perched water within the made ground), in addition to unexploded ordnance (UXO) and the presence of Japanese Knotweed, an invasive plant species which can be regarded as a soil contaminant.

b. describe and assess the impacts and significant effects of the interaction between these contaminants and the built environment, human and environmental receptors as a result of construction of the proposed development (taking into account any embedded measures).

8.1.3 There are a number of interfaces between land quality and other topic sections, as summarised below:

a. Section 13 - Water resources – groundwater assesses the likely significant effects to water resources from soil, perched water and groundwater contamination. The land quality assessment considers potential risks to human health receptors (eg, construction workers) from contaminated perched water and groundwater, including free phase[i] contamination.

b. Section 4 - Air quality and odour assesses the likely significant effects to the air quality during the construction and operation of the site. The land quality assessment considers potential risks from, for example, the generation of dust and soil vapour from exposed ground and soils during construction.

c. Section 5 - Ecology – aquatic and Section 14 - Water resources – surface water, these sections consider the mobilisation of sediments associated with in-river construction. The surface water section also considers the likely significant effects to controlled waters from land contamination (eg, contaminated run-off) and use of contaminating substances during construction.

8.1.4 No further assessment of these impacts and effects is made in the land quality Section.

[i] Free phase contamination - hydrocarbons that form a discrete layer within groundwater, either floating on the groundwater surface or at the base of a groundwater body.

8.1.5 Operational land quality effects for this site have not been assessed. This is on the basis of the embedded measures adopted during the construction and operational phases (refer to Section 8.2 and Vol 2 Section 8.6). No significant operational effects are considered likely and for this reason only information relating to construction is presented in the assessment of effects on land quality.

8.1.6 The assessment of the likely significant effects of the project on land quality has considered the requirements of the National Policy Statement for Waste Water (Defra, 2012)[1] section 4.8. The risk posed by construction on previously developed land is addressed in the following assessment and through measures embedded in the *Code of construction practice* (*CoCP*) (further details can be found in Vol 2 Section 8.3). The CoCP is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

8.1.7 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 7 Putney Embankment Foreshore Figures).

8.2 Proposed development relevant to land quality

8.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to land quality are set out below.

Construction

8.2.2 The main elements of the proposed development relevant to land quality would consist of the following:

a. construction of a temporary cofferdam including connection to the existing river wall and construction of a campshed at the main site

b. partial demolition of existing river wall and construction of a new section

c. remove and replacement of CSO outfall apron

d. construction of pits, chambers, ducts and pipes for cables, pipes, utility connections and diversions and drainage

e. combined sewer overflow (CSO) drop shaft, the invert of which would be located at an approximate depth of 36m below ground level (bgl)

f. short connection tunnel constructed between the drop shaft and the main tunnel

g. construction of an interception chamber, CSO overflow structure, culverts, pipes and other hydraulic structures

h. construction of air management plant and equipment including filter and ventilation columns and associated below ground ducts and chambers

i. construction of electrical and control kiosks

j. construction of a temporary slipway at the secondary site.

8.2.3 The above works would involve extensive below ground construction, resulting in the excavation and removal of material, including made ground and natural soils below.

8.2.4 An area would also be required within the site for construction logistics, such as materials handling and storage areas, site welfare facilities and offices (as shown in the Putney Embankment Foreshore site construction plans - see separate volume of figures).

Code of construction practice

8.2.5 The embedded design measures relevant to land quality at the site are set out in the *CoCP* and are summarised below. Reference should be made to the *CoCP Part A* for full details.

8.2.6 There are no *CoCP Part B* measures which are relevant to this land quality assessment.

8.2.7 Land quality issues would be managed in close liaison with the local authority, London Borough (LB) of Wandsworth, and the Environment Agency (EA) prior to and during construction.

Pre-construction

8.2.8 The proposed development has been characterised and assessed with respect to land quality through the application of the following steps (which are dictated by the regulatory framework outlined in section 9 of the *CoCP Part A*):

a. completion of a desk study which includes a review of available information sources (see Vol 7 Appendix F.1) as well as review of site specific ground investigation data and the production of an initial conceptual site model

b. undertaking of specialist site surveys, such as Japanese Knotweed and UXO, which to date has included a UXO desk study for the Putney Embankment Foreshore site (see Vol 7 Appendix F.3)

c. drilling of boreholes and assessment of soil and groundwater quality.

8.2.9 In view of the lack of contaminative history within the site area, the results of the preliminary ground investigation and the low risk current land use (River Thames foreshore for both main and secondary sites), it is judged that further intrusive investigations and specific remediation works for land quality purposes in advance of the main construction works would be unnecessary.

8.2.10 The information used to produce this *Environmental Statement* would be reformatted into a Preliminary Risk Assessment compliant with the guidance set out in BS10175[2] and CLR11 *Model procedures for the management of land contamination* (EA, 2004)[3] for submission to the regulators prior to the start of construction.

Construction

8.2.11 Health and safety measures for the protection of construction workers with respect to land quality issues would, as standard, include:

a. the provision of adequate training for all construction site workers to recognise and appropriately respond to potential land quality issues

b. site welfare facilities and where appropriate, decontamination units (ie, dirty in, clean out welfare units)

c. use of standard construction site personal protective equipment (PPE) (eg, high visibility clothing, safety boots, hard hat, safety glasses gloves and respiratory equipment)

d. robust emergency procedures (eg, with respect to UXO, or previously unidentified contamination), which would be periodically reviewed. In the event of previously unidentified conditions being encountered, works would be suspended, the work area evacuated and specialist advice obtained. Where appropriate, additional risk assessments would be undertaken and additional control measures implemented prior to any works recommencing.

8.2.12 During construction, effective material management procedures, such as the storage and handling of excavated soils, fuels and other chemicals (as detailed further in the surface water section of the *CoCP*), would be implemented).

8.2.13 Although it is unlikely to be specifically required due to poor soil quality, site control measures would as a standard be implemented to reduce dust (see air quality section of the *CoCP*) and the spread of mud by vehicles (see public access, the highway and river transport section of the *CoCP*).

8.2.14 Monitoring of excavations would be undertaken by a UXO specialist due to the high risk of encountering UXO within the foreshore environment.

8.3 Assessment methodology

Engagement

8.3.1 Volume 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of land quality are presented here.

8.3.2 The LB of Wandsworth was specifically consulted with respect to any land quality data they hold at the site and surrounding area. A review of this data as well as the response from the Council is presented in Vol 7 Appendix F.1 and Vol 7 Appendix F.2. No other site specific comments were received.

Baseline

8.3.3 The baseline methodology follows the methodology described in Vol 2. There are no site-specific variations for identifying the baseline conditions for this site.

Construction

8.3.4 The assessment methodology for the construction phase follows that described in Vol 2. There are no site-specific variations for undertaking the construction assessment of this site.

8.3.5 The construction assessment area considered for the assessment of land quality includes the limit of land to be acquired or used (LLAU) and an additional 250m buffer area. This assessment area has been selected in order to take account of any off-site sources that could impact on the land quality of the site as well as any nearby sensitive receptors.

8.3.6 The construction assessment has been undertaken for Site Year 1 of the construction phase.

8.3.7 The base case and cumulative assessment in Site Year 1 of construction take into account the schemes described on Vol 7 Appendix N. The baseline is not anticipated to change substantially between the baseline and Site Year 1 of construction (2016). There are two developments within the 250m buffer area which are likely to be complete and operational by the commencement of the construction phase and as a result forms part of the construction base case (see Vol 7 Table 8.3.1 below).

8.3.8 There is one proposed development expected to be under construction during Site Year 1 of construction which is included in the cumulative assessment (the development at 45-53 Putney High Street and 329-339 Putney Bridge Road – see Vol 7 Table 8.3.1 below).

Vol 7 Table 8.3.1 construction base case and cumulative assessment developments (2016)

Development	Distance from site	Construction base case	Cumulative impact assessment
No2 Putney High Street (development of vaults to provide cafe floor space within existing basement vault and provision of an opening in the river wall with flood barrier to provide access to Watermans Green).	Adjacent	✓	✗
No. 4 - 6 Putney High Street (formation of arched opening in listed river wall for each vault to No 4 and No 6 to provide additional café floorspace; installation of glazed assembly with side louvre panels with new opening. Installation of	Adjacent	✓	✗

Development	Distance from site	Construction base case	Cumulative impact assessment
spring dam flood barrier system to each new opening. Formation of new opening between vaults installation of newton 500 drained cavity membrane system to both vaults).			
45-53 Putney High Street & 329-339 Putney Bridge Road (redevelopment for erection of a building of part 15 and part 7 storeys, plus 2 storey basement).	170m southeast	✗	✓

Symbols ✓ applies ✗ does not apply

8.3.9 Section 8.5 details the likely significant effects arising from the construction at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on land quality within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

Development of conceptual model

8.3.10 The assessment of land quality effects is based on the development of a source-pathway-receptor (SPR) conceptual model. This model aims to understand the presence and significance of potentially complete pollutant linkages.

8.3.11 The SPR conceptual model is based on guidance given in CLR113. This type of assessment specifically relates to risk assessment and management of land contamination and has been used to inform the EIA which seeks to identify the likely significant effects of the proposed development.

8.3.12 The impact assessment considers the anticipated level of contamination likely during Site Year 1 of construction using the categories of receptor sensitivity and impact magnitude given in Vol 2 Section 8.4 and Vol 2 Section 8.5, respectively.

8.3.13 The significance of effects has been determined using the generic matrix given in Vol 2 Table 3.7.1. A description of the significance criteria is presented in Vol 2 Table 8.5.2.

8.3.14 The methodology for undertaking both source-pathway-receptor analysis and the impact assessment is provided in Vol 2 Section 8 Land quality.

Assumptions and limitations

8.3.15 The assumptions and limitations associated with this assessment are presented in Vol 2. Assumptions and limitations specific to the site are detailed below.

Assumptions

8.3.16 There are no site specific assumptions for the Putney Embankment Foreshore site.

Limitations

8.3.17 There is limited site specific data on soil and groundwater quality available within some parts of the LLAU. It is however, considered that there is sufficient information to provide a robust assessment.

8.4 Baseline conditions

8.4.1 The following section sets out the baseline conditions for land quality within and around the site. Future baseline conditions (base case) are also described.

Current baseline

Introduction

8.4.2 A full list of the data sets drawn upon in this assessment is presented in Vol 2.

8.4.3 A baseline report is presented in Vol 7 Appendix F.1 which details the data obtained for this site and identifies the contamination sources that may have affected the site. In addition to Vol 7 Appendix F.1, this section should also be read in conjunction with Vol 7 Figure F.1.1, Figure F.1.2 and Figure F.1.3 (see separate volume of figures).

Summary of baseline conditions

Geology

8.4.4 The site is underlain by a thin cover of River Terrace Deposits (less than 0.5m thick) overlying the London Clay Formation.

8.4.5 On the embankment a layer of made ground would be present (and would be expected to be approximately 2m in depth) (See Vol 7 Appendix F Table F.3 for the full geological succession).

Contamination

8.4.6 The area within the LLAU has not been subject to major contaminative land uses in the past. No notable contamination sources were identified within the site or in the immediate vicinity of the site.

8.4.7 The site includes an area of River Thames foreshore. The Thames foreshore sediments within the tidal reaches have been found to contain low levels of polycyclic aromatic hydrocarbons (PAHs) and metals from historic activities within the wider River Thames and coliforms from sewage discharges (see Vol 2 Appendix F.2 for sediment sampling report).

8.4.8 The levels of various potential contaminants in the sediments are relatively low in terms of risk to human health (when compared to widely used screening values [4,5]) and are relatively immobile (not readily leachable). These sediments are also restricted to the upper part of the proposed excavation works (less than one metre in thickness). The majority of the excavated materials at the site from the CSO drop shaft would therefore be essentially uncontaminated.

8.4.9 Overall on the basis of the current information it is considered that the site has a very low risk of containing contaminated soils or groundwater.

UXO

8.4.10 A desk based assessment for UXO threat has been undertaken for this site. The report reviews information sources such as the Ministry of Defence (MoD), Public Records Office and the Port of London Authority (PLA). The report is presented in Appendix F.3.

8.4.11 The report indicates that no Word War II targets were identified within the site although numerous “opportunistic” targets were identified to the east.

8.4.12 The main site in the foreshore is considered to have a high risk of UXO and the secondary site, a medium/high risk.

Summary of receptors

8.4.13 The receptors identified at this site by the baseline survey (see Vol 7 Appendix F.1) and their corresponding sensitivity following the criteria set out in Vol 2 are as follows:

a. construction workers: low sensitivity for general above ground site workers such as staff in site offices or delivery drivers and high sensitivity for those site workers involved in below ground excavation works and associated activities

b. adjacent land-users: residents (high sensitivity), users of the Waterman’s Green open space (medium sensitivity) and workers in the adjacent commercial/retail properties, Thames Path users and church users (low sensitivity)

c. built environment: listed structures such as the Grade II listed Putney Bridge and Grade II* Listed St Mary’s Church (high sensitivity) and commercial, retail, residential properties and river wall (all low sensitivity).

Construction base case

8.4.14 For land quality, the assessment of construction effects is based on the conditions which are likely to be experienced in Site Year 1 of construction (the base case). It is not anticipated that the base case would differ materially from the baseline, for the reasons described in para 8.5.1.

8.5 Construction effects assessment

Construction assessment case

8.5.1 Land quality baseline conditions are unlikely to have changed from those described above by the commencement of the construction phase. This is primarily due to the majority of works being located within the foreshore environment but also applies to other areas due to the lack of contaminative land use history and low potential for harmful levels of contamination to be present within the LLAU.

Development of conceptual model

Interactions between source-pathway-receptor

8.5.2 The following section outlines how the contamination sources summarised in paras. 8.4.4 to 8.4.7 may interact with the receptors identified during the construction phase (see para. 8.4.13) following the application of the embedded measures (see Section 8.2).

8.5.3 The main land quality SPR interactions are considered to be from the exposure of potential contamination to:

a. construction workers (receptor) via dermal contact, ingestion, inhalation of dust and soil vapours/soil gas and direct contact

b. adjacent land-users including members of the public (receptor) via off-site migration of soil vapour (by diffusion or due to wind) and wind-blown dust contaminant pathways as well as accidental UXO detonation

c. the built environment (on and off-site receptors) via the accidental detonation of previously unidentified UXO

8.5.4 The SPR impacts are summarised in Vol 7 Table 8.5.1. For simplicity the various sources identified have been grouped together into the different phases in which they may be found (ie, solid, liquid, and gaseous), as these interact with receptors in a similar manner.

Vol 7 Table 8.5.1 Land quality – source-pathway-receptor summary (construction)

Receptors / Generic sources	Construction workers	Adjacent land users	Built environment
Contaminated soils / sediments	Inhalation, dermal contact, ingestion	Wind -blown dust, inhalation, vapour migration (and subsequent ingestion or inhalation)	N/A
UXO	UXO detonation	UXO detonation	UXO detonation

N/A =Not applicable

Impacts and effects

8.5.5 The following section discusses the potential impacts and likely significant effects on receptors as a result of the land quality conditions at the site.

8.5.6 The assessment focuses on those linkages between sources, pathways and receptors that could generate significant effects and is based on available information and professional judgement.

Construction workers

8.5.7 A number of embedded measures set out in the *CoCP* are designed to effectively manage any potential land quality impacts to construction workers associated with the construction phase of the proposed development (measures are summarised in Section 8.2).

Contamination

8.5.8 Desk based information suggests that the soils/sediments at the site are unlikely to be substantially contaminated and thus are unlikely to pose a risk to construction workers via direct contact pathways. There may however be some minor risks from bacteriological contamination associated with the sewage outfall which could impact construction workers through the ingestion pathway (such risk are easily mitigated through observance of basic hygiene principles).

8.5.9 Given the low risk nature of the site and the measures to be adopted as part of the *CoCP* (such as the use of PPE, risk assessments and welfare facilities), the overall magnitude of the impact to construction workers (both below and above ground) is assessed to be negligible.

8.5.10 This would result in a **negligible** effect on above ground construction workers and a **minor adverse** effect on those involved in intensive below ground works (although the effect is defined as minor adverse, it is considered unlikely that the effect would occur).

UXO

8.5.11 The management of UXO risk would be achieved through advice from a specialist contractor with experience of managing such risks. This would include an initial assessment of UXO being present at the site (such as that already undertaken) and a proportional response to this risk. With a high risk site such as the Putney Embankment Foreshore site, this is likely to include site-specific risk assessments, safe methods of work/tool box talks and emergency response procedures as well as a UXO watching brief as excavations progress.

8.5.12 These measures are successfully utilised in major construction schemes within London on regular basis. Therefore with these measures in place, the overall magnitude of the impact to construction workers (both below and above ground) is assessed to be negligible.

8.5.13 This would result in a **negligible** effect on above ground construction workers and a **minor adverse** effect on those involved in intensive below ground works (although the effect is defined as minor adverse, it is considered unlikely that the effects would occur).

Adjacent land- users

Contamination

8.5.14 As previously stated it is unlikely that contaminated soils would be encountered during the works at the Putney Embankment Foreshore site.

8.5.15 In addition there are a number of standard measures within the *CoCP* that would reduce the potential for the off-site migration of dusts or vapours for air quality purposes. These would include the damping down of excavations, storage of potentially contaminated soils in secure (covered) areas, wheel washes at the site entrance and the maintenance, construction and cleaning of hardstanding.

8.5.16 As such the impacts to adjacent land users from existing contamination being spread through dust or vapour migration are considered to be negligible.

8.5.17 Based on the assessed impact magnitude and receptor sensitivity, it is considered that the proposed development would result in a **negligible** effect on the adjacent commercial and retail users and St Mary's Church, the Thames Path and Waterman's Green open space users and a **minor adverse** effect on the adjacent residential land users (although the effect is defined as minor adverse, it is considered unlikely that the effects would occur).

UXO

8.5.18 Impacts on adjacent land-users could occur via accidental detonation of UXO during below ground works. The embedded measures are set out in the *CoCP*, such as the use of specialised UXO contractors offering site-specific advice and where necessary on-site monitoring. These measures are designed to effectively manage any impacts to the adjacent land-users associated with the construction phase of the proposed development.

8.5.19 With these measures in place the overall magnitude of the impact to all adjacent land-users is assessed to be negligible.

8.5.20 Based on the assessed impact magnitude and receptor sensitivity, it is considered that the proposed development would result in a **negligible** effect on the adjacent commercial and retail users and St Mary's Church, the Thames Path and Waterman's Green open space users and a **minor adverse** effect on the adjacent residential land users (although the effect is defined as minor adverse, it is considered unlikely that the effects would occur).

Built environment

8.5.21 Impacts from existing land quality relate to the accidental detonation of UXO during preliminary surveys or construction works.

8.5.22 A number of embedded design measures set out in the *CoCP*, as summarised in Section 8.2, are designed to effectively manage any land quality impacts (eg, from UXO) to the built environment associated with the construction phase of the proposed development.

8.5.23 With these measures in place the overall magnitude of the impact to the built environment is assessed to be negligible.

8.5.24 Based on the assessed impact magnitude and the receptor sensitivity, the proposed development is considered to result in a **negligible** effect to the adjacent residential and retail / commercial buildings and river wall, and a **minor adverse** effect to the listed Putney Bridge, St Marys Church and other listed structures (although the effect is defined as minor adverse, it is considered unlikely that the effects would occur).

8.6 Operational effects assessment

8.6.1 Operational effects have not been assessed for land quality (see para 8.1.5).

8.7 Cumulative effects assessment

Construction effects

8.7.1 Of the projects described in Vol 7 Appendix N, which could potentially give rise to cumulative effects with the proposed development at Putney Embankment Foreshore, only one development has been identified (see Vol 7 Table 8.3.1).

8.7.2 No cumulative effects on land quality are expected during the construction of the Thames Tideway Tunnel project and the non-Thames Tunnel scheme, since impacts from the works at Putney Embankment Foreshore would be constrained to the footprint of the development by the measures incorporated in the *CoCP* Section 9, such that there would be no receptors in common between the two developments.

8.8 Mitigation

8.8.1 The assessment presented above does not identify the need for mitigation during construction over and above those measures set out in the *CoCP*. No further mitigation, enhancement or monitoring is therefore proposed.

8.9 Residual effects assessment

Construction effects

8.9.1 As no mitigation measures are proposed, the residual construction effects remain as described in Section 8.5. All residual effects are presented in Section 8.10.

8.10 Assessment summary

Vol 7 Table 8.10.1 Land quality – summary of construction assessment

Receptor (sensitivity)	Effect	Significance of effect	Mitigation	Significance of residual effect
Construction workers – general above ground site staff (Low)	Health effects from exposure to contaminated soils, liquids, soil gases / vapours	Negligible	None	Negligible
	Health effects from detonation of UXO	Negligible	None	Negligible
Construction workers – below ground site staff (High)	Health effects from exposure to contaminated soils / sediments, liquids, soil gases / vapours	Minor adverse	None	Minor adverse*
	Health effects from detonation of UXO	Minor adverse	None	Minor adverse*
Adjacent land-users, workers within retail / commercial properties, church users and Thames Path users (Low)	Health effects from exposure to wind-blown dust or vapours	Negligible	None	Negligible
	Health effects from detonation of UXO	Negligible	None	Negligible
Adjacent land-users, Waterman's Green open space users (Medium)	Health effects from exposure to wind-blown dust or vapours or	Negligible	None	Negligible

Receptor (sensitivity)	Effect	Significance of effect	Mitigation	Significance of residual effect
	detonation of UXO			
Adjacent land-users, residential properties (High)	Health effects from exposure to wind-blown dust or vapours	Minor adverse	None	Minor adverse*
	Health effects from detonation of UXO	Minor adverse	None	Minor adverse*
Built environment – residential / retail / commercial properties and river wall (Low)	Damage to structures from detonation of UXO	Negligible	None	Negligible
Built environment – listed structures such as Putney Bridge and St Mary's Church (High)	Damage to structures from detonation of UXO	Minor adverse	None	Minor adverse*

**Although the effect is minor adverse, it is considered unlikely that the effect would occur.*

References

[1] Defra. *National Policy Statement for Waste Water* (2012)

[2] British Standards Institution. BS10175 Investigation of potentially contaminated sites: Code of Practice (2011)

[3] Environment Agency. *Model procedures for the management of land contamination: Contaminated Land Report 11* (2004).

[4] Department for Environment, Food and Rural Affairs/Environment Agency, *Soil Guidance Values 2009 and supporting documents,* Environment Agency, Available from http://www.environment-agency.gov.uk/research/planning/64015.aspx, accessed 11th October 2012.

[5] Land Quality Management/Chatered Institute of Environmental Health, *Generic Assessment Criteria for the Assessment of Human Health*, 2nd Edition, Land Quality Press.

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 9: Noise and vibration

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 7: Putney Embankment Foreshore site assessment

Section 9: Noise and vibration

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9 Noise and vibration

9.1 Introduction

9.1.1 This section presents the findings of the assessment of the likely significant effects on noise and vibration at the Putney Embankment Foreshore main and secondary sites (see Vol 7 Section 2, para 2.1.1).

9.1.2 The proposed development has the potential to affect noise and vibration levels at receptors due to:

a. construction site activities (noise and vibration)

b. construction traffic on roads outside the site (noise)

c. tugs pulling river barges conveying materials to and from the site (noise)

d. operation of the proposed development (noise and vibration).

9.1.3 Each of these is considered within the assessment.

9.1.4 The tunnel drive for the main tunnel does not run beneath this location. Groundborne noise and vibration from the tunnelling activities associated with the main tunnel, long connection tunnels and certain short connection tunnels are considered in Volume 3 Project-wide effects assessment[i].

9.1.5 The assessment of noise and vibration presented in this section has considered the requirements of the National Policy Statement for Waste Water Section 4.9 (noise and vibration) (Defra, 2012)[1]. Further details of these requirements can be found in Volume 2 Environmental assessment methodology Section 9.3.

9.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 7 Putney Embankment Foreshore Figures).

9.2 Proposed development relevant to noise and vibration

9.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to noise and vibration are set out below.

[i] Surface activities to facilitate construction of the short connection tunnel are considered within this assessment. Construction of the short connection tunnel at this site is not considered within Volume 3 as the connection tunnel would be constructed beneath the river away from sensitive receptors and effects from groundborne noise and vibration are therefore not considered likely.

Construction

Construction traffic

9.2.2 During construction, cofferdam fill (both import and export), shaft and other excavated material (export) would be transported by barge. For the noise assessment it has been assumed that 90% of these materials would be taken by river. This allows for periods that the river is unavailable and material unsuitable for river transport. All other materials would be transported by road. Estimated barge and vehicle numbers are presented in Vol 7 Sections 3.3 and 12.2.

Construction activities

9.2.3 Vol 7 Section 3.3 sets out the assumed construction duration and programme for the Putney Embankment Foreshore site.

9.2.4 The construction works at this location would involve the following activities that have the potential to affect noise and vibration levels in the vicinity of the site:

a. utility diversions

b. hoarding and site setup

c. demolition

d. cofferdam construction

e. shaft construction and excavation

f. connection tunnel construction

g. shaft secondary lining

h. interception and culvert works

i. landscaping (including construction and fit-out of permanent structures).

9.2.5 Further detail on the plant used in these construction stages is given in Vol 7 Appendix G.2.

9.2.6 Working hours have been subject to consultation and agreement with the local authority. As part of the *Code of Construction Practice (CoCP)* requirements, Section 61 consents would be agreed with the local authority to confirm methodologies. Construction activities would be carried out during the following periods, as identified in the *CoCP*:

a. standard (core) hours (08.00-18.00 weekdays and 08.00-13.00 Saturdays).

b. continuous working (24 hours a day, 7 days a week) for construction of the short connection tunnel from the shaft to the main tunnel. This would be carried out over a period of approximately two months.

Code of Construction Practice

9.2.7 The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B)

9.2.8 The *CoCP Part A* (Sections 4.3 and 6.4) specifies the use of best practicable means (BPM) to reduce noise and vibration effects. Generic measures include:

a. careful selection of construction plant, construction methods and programming
b. equipment would be suitably sited so as to minimise noise impact on sensitive receptors
c. use of site enclosures, and temporary stockpiles to provide acoustic screening
d. choice of routes and programming for the transportation of construction materials, excavated material and personnel to and from the site
e. careful programming so that activities which may generate significant noise would be planned with regard to local occupants and sensitive receptors
f. hoarding would be of a standard height of 2.4m and of an extent to achieve appropriate noise attenuation.

9.2.9 Site specific measures incorporated into the *CoCP Part B* (Sections 4 and 6) to reduce noise and vibration effects include:

a. a 2.4m high noise screen would be located on the western edge of the cofferdam sections perpendicular to the river wall
b. the loading and unloading of barges would only be carried out during standard working hours
c. during connection tunnel works outside of standard working hours the use of surface cranes would be minimised. This would involve the stockpiling of materials/ equipment at the bottom of the shaft for use during the evening and night for removal during standard working hours. In addition the work would utilise measures to reduce noise including the use of electric gantry cranes, gas/electric fork lift and measures to reduce noise from skip movements and unloading

Operation

9.2.10 A ventilation chamber would contain plant and filter equipment below ground with an above ground ventilation column. The operational plant installed would have the potential to create noise impacts, and these are considered in the assessment.

9.2.11 During tunnel filling events water would descend via a vortex structure through the drop shaft to the connection tunnel below. The potential for noise generated by this movement of water through the shaft has been assessed.

Environmental design measures

9.2.12 The operational plant associated with the surface structures would incorporate environmental design measures to control noise emission to the nearest sensitive receptors to acceptable noise limits. These limits are as defined by the Local Authority in which the receptor lies. At the Putney Embankment Foreshore site, receptors within the London Borough (LB) of Wandsworth have been considered, alongside receptors on the opposite bank of the Thames which lie within London Borough (LB) of Hammersmith and Fulham (see para. 9.3.17).

9.2.13 The environmental design measures have considered the following noise sources:

a. hydraulic plant for penstock operation (pumps, motors)

b. uninterruptable power supply (UPS) plant.

9.2.14 In considering the noise from the above items, the sound insulation of the housing for the equipment has been taken into consideration.

9.2.15 The design of the drop shaft would control the descent of water by channelling the flow around the internal face of a vortex drop tube within the drop shaft, rather than allowing the water to free fall. The vortex design allows large volumes of water to descend with less noise generation than a falling cascade design.

9.3 Assessment methodology

Engagement

9.3.1 Volume 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of noise and vibration are presented here.

9.3.2 The survey methodology and monitoring locations were agreed with LB of Wandsworth. The limits for plant noise from the operation of the site were also obtained from LB of Wandsworth.

9.3.3 LB of Hammersmith and Fulham was also consulted with regards to the limits for plant noise from the operation of the site, however a response was not received. As such operational limits for plant noise were determined according to the general methodology outlined in Volume 2 (see para 9.3.17).

9.3.4 No site specific comments in relation to noise or vibration have been received for this location from stakeholders at scoping or other consultation stages.

Baseline

9.3.5 The baseline methodology follows the methodology provided in Volume 2. There are no site specific variations for this site.

Construction

9.3.6 The assessment methodology for the construction phase follows that described in Volume 2. There are no site specific variations for undertaking the construction assessment of this site.

9.3.7 Section 9.5 details the likely significant effects arising from the construction at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on noise and vibration within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

9.3.8 The construction noise and vibration assessment has considered the effects across the whole duration of the construction phase and the worst-case exposure levels are reported. The development case (with the Thames Tideway Tunnel project) has been assessed against the base case (without the Thames Tideway Tunnel project).

9.3.9 Of the schemes outlined in the development schedule (Vol 7 Appendix N) the No. 2 Putney High Street café development and Nos. 4-6 Putney High Street café development are considered relevant to the construction assessment base case as they would be complete and operational by the Thames Tideway Tunnel construction phase. As the café development at No. 2 Putney High Street is the closest of these developments to the site, it has been included as a receptor in the construction assessment. The café development at Nos. 4-6 Putney High Street has been considered as a secondary receptor (see para. 9.4.6).

9.3.10 Of the schemes outlined in the development schedule (Vol 7 Appendix N), most are not relevant to the cumulative construction assessment as they lie outside of the 300m assessment area and are therefore not considered. However, the 45-53 Putney High Street and 329-339 Putney Bridge Road development has been considered in the cumulative assessment as it is in the locality and assumed to be under construction at the same time as the Putney Embankment Foreshore site.

9.3.11 All other schemes in the development schedule (Vol 7 Appendix N) are either screened from the site by existing assessed receptors or outside of the assessment screening distance of 300m and are therefore not considered in the base case or cumulative assessments.

9.3.12 Traffic flows on construction traffic routes have been examined to determine if there are any routes where there is the potential for traffic noise changes of 1dB(A) or more. This is according to the flow, speed or composition change criteria specified in Volume 2. The results show that there are no traffic changes on the road network associated with this site which meet the relevant criteria. This is discussed further in the assessment section from para. 9.5.82.

9.3.13 The assessment of construction effects also considers the extent to which the effects on noise and vibration would be likely to be materially different should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Construction assessment area

9.3.14 As described in Volume 2 the assessment area considers unscreened receptors up to a maximum of 300m from the site boundary based on professional judgement of the likelihood of significant effects. The assessment primarily concentrates on those receptors closest to the site which would generally be most affected, rather than those further away which would be well screened by intervening buildings. Effects at more distant receptors beyond those closest to the site have been considered where necessary by reference to the impacts determined at the primary (closest) receptors.

Operation

9.3.15 The operational phase assessment methodology follows the methodology provided in Volume 2. Site specific variations to this methodology are set out below.

9.3.16 For this site, LB of Wandsworth requires that for residential receptors, noise emissions from this type of source are designed to meet a rating level (as defined in BS4142 (British Standards Institution, 1997)[2]) which is 10dB(A) below the typical background noise level over the operational period of the plant at 1m from the facade of the nearest residential receptor.

9.3.17 For the receptor on the north side of the River Thames a response has not been received from LB of Hammersmith and Fulham specifying their requirements for the control of noise from fixed plant noise sources. Volume 2 refers to a proposed approach where guidance has not been received from the local authority. This approach is that noise emissions from this type of source are designed to meet a rating level (as defined in BS4142 (British Standards Institution, 1997)[1]) which is 5dB below the typical background noise level over the operational period of the plant at 1m from the facade of the nearest residential receptor.

9.3.18 The operational assessment year is taken to be Year 1 of operation.

9.3.19 Section 9.6 details the likely significant effects arising from the operation of the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on noise and vibration within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

9.3.20 Of the schemes outlined in the development schedule (Vol 7 Appendix N) the No. 2 Putney High Street café and Nos 4-6 Putney High Street café developments are considered relevant to the operational assessment base case as they would be complete and operational by the Thames Tideway Tunnel project operational phase. As the café development at No. 2 Putney High Street is the closest of these developments to the site, it has been included as a receptor in the operational assessment. The café development at Nos. 4-6 Putney High Street has been considered as a secondary receptor (see para 9.4.6)

9.3.21 There are no schemes identified in Vol 7 Appendix N that are considered of relevance to the cumulative operational assessment, because due to their use, none are expected to generate significant noise or vibration levels during their operation.

9.3.22 All other schemes in the development schedule (Vol 7 Appendix N) are either screened from the site by existing assessed receptors or outside of the assessment screening distance of 300m and are therefore not considered in this assessment.

9.3.23 Based on the traffic flow, speed or composition change criteria specified in Volume 2, there are no routes where potential for operational traffic noise effects would occur.

9.3.24 The assessment of operational effects also considers the extent to which the effects on noise and vibration would be likely to be materially different should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Operational assessment area

9.3.25 Operational effects are considered up to 300m from the site boundary, although the focus is on those receptors closest.

Assumptions and limitations

9.3.26 The generic assumptions and limitations associated with this assessment are presented in Volume 2. The site specific assumptions and limitations are presented in the following section.

Assumptions

9.3.27 The working hours assumed for the assessment are as described in para. 9.2.6.

Limitations

9.3.28 A response has not been received from LB Hammersmith and Fulham with regards to the borough's limits for noise from operational plant. As discussed in para. 9.3.17 a general methodology for determining limits for operational noise (set out in Vol 2) has been applied and as such the assessment is considered robust.

9.4 Baseline conditions

9.4.1 The following section sets out the baseline conditions for noise and vibration within and around the site. Future baseline conditions (base case) are also described.

Current baseline

9.4.2 The current baseline noise conditions are as described in the baseline survey. The specific details of this survey, such as the measurement times, locations measured, results and local conditions are described in Vol 7 Appendix G.1. Vol 7 Table 9.4.1 below shows that the noise levels for the daytime period fall within a relatively small range, the noise levels being primarily influenced by road traffic noise from Lower Richmond Road, and the A219 Putney High Street/Putney Bridge Approach.

Receptors

9.4.3 This section describes the setting and receptor characteristics of the site for the purposes of this assessment.

9.4.4 The closest noise and vibration sensitive receptors selected for the noise and vibration assessment are identified in Vol 7 Table 9.4.1 below (and shown in Vol 7 Figure 9.4.1, see separate volume of figures). These were selected as they are representative of the range of noise climates where sensitive receptors are situated around the site. The approximate number of residential properties affected at each location (where known) is indicated in Vol 7 Table 9.5.1.

9.4.5 The nearest residences to the site are the houseboats at Putney Pier. There are also residential buildings on Lower Richmond Road, Embankment, Putney High Street and Ruvigny Gardens on the south bank of the Thames in LB of Wandsworth. On the north bank of the Thames the residences on Fulham High Street in LB of Hammersmith and Fulham have been assessed. The non-residential Chas Newens Marine on Embankment, Thai Square restaurant, Café 2 and St. Mary's Church are also assessed.

9.4.6 Beyond these closest receptors there are other residential and non-residential locations, which are screened from the site by intervening buildings, or are located further from the site than the buildings included in the assessment. This includes a café development at Nos. 4-6 Putney High Street (see paras. 9.3.9 and 9.3.20) and this has been considered as a secondary receptor to the café development at 2 Putney High Street.

Receptor sensitivity

9.4.7 The noise and vibration sensitive receptors have been assessed according to their sensitivity, using the methodology outlined in Volume 2 Section 9.4. The sensitivities of all assessed receptors are presented in Vol 7 Table 9.4.1.

Vol 7 Table 9.4.1 Noise and vibration – sensitive receptors and noise levels

Ref	Receptor addresses	Sensitivity	Local authority	Measured average ambient noise level, day/ evening / night, dBLAeq*	Noise survey location
PE1	Star & Garter, Mansions and public house staff accommodation (residential)	High	LB of Wandsworth	67/62/48	PEF04
PE2	1-24 Kenilworth Court (residential)	High	LB of Wandsworth	74/71/63	PEF02
PE3	31-78 Kenilworth Court	High	LB of Wandsworth	74/71/63	PEF02

Ref	Receptor addresses	Sensitivity	Local authority	Measured average ambient noise level, day/ evening / night, dBLAeq*	Noise survey location
	(residential)				
PE4	St Mary's Church (place of worship)	Medium	LB of Wandsworth	76/77/67	PEF01
PE5	1-67 Putney Wharf Tower (residential)	High	LB of Wandsworth	76/77/67	PEF01
PE6	Richmond Mansions (residential)	High	LB of Wandsworth	74/71/63	PEF02
PE7	Ruvigny Mansions (residential)	High	LB of Wandsworth	67/62/48	PEF04
PE8	Chas Newens Marine (retail)	Medium	LB of Wandsworth	67/62/48	PEF04
PE9	10 Ruvigny Gardens (residential)	High	LB of Wandsworth	67/62/48	PEF04
PE10	Putney Pier Houseboats (residential)	High	LB of Wandsworth	67/62/48	PEF04
PE11	Thai Square (restaurant)	Medium	LB of Wandsworth	67/62/48	PEF04
PE12	Fulham High Street (residential)	High	LB of Hammersmith and Fulham	76/77/67	PEF01**
PE13	Café at 2 Putney High Street	Medium	LB of Wandsworth	74/71/63	PEF02

** Noise level includes correction for façade acoustic reflection unless receptor position is an open outdoor space (eg park)*
*** Noise level measured on opposite bank, however considered representative as road traffic is the major noise source, and the flows would be very similar*

9.4.8 The baseline noise level is considered representative of the relevant receptor. Consideration has been given to the distance of the measurement location to the receptor, the orientation of the primarily affected façade and location of the controlling noise source(s).

9.4.9 The criteria for determining the significance of noise effects at residences from construction sources are partly dependent upon the existing ambient noise levels. From the ambient noise levels measured during the baseline survey, the assessment category and assessment noise threshold levels for the residential receptors near the Putney Embankment Foreshore site have been identified and are as shown in Vol 7 Table 9.5.2.

9.4.10 The assessment of significance at non-residential receptors is made according to the construction noise level relative to the ambient noise level (see Vol 7 Table 9.5.2) using the impact criteria described in Volume 2 Section 9.5 (where appropriate) and other factors described in Volume 2.

Vol 7 Table 9.4.2 Noise – residential receptors and airborne construction noise assessment categories

Ref	Noise sensitive receptor* (No. of dwellings)	Ambient noise level, rounded to nearest 5dBL_{Aeq}* day/ evening/ night	Assessment category* day/ evening/ night	Significance criterion threshold level*, day, dB$L_{Aeq\ 10hour}$/ evening dB$L_{Aeq\ 1hour}$/ night, dB$L_{Aeq\ 1hour}$
PE1	Star & Garter, Mansions and public house staff accommodation (residential)	65/60/50	B/C/C	70/65/55
PE2	1-24 Kenilworth Court (residential)	75/70/65	C/C**/C**	75/71/63
PE3	31-78 Kenilworth Court (residential)	75/70/65	C/C**/C**	75/71/63
PE5	1-67 Putney Wharf Tower (residential)	75/75/65	C**/C**/C**	76/77/67
PE6	Richmond Mansions (residential)	75/70/60	C/C**/C**	75/71/63
PE7	Ruvigny Mansions (residential)	65/60/50	B/C/C	70/65/55
PE9	10 Ruvigny Gardens (residential)	65/60/50	B/C/C	70/65/55

Ref	Noise sensitive receptor* (No. of dwellings)	Ambient noise level, rounded to nearest 5dBL_{Aeq}* day/ evening/ night	Assessment category* day/ evening/ night	Significance criterion threshold level*, day, dB$L_{Aeq\ 10hour}$/ evening dB$L_{Aeq\ 1hour}$/ night, dB$L_{Aeq\ 1hour}$
PE10	Putney Pier Houseboats (residential)	65/60/50	B/C/C	70/65/55
PE12	Fulham High Street (residential)	75/75/65	C**/C**/C**	76/77/67

** From 'ABC' method – BS5228:2009 (British Standards Institution, 2009)[3]*
*** Where the ambient noise level is greater than category C levels the ambient noise level shall be used as the significance criterion threshold.*

Construction base case

9.4.11 The construction of the cofferdam at Putney Embankment Foreshore would necessitate the relocation of the eastern houseboat moored at Putney Pier. The assessment has considered the relocation of this boat to adjacent to the western mooring point on Putney Pier.

9.4.12 The noise level for the base case for the assessment is expected to be as measured during the baseline noise survey in 2011.

9.4.13 However, there is the potential for variations to occur in the ambient noise levels between 2011 and the base case year. If the noise levels were to vary, it is likely that they would increase compared to the measured data from 2011 (due to natural traffic growth). The estimated traffic increases for the construction base case in Site Year 1 are such that noise levels would be expected to increase by less than 1dB(A) from those measured in 2011. The assessment based on data from 2011 therefore presents a worst-case assessment.

9.4.14 It is considered that there are no other circumstances at this location that would cause the baseline noise levels at the receptor locations to change significantly between 2011 and Year 1 of construction.

9.4.15 There are no existing major vibration sources that have been identified and therefore it is considered that vibration levels are unlikely to change between the present time and the base case.

Operational base case

9.4.16 The operational base case has been estimated from traffic flow expectations for the Year 1 of the operational phase as a result of natural growth and new development in the vicinity. The estimated traffic increases for the operational base case in Year 1 of operation are such that noise levels would be expected to increase by less than 1dB(A) from those measured in 2011.

9.5 Construction effects assessment

Noise

9.5.1 The results of the assessment of construction noise are presented in Vol 7 Table 9.5.1 and Vol 7 Table 9.5.2. The tables show the range of predicted construction noise levels during the entire period of the works and a typical monthly construction noise level. The typical monthly level is the most frequently occurring monthly noise level during the works. The tables also show the total number of months across all construction stages that the noise level would be likely to exceed the impact criterion threshold level indicating potential significance. The final columns in the tables show the worst-case excess above the impact criterion together with the duration of the worst-case noise level. In cases when the impact criterion is exceeded (as marked by an asterisk in Vol 7 Table 9.5.1), further assessment of the likely noise ingress to the interior of the building has been carried out to more precisely estimate the resulting noise impact on the occupants. The noise ingress would depend on the degree of façade noise insulation of the particular buildings which is considered in further detail in these cases.

9.5.2 To illustrate the predicted variation in construction noise levels at each receptor position across the duration of the construction phase, Vol 7 Plates G5 to G17 in Vol 7 Appendix G show the estimated noise levels plotted month-by-month over the duration of the works. The appendix also lists the construction plant and operations assumed for the calculations. The predicted impacts and assessed effects at each representative receptor location are described below.

Impacts at residential receptors

9.5.3 The results for residential receptors are shown below.

Vol 7 Table 9.5.1 Noise – impacts at residential receptors (high sensitivity)

Ref/ receptor[a] (No. of noise sensitive properties)	ABC impact criterion threshold level (potential significance for residential), dBL_{Aeq}[b]	Range of construction noise levels, dBL_{Aeq}[c,d]	Typical[e] monthly construc-tion noise levels, dBL_{Aeq}	Magnitude		
				Total duration above criterion for all works, months	Worst-case excess above criterion, dBL_{Aeq}[f] (*further assessment undertaken for excess above criterion)	Duration of worst-case excess above criterion, months
PE1/ Star & Garter, Mansions and public house staff accommodation (14)	70	62-72 (day)	65	2	+2*	1
	65	56 (evening)	56	0	-9	0
	55	53 (night)	53	0	-2	0
PE2/ 1-24	75	62-69 (day)	64	0	-6	0

Kenilworth Court (24)	71	51 (evening)	51	0	-20	0
	63	47 (night)	47	0	-16	0
PE3/ 31-78 Kenilworth Court (48)	75	66-73 (day)	67	0	-2	0
	71	60 (evening)	60	0	-11	0
	63	56 (night)	56	0	-4	0
PE5/ 1-67 Putney Wharf Tower (50)	76	56-67 (day)	60	0	-9	0
	77	49 (evening)	49	0	-28	0
	67	45 (night)	45	0	-22	0
PE6/ Richmond Mansions (9)	75	62-75 (day)	66	0	0	0
	71	55 (evening)	55	0	-16	0
	63	52 (night)	52	0	-11	0
PE7/ Ruvigny Mansions (15)	70	43-67 (day)	43	0	-3	0
	65	36 (evening)	36	0	-29	0
	55	32 (night)	32	0	-23	0
PE9/ 10 Ruvigny Gardens (12)	70	46-74 (day)	51	2	+4*	1
	65	40 (evening)	40	0	-25	0
	55	36 (night)	36	0	-19	0
PE10/ Putney Pier Houseboats (2)	70	65-80 (day)	68	15	+10*	6
	65	52 (evening)	52	0	-13	0
	55	48 (night)	48	0	-7	0
PE12/ Fulham High Street (-)	76	53-62 (day)	55	0	-14	0
	77	46 (evening)	46	0	-31	0
	67	42 (night)	42	0	-25	0

[a] *Floors subject to highest noise level assessed – not necessarily the highest floor level*

[b] *The potential significance threshold is based on the ambient noise level as defined in Volume 2*

[c] *Construction noise only, excludes ambient noise. Refer to Volume 2 Section 9.5*

[d] *Noise level includes correction for façade acoustic reflection*

[e] *Most frequently occurring monthly construction noise level during works*

[f] *Positive value indicates exceedance, negative value indicates noise below criterion*

Star & Garter Mansions and Star & Garter public house staff accommodation (PE1)

9.5.4 Star & Garter Mansions is a four storey residential building located 40m from the main site boundary, and 40m from the temporary slipway works (the 'secondary site' boundary). The upper floors would have an unscreened view of the site. Adjacent to the residences there is the Star and Garter Public House, the top floors of which are staff accommodation for the Pub below. As a non-residential receptor, this has been considered further in para. 9.5.76.

9.5.5 The typical daytime noise levels (most frequently occurring monthly level) is 65dBL_{Aeq}. The construction of the cofferdam is expected to cause the worst-case noise level of 72dBL_{Aeq} for one month.

9.5.6 During the evening and night-time, the construction of the connection tunnel is expected to cause the worst-case noise levels of 56dBL_{Aeq} and 53dBL_{Aeq} respectively.

9.5.7 The construction noise levels are estimated to exceed the potential significance criteria for a residential receptor during the day for approximately two months.

9.5.8 The worst-case exceedances during the daytime are due to vibro-piling works close to the receptor. The noise levels presented in Vol 7 Table 9.5.1 are monthly averaged noise levels. For these activities, the noise levels have the potential to vary both during the day, and also from day to day, as the activities move around the site (for example sheet piling of the cofferdam) and as different items of plant are used.

9.5.9 During the night, the noise levels are likely to vary less, as the activities generating the noise are mainly fixed items of plant (eg conveyors) which operate continuously.

9.5.10 Because potentially significant effects have been identified using the ABC criterion, noise levels within the rooms most exposed to the construction works have been estimated. This has been based on conservative assumptions regarding the noise transmission through the façade with the windows closed. The approach to estimating internal noise levels is described in the methodology in Volume 2. Single glazing has been assumed for this receptor (based on the age of the property and external observations) and takes into account the glazed area of the façade and a typical reverberant characteristic for a domestic room.

9.5.11 The worst-case internal noise level during the day is estimated to be 42dBL_{Aeq} for one month with windows closed or approximately 53dBL_{Aeq} if windows were opened on the most exposed facade. For the other month during which the potential significance threshold is exceeded, the internal noise levels are estimated to be 41dBL_{Aeq} with windows closed. Although the worst-case noise level is expected for only a short proportion of the works (one month), this impact, together with the other month period over the internal guidance noise level[4] of 40dBL_{Aeq} is assessed as causing a **significant** effect given the number of affected residences.

9.5.12 During the evening and night, the worst-case internal noise levels are below the ABC potential significance threshold and therefore assessed as **not significant**.

1-24 Kenilworth Court (PE2)

9.5.13 1-24 Kenilworth Court is a six storey residential building located 20m from the main site boundary. The upper floors would have an unscreened view of the site. Some of the residential dwellings would be screened by the Thai Square Restaurant.

9.5.14 The predicted noise levels at these dwellings due to construction activities are shown in Vol 7 Table 9.5.1.

9.5.15 The typical daytime noise levels (most frequently occurring monthly level) is $64dBL_{Aeq}$. The construction of the cofferdam is expected to cause the worst-case noise level of $69dBL_{Aeq}$.

9.5.16 During the evening and night-time, the construction of the main tunnel is expected to cause the worst-case noise levels of $51dBL_{Aeq}$ and $47dBL_{Aeq}$ respectively.

9.5.17 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore assessed as **not significant**.

9.5.18 To the rear of 1-24 Kenilworth Court lie other residences within Kenilworth Court, all of which are further away from the development and most of which are screened by the blocks facing onto Lower Richmond Road. As the impact to these properties would be lower, the effect is also not significant to these properties.

31-78 Kenilworth Court (PE3)

9.5.19 31-78 Kenilworth Court is a six storey residential building located 20m from the main site boundary. The upper floors would have an unscreened view of the site.

9.5.20 The predicted noise levels at these dwellings due to construction activities are shown in Vol 7 Table 9.5.1.

9.5.21 The typical daytime noise levels (most frequently occurring monthly level) is $67dBL_{Aeq}$. The construction of the cofferdam is expected to cause the worst-case noise level of $73dBL_{Aeq}$.

9.5.22 During the evening and night-time, the construction of the short connection tunnel is expected to cause the worst-case noise levels of $60dBL_{Aeq}$ and $56dBL_{Aeq}$ respectively.

9.5.23 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore assessed as **not significant**.

9.5.24 To the rear of 31-78 Kenilworth Court there are other residences (eg Mount Court), all of which are further away from the development and most of which are screened by the blocks facing onto Lower Richmond Road. As the impact to these properties would be lower, the effect is also not significant to these properties.

1-67 Putney Wharf Tower (PE5)

9.5.25 1-67 Putney Wharf Tower is a ten storey residential building located 90m from the main site boundary. The upper floors would have a view of the development, although the lowest floors would be screened by Putney Bridge and St. Mary's Church.

9.5.26 The predicted noise levels at these dwellings due to construction activities are shown in Vol 7 Table 9.5.1.

9.5.27 The typical daytime noise levels (most frequently occurring monthly level) is $60dBL_{Aeq}$. The construction of the cofferdam is expected to cause the worst-case noise level of $67dBL_{Aeq}$.

9.5.28 During the evening and night-time, the construction of the short connection tunnel is expected to cause the worst-case noise levels of 49dBL_{Aeq} and 45dBL_{Aeq} respectively.

9.5.29 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore assessed as **not significant**.

9.5.30 Other than those assessed there are no other residential properties in the vicinity of this receptor that are close enough to be subject to significant adverse effects.

Richmond Mansions (PE6)

9.5.31 Richmond Mansions is a five storey residential building located 20m from the main site boundary. The upper floors would have an unscreened view of the site.

9.5.32 The predicted noise levels at these dwellings due to construction activities are shown in Vol 7 Table 9.5.1.

9.5.33 The typical daytime noise levels (most frequently occurring monthly level) is 66dBL_{Aeq}. The construction of the cofferdam is expected to cause the worst-case noise level of 75dBL_{Aeq}.

9.5.34 During the evening and night-time, the construction of the main tunnel is expected to cause the worst-case noise levels of 55dBL_{Aeq} and 52dBL_{Aeq} respectively.

9.5.35 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore assessed as **not significant**.

9.5.36 Other than those assessed there are no other residential properties in the vicinity of this receptor that are close enough to be subject to significant adverse effects.

Ruvigny Mansions (PE7)

9.5.37 Ruvigny Mansions is a five storey residential building located more than 200m from the main site boundary, but 10m from the temporary slipway works. The upper floors would have an unscreened view of the temporary slipway site.

9.5.38 The predicted noise levels at these dwellings due to construction activities are shown in Vol 7 Table 9.5.1.

9.5.39 The typical daytime noise levels (most frequently occurring monthly level) is 43dBL_{Aeq}. The construction of the construction of the temporary slipway is expected to cause the worst-case noise level of 67dBL_{Aeq}.

9.5.40 During the evening and night-time, the construction of the main tunnel is expected to cause the worst-case noise levels of 36dBL_{Aeq} and 32dBL_{Aeq} respectively.

9.5.41 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore assessed as **not significant**.

9.5.42 Other than those assessed there are no other residential properties in the vicinity of this receptor that are close enough to be subject to significant adverse effects.

10 Ruvigny Gardens (PE9)

9.5.43 10 Ruvigny Gardens are three storey residential terraced houses located more than 150m from the main site boundary, but 15m from the temporary slipway works. The upper floors would have an unscreened view of the temporary slipway site.

9.5.44 The predicted noise levels at these dwellings due to construction activities are shown in Vol 7 Table 9.5.1.

9.5.45 The typical daytime noise levels (most frequently occurring monthly level) is 51dBL_{Aeq}. The construction of the temporary slipway is expected to cause the worst-case noise level of 74dBL_{Aeq}.

9.5.46 During the evening and night-time, the construction of the connection tunnel is expected to cause the worst-case noise levels of 40dBL_{Aeq} and 36dBL_{Aeq} respectively.

9.5.47 The construction noise levels are estimated to exceed the potential significance criteria for a residential receptor during the day for two months.

9.5.48 Because potentially significant effects have been identified using the ABC criterion during the daytime, noise levels within the rooms most exposed to the construction works have been estimated. This has been based on conservative assumptions regarding the noise transmission through the façade with the windows closed. The approach to estimating internal noise levels is described in the methodology in Volume 2. Single glazing has been assumed for receptors in this vicinity, some of the façades also have large glazed conservatory structures. These assumptions are based on the age of the properties and external observations. Noise transmission to the interior takes into account the glazed area of the façade and a typical reverberant characteristic for a domestic room.

9.5.49 The worst-case internal noise level during the day is estimated to be 49dBL_{Aeq} for one month with windows closed or approximately 56dBL_{Aeq} if windows were opened on the most exposed facade. For the other month during which the potential significance threshold is exceeded, the internal noise levels is estimated to be 48dBL_{Aeq} with windows closed. Although the worst-case noise level is expected for only a short proportion of the works (one month), this impact, together with the other month period over the internal guidance noise level of 40dBL_{Aeq} is assessed as causing a **significant** effect given the number of affected residences.

9.5.50 During the evening and night, the worst-case internal noise levels are below the ABC potential significance threshold and therefore assessed as not significant.

Putney Pier Houseboats (PE10)

9.5.51 The two Houseboats moored at Putney Pier are located adjacent to the main site boundary. During the cofferdam construction, the houseboat on the eastern mooring point would be relocated to adjacent to the western mooring point, and the assessment reflects this.

9.5.52 The predicted noise levels at these dwellings due to construction activities are shown in Vol 7 Table 9.5.1.

9.5.53 The typical daytime noise levels (most frequently occurring monthly level) is 68dBL_{Aeq}. The construction of the cofferdam is expected to cause the worst-case noise level of 80dBL_{Aeq}.

9.5.54 During the evening and night-time, the construction of the connection tunnel is expected to cause the worst-case noise levels of 52dBL_{Aeq} and 48dBL_{Aeq} respectively.

9.5.55 The construction noise levels are estimated to exceed the potential significance criteria for a residential receptor during the day for approximately 15 months.

9.5.56 Given the predicted noise level, the particular receptor sensitivity (due to relatively low sound insulation), the duration that the potential significance criteria is exceeded and the number of affected residents, the effect is therefore considered **significant** during the daytime only.

9.5.57 Other than those assessed there are no other residential properties in the vicinity of this receptor that are close enough to be subject to significant adverse effects.

Fulham High Street (PE12)

9.5.58 The residences on Fulham High Street are four storey residential buildings located more than 250m from the main site boundary. The upper floors would have a partial view of the site, although the majority would be screened by Putney Bridge.

9.5.59 The predicted noise levels at these dwellings due to construction activities are shown in Vol 7 Table 9.5.1.

9.5.60 The typical daytime noise levels (most frequently occurring monthly level) is 55dBL_{Aeq}. The construction of the cofferdam is expected to cause the worst-case noise level of 62dBL_{Aeq}.

9.5.61 During the evening and night-time, the construction of the main tunnel is expected to cause the worst-case noise levels of 46dBL_{Aeq} and 42dBL_{Aeq} respectively.

9.5.62 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor. The effect is therefore assessed as **not significant**.

9.5.63 Other than those assessed there are no other residential properties in the vicinity of this receptor that are close enough to be subject to significant adverse effects.

Impacts at non-residential receptors

9.5.64 The results for non-residential receptors are shown below.

Vol 7 Table 9.5.2 Noise – impacts at non-residential receptors

Ref/receptor	Receptor sensitivity[a]	Range of construction noise levels, dBL_{Aeq}[b,c,d]	Ambient baseline noise level, dBL_{Aeq}[d]	Typical[e] monthly construc-tion noise levels, dBL_{Aeq}	Magnitude	
					Total duration above ambient for <u>all</u> works, months	Worst-case excess above ambient, dBL_{Aeq}
PE4/ St Mary's Church	Medium	46-62 (day)	76	50	0	-14
PE8/ Chas Newens Marine	Medium	43-71 (day)	67	46	2	+4
PE11/ Thai Square / Star & Garter public house	Medium	68-74 (day)	67	68	33	+7
		62 (evening)	62	62	0	0
PE13/ Café at 2 Putney High Street	Medium	51-70 (day)	71	52	0	-1

[a] *Assumed typical façade transmission loss and appropriate internal noise guidelines*

[b] *Floors subject to highest level assessed – not necessarily the highest floor level*

[c] *Construction noise only, excludes ambient noise. Refer to Volume 2*

[d] *Noise level includes correction for façade acoustic reflection unless receptor position is an open outdoor space (eg park)*

[e] *Most frequently occurring monthly construction noise level during works*

St. Mary's Church (PE4)

9.5.65 St. Mary's Church is located 50m from the main site boundary. The site is partially screened from the church by Putney Bridge and the site hoardings.

9.5.66 The noise level for this receptor is shown in Vol 7 Table 9.5.2. The typical daytime noise levels (most frequently occurring monthly level) is $50dBL_{Aeq}$. The worst-case noise level of $62dBL_{Aeq}$ during the daytime is less than the current ambient noise level for the respective period.

9.5.67 This is therefore assessed as **not significant**.

Chas Newens Marine (PE8)

9.5.68 Chas Newens Marine on the Embankment is a workshop/office/shop located less than 10m from the secondary site boundary. The prediction has been made at the upper floor of the offices, as this part of the offices would be expected to be subject to the highest construction noise levels and this is the most sensitive use of the building.

The noise level for this receptor is shown in Vol 7 Table 9.5.2. The typical daytime noise levels (most frequently occurring monthly level) is $46dBL_{Aeq}$. The worst-case noise level of $71dBL_{Aeq}$ during the daytime is predicted to occur during the construction of the temporary slipway, for a period of two months. This average noise increase over the day would be noticeable relative to average ambient noise.

9.5.69 During the daytime, the estimated noise transmitted to the office is not expected to exceed guideline noise levels given in BS8233 for office use. However, given that the ambient noise level is exceeded it is likely that the noise levels from construction activity associated with the temporary slipway would be noticeable during this period.

9.5.70 During the remainder of the construction period, the noise levels at this receptor would be below the ambient noise level.

9.5.71 Given the degree and duration of impact, and the level of construction noise ingress to the office, this is assessed as **not significant**.

Thai Square Restaurant / Star and Garter Public House (PE11)

The Thai Square Restaurant is a located less than 10m from the main site boundary. The prediction has been made at the upper floor of the restaurant, as this part of the building would be expected to be subject to the highest construction noise levels. The Star and Garter Public House is located approximately 50m from the main site boundary. The noise level for this receptor is shown in Vol 7 Table 9.5.2.

9.5.72 The typical daytime noise levels (most frequently occurring monthly level) is 68dBL_{Aeq}. The worst-case daytime noise level of 74dBL_{Aeq} would occur for approximately two months of the works (not four contiguous months). during the start of the construction for the drive connection tunnel. During this period, the construction noise levels are predicted to exceed the ambient noise level by 7dB(A). Over the whole construction period, the construction noise level is predicted to exceed the ambient noise level for a period of 33 months. During the other 29 months (i.e. outside of the one month during which the connection tunnel drive would take place), the excess over the ambient noise level would be less than 7dB(A). The worst-case average noise increase over the day would be noticeable relative to the average ambient noise.

9.5.73 During the daytime, the estimated noise transmitted to the restaurant interior is not expected to exceed guideline noise levels given in BS8233[3] for restaurant use. Given the increase above ambient noise level, it is likely that during the daytime construction noise levels would be noticeable to users of the restaurant depending on the type of construction activities in progress.

9.5.74 The worst-case evening noise level of 62dBL_{Aeq} would occur during construction of the connection tunnel. This is equivalent to the existing ambient noise level.

9.5.75 Given the degree of impact and the level of construction noise ingress to the restaurant, this is assessed as **not significant**.

9.5.76 The construction noise exposure at the Star and Garter Public House is estimated to be equivalent to that at the Thai Square Restaurant, given its position relative to the construction works. During the daytime, the estimated noise transmitted to the bar and conference facilities is not expected to exceed guideline noise levels given in BS8233 for restaurant use and conference use. Given the increase above ambient noise level, it is likely that during the daytime, construction noise levels may be noticeable to users of the building depending on the type of construction activities in progress.

9.5.77 Given the degree of impact and the level of construction noise ingress to the restaurant, this is assessed as **not significant**.

Café at 2 Putney High Street (PE13)

9.5.78 The Café at 2 Putney High Street is mostly located within the underground vaults below Lower Richmond Road, but would have an entrance at 2 Putney Bridge Road and would include an opening onto Watermans Green. The Café would be fully screened by the site hoarding and existing road and bridge structures. The noise level for this receptor is shown in Vol 7 Table 9.5.2.

9.5.79 The typical daytime noise levels (most frequently occurring monthly level) is 52dBL_{Aeq}. The worst-case noise level of 70dBL_{Aeq} would occur only for one month of the works during the construction of the cofferdam. The ambient noise level is not expected to be exceeded over the duration of the works.

9.5.80 Given the degree of impact and the level of construction noise ingress to the cafe, this is assessed as **not significant**.

9.5.81 The adjacent café at 4-6 Putney High Street would also have access to Watermans Green. Given that this building has less of a view over the site than the café at 2 Putney High Street and lies further from the site, the impact at this property would be less than at 2 Putney High Street. Effects at this receptor are therefore also **not significant**.

Road-based construction traffic

9.5.82 The location of the site adjacent to Putney Bridge provides access via Lower Richmond Road to the major road network through London. The construction programme would result in varying traffic generation over a period of three years. Assuming that all traffic from Putney High Street uses Lower Richmond Road, the link adjacent to the site, to access the site, during the peak construction period the traffic generation on Lower Richmond Road is forecast to peak at an average 21 Heavy Goods Vehicles (HGV) (equivalent to 42 HGV movements) per day for a period of approximately one month.

9.5.83 Other major road links adjacent to and leading to the site are Putney Bridge, Putney Bridge Road, Putney High Street, Putney Hill, Upper Richmond Road, New Kings Road and Fulham High Street.

9.5.84 Vehicles would use Thames Place and Embankment to access the site adjacent to Putney Bridge and Glendarvon Road and Embankment to access the temporary slipway site. Other local roads would not be used.

9.5.85 A flow change of about 25% is required to cause a change in noise level of 1dB and by 100% to cause a change of 3dB, the latter which is considered to be the minimum change perceptible to the human ear. Alternatively, a change in HGV proportion in total traffic flow of 5% is also considered to cause a change in noise level of approximately 1dB.

9.5.86 The traffic modelling shows that the 18hr Annual Average Weekday Traffic (AAWT) flow on Embankment, the link which provides direct access to the site, is currently under 800 vehicles per day (vpd), with average speeds of 30 mph (48 kph) and 0.6 % HGVs. The total number of HGVs per day is therefore currently five.

9.5.87 Putney Bridge currently has the highest 18hr flow, with over 46,000 vpd and 7.3% HGVs. The 18hr AAWT flows on other major roads are varied, with the majority of flows ranging from approximately 14,000 to approximately 41,000vpd. The 18hr AAWT flow on Thames Place is much lower, with just above 1,000 vpd. The percentage of HGVs is also varied across the major links, with HGV percentages ranging from 4.3% to 12.2%. The HGV percentage on Thames Place is much lower at 2.8%.

9.5.88 The modelling of construction traffic on these links indicates that the highest percentage increase in total flow due to construction traffic would occur on Embankment. This assumes all construction traffic from Putney High Street uses Lower Richmond Road, and the Embankment to access the site. Using this assumption, the number of construction HGVs on Embankment during the peak month of construction is 21 (equivalent 42 movements). The current total flow on the link is just under 800 vpd. Therefore, the construction traffic results in a percentage increase in flow of just below 5%.

9.5.89 Using the assumption stated in para. 9.5.88 above, the modelling of the construction traffic on these links indicates that the highest increase in HGV proportion would occur on Embankment. The average daily number of construction HGV movements on this link during the peak month of construction is 42, which represents an increase in HGV proportion just below 5.0%.

9.5.90 Therefore, the percentage flow change and change in HGV percentage do not meet the criteria for causing a 1dB change in noise level. The additional numbers of HGVs would cause only negligible change to the traffic noise levels and the effects are assessed as **not significant**.

River-based construction traffic

9.5.91 The use of barges for the transport of materials to and from the site could result in noise impacts at nearby receptors.

9.5.92 The movement of barges would be at appropriate tidal states. In between times, and during standard working hours, the moored barges would be unloaded or loaded. The engine noise from movement of the barges on the river is limited to 75dB(A) at 25m (Port of London Authority)[5].

9.5.93 The use of tugs is planned during the construction period, operating twice a day with the tide. At peak periods, river movements would comprise two barges with one tug. Each movement (delivery and removal) would be 20 minutes, totalling 80 minutes over two periods in one day.

9.5.94 The operation, loading and removal of the river barges which takes place within the site boundary has been considered in the construction noise assessment above.

9.5.95 The operation of the tugs on the river outside of the site boundary have been assessed in relation to the nearest residential receptors including the houseboats at Putney Pier, Kenilworth Court and 10 Ruvigny Gardens.

9.5.96 The nearest residential receptors are the Houseboats on Putney Pier which are moored in the river. It is proposed that one of the houseboats would be relocated during the cofferdam construction phase. At the revised location, the tugs would operate at a minimum distance of 40m. At this distance the predicted day and evening (07.00 to 23.00) noise from this activity would be 55dBL_{Aeq} at the receptor (see Vol 7 Appendix G, Table G.9). The survey indicates the day/evening noise level at this location is 65dBL_{Aeq}, which is greater than the tug noise and therefore the noise from river based construction traffic is considered to be **not significant.**

9.5.97 At Kenilworth Court tugs would operate at a minimum distance of 80m. At this distance the predicted noise from this activity would be 49dBL_{Aeq} at the dwelling. The survey indicates the day/evening noise levels at this location is 67dBL_{Aeq} (see Vol 7 Appendix G, Table G.9), which is greater than the tug noise and therefore the noise from river based construction traffic is considered to be **not significant**.

9.5.98 At 10 Ruvigny Gardens tugs would operate at a minimum distance of 65m. At this distance the predicted noise from this activity would be 49dBL_{Aeq} at the dwelling. The survey indicates the day/evening (07.00 to 23.00) noise levels at this location is 65dB$L_{Aeq,}$ which is greater than the tug noise and therefore the noise from river based construction traffic is considered to be **not significant**.

Vibration

9.5.99 The assessment of construction vibration considers events which have the potential to cause human disturbance, or damage to buildings and structures. The assessments of human disturbance and effects on building structures are carried out separately using different parameters.

9.5.100 The assessment has been conducted using the methodology defined in Volume 2.

9.5.101 The assessment of human disturbance due to construction vibration impacts at neighbouring receptors has been assessed using the predicted estimated Vibration Dose Value (eVDV). The results from the assessment are presented in Vol 7 Table 9.5.3.

Vol 7 Table 9.5.3 Vibration – impact and magnitude of human response to vibration impacts

Ref	Receptor	Impact (highest predicted eVDV across all activities, $m/s^{1.75}$)*	Value/ sensitivity	Magnitude
PE1	Star & Garter, Mansions and public house staff accommodation	<0.3	High	Low probability of adverse comment - No impact
PE2	1-24 Kenilworth Court	<0.8	High	Adverse comment possible - Impact
PE3	31-78 Kenilworth Court	<0.8	High	Adverse comment possible - Impact
PE4	St Mary's Church	<0.3	Medium	Below Low probability of adverse comment - No impact
PE5	1-67 Putney Wharf Tower	<0.3	High	Low probability of adverse comment - No impact
PE6	Richmond Mansions	<0.8	High	Adverse comment possible - Impact
PE7	Ruvigny Mansions	<0.2	High	Below Low probability of adverse comment - No impact
PE8	Chas Newens Marine	<0.2	Medium	Below Low probability of adverse comment - No impact
PE9	10 Ruvigny Gardens	<0.2	High	Below Low probability of adverse comment - No impact
PE 10	Putney Pier Houseboats	<0.4**	High	Low probability of adverse comment - No Impact

Ref	Receptor	Impact (highest predicted eVDV across all activities, $m/s^{1.75}$)*	Value/ sensitivity	Magnitude
PE 11	Thai Square/ Star & Garter Public House	<2.0	Medium	Adverse comment probable - Impact
PE 12	Fulham High Street	<0.1	High	Below Low probability of adverse comment - No Impact
PE 13	Café at 2 Putney High Street	<0.8	Medium	Low probability of adverse comment - No Impact

**Most affected floor*
*** Predicted vibration levels assume groundborne transmission. For boats moored in the river it is expected that vibration transmission would be reduced and the vibration levels would be lower than those estimated.*

9.5.102 The predicted eVDV levels at Star & Garter Mansions and public house staff accommodation, St Marys Church, 1-67 Putney Wharf Tower, Ruvigny Mansions, Chas Newens Marine, 10 Ruvigny Gardens, Putney Pier Houseboats, Fulham High Street and Café 2 fall within or below the 'Low probability of adverse comment' band, as described in Volume 2 and therefore significant effects are not anticipated at these locations.

9.5.103 The predicted eVDV levels at 1-78 Kenilworth Court, Richmond Mansions and Thai Square/Star & Garter public house and fall within the 'Adverse comment possible' band, as described in Volume 2. These levels are associated with the cofferdam piling which would occur closest to these receptors. The impact is predicted to occur for less than 1 week, during the daytime only and therefore significant effects are not anticipated at these locations.

9.5.104 The assessment of potential construction vibration effects at adjacent buildings / structures has been assessed using the predicted Peak Particle Velocity (PPV), according to the criteria given in Volume 2. The results of the assessment of construction vibration are presented in Vol 7 Table 9.5.4.

Vol 7 Table 9.5.4 Vibration – building vibration impacts and their magnitudes

Ref	Receptor	Impact (highest predicted PPV across all activities, mm/s)	Value/ sensitivity	Magnitude

Ref	Receptor	Impact (highest predicted PPV across all activities, mm/s)	Value/ sensitivity	Magnitude
PE1	Star & Garter, Mansions and public house staff accommodation	<0.3	High	Below threshold of potential cosmetic damage - No impact
PE2	1-24 Kenilworth Court	<0.5	High	Below threshold of potential cosmetic damage - No impact
PE3	31-78 Kenilworth Court	<0.5	High	Below threshold of potential cosmetic damage - No impact
PE4	St Mary's Church	<1.0	Medium	Below threshold of potential cosmetic damage - No impact
PE5	1-67 Putney Wharf Tower	<0.3	High	Below threshold of potential cosmetic damage - No impact
PE6	Richmond Mansions	<0.5	High	Below threshold of potential cosmetic damage - No impact
PE7	Ruvigny Mansions	<0.3	High	Below threshold of potential cosmetic damage - No impact
PE8	Chas Newens Marine	<0.3	Medium	Below threshold of potential cosmetic damage - No impact

Ref	Receptor	Impact (highest predicted PPV across all activities, mm/s)	Value/ sensitivity	Magnitude
PE9	10 Ruvigny Gardens	<0.3	High	Below threshold of potential cosmetic damage - No impact
PE10	Putney Pier Houseboats	<1.0*	High	Below threshold of potential cosmetic damage - No impact
PE11	Thai Square/Star & Garter Public House	<1.5	Medium	Below threshold of potential cosmetic damage - No impact
PE12	Fulham High Street	<0.1	High	Below threshold of potential cosmetic damage - No impact
PE13	Café at 2 Putney High Street	<0.5	High	Below threshold of potential cosmetic damage - No impact

** Predicted vibration levels assume groundborne transmission. For boats moored in the river it is expected that vibration transmission would be reduced and the vibration levels would be lower than those estimated.*

9.5.105 The vibration levels reported here are well below the levels likely to cause cosmetic building damage according to the criteria described in Volume 2.

9.5.106 Vibration effects are **not significant** at any receptors.

Sensitivity test for programme delay

9.5.107 For the assessment of noise and vibration effects during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the assessment findings reported above for the existing and proposed receptors. Based on the development schedule (Vol 7 Appendix N), there would be no new receptors, within the assessment area, requiring assessment as a result of a one year delay.

9.6 Operational effects assessment

Impacts from potential noise and vibration sources

9.6.1 The following section describes the potential noise and vibration effects from various operational sources identified for assessment.

Noise from operational plant at above ground structures

9.6.2 The prediction method and assumptions are described in Volume 2. Vol 7 Table 9.6.1 shows, for each receptor, that the estimated plant noise level is below the local authority limit or is less than ambient levels for residential and non-residential receptors, respectively.

9.6.3 The appropriate emission limits are shown below in Vol 7 Table 9.6.1 based on local authority requirements to ensure that no adverse effects would occur. As there is no active ventilation plant for the drop shaft to generate noise at this site, these limits would only apply to any minor plant equipment. It is not planned to include any cooling fans for the kiosks but if detailed design showed this to be necessary, these small wall-mounted units would be controlled to meet the criteria in Vol 7 Table 9.6.1. However, it should be noted that any such small fans would be expected to have a relatively low noise emission (approximately 45dB(A) at 3m).

9.6.4 There would be a pump to maintain hydraulic pressure in the hydraulic pipe-work and rams for the penstocks, although the noise emission would be short and infrequent. It is expected that this would produce a whirring noise about once a week with a duration of 30 seconds to 2 minutes depending on the size of the penstock and hydraulic system. The plant would be operated for testing purposes once every three months. The power pack, pump and motor would be located within the kiosk and would be shielded with an acoustic surround if necessary to meet the requirements in Vol 7 Table 9.6.1.

9.6.5 Vol 7 Table 9.6.1 shows, for each receptor, that the estimated plant noise level is below the local authority limit or is less than ambient levels for residential and non-residential receptors respectively.

Vol 7 Table 9.6.1 Noise – operational airborne noise impacts

Ref	Receptor	Lowest baseline noise level	Impact	Value/ sensitivity	Magnitude
PE1	Star & Garter, Mansions and public house staff accommodation	$41dBL_{A90,}$ 15 minutes	Plant noise emission rating level at receptor less than $31dBL_{Ar,Tr}$	High	Plant noise level below local authority limit* – no adverse impact
PE2	1-24 Kenilworth	$44dBL_{A90,}$ 15 minutes	Plant noise emission	High	Plant noise level below

Ref	Receptor	Lowest baseline noise level	Impact	Value/ sensitivity	Magnitude
	Court		rating level at receptor less than $34dBL_{Ar,Tr}$		local authority limit* – no adverse impact
PE3	31-78 Kenilworth Court	$44dBL_{A90,\ 15\ minutes}$	Plant noise emission rating level at receptor less than $34dBL_{Ar,Tr}$	High	Plant noise level below local authority limit* – no adverse impact
PE4	St Mary's Church	$76dBL_{A90,\ 15\ minutes}$	Plant noise emission level at receptor less than $76dBL_{Aeq.}$	Medium	Plant noise level below ambient evening level – no adverse impact
PE5	1-67 Putney Wharf Tower	$49dBL_{A90,\ 15\ minutes}$	Plant noise emission rating level at receptor less than $39dBL_{Ar,Tr}$	High	Plant noise level below local authority limit* – no adverse impact
PE6	Richmond Mansions	$44dBL_{A90,\ 15\ minutes}$	Plant noise emission rating level at receptor less than $34dBL_{Ar,Tr}$	High	Plant noise level below local authority limit* – no adverse impact
PE7	Ruvigny Mansions	$41dBL_{A90,\ 15\ minutes}$	Plant noise emission rating level at receptor less than $31dBL_{Ar,Tr}$	High	Plant noise level below local authority limit* – no adverse impact
PE8	Chas Newens Marine	$59dBL_{Aeq}$	Plant noise emission level at receptor less than $59dBL_{Aeq.}$	Medium	Plant noise level below ambient daytime level – no adverse impact
PE9	10 Ruvigny Gardens	$41dBL_{A90,\ 15\ minutes}$	Plant noise emission rating level at	High	Plant noise level below limit* – no

Ref	Receptor	Lowest baseline noise level	Impact	Value/ sensitivity	Magnitude
			receptor less than $31dBL_{Ar,Tr}$		adverse impact
PE 10	Putney Pier Houseboats	$41dBL_{A90,}$ 15 minutes	Plant noise emission rating level at receptor less than $31dBL_{Ar,Tr}$	High	Plant noise level below limit* – no adverse impact
PE 11	Thai Square	$55dBL_{Aeq}$	Plant noise emission level at receptor less than $55dBL_{Aeq.}$	Medium	Plant noise level below ambient evening level – no adverse impact
PE 12	Fulham High Street	$49dBL_{A90,}$ 15 minutes	Plant noise emission rating level at receptor less than $44dBL_{Ar,Tr}$	High	Plant noise level below limit* – no adverse impact
PE 13	Café at 2 Putney High Street	$65dBL_{Aeq}$	Plant noise emission level at receptor less than $65dBL_{Aeq.}$	Medium	Plant noise level below ambient evening level – no adverse impact

** Limit referred to is that identified for the Local Authority in which the receptor is located (see paras 9.3.16 and 9.3.17)*

9.6.6 A passive system is to be installed at Putney Embankment Foreshore site and therefore there is no requirement to install active ventilation equipment at this location. The results given above in Vol 7 Table 9.6.1 show that there are no adverse impacts and the effects of plant noise at these emission levels is assessed as not significant. In the case of the residential receptors, this is based on compliance with the project requirement to prevent disturbance. For the non-residential receptors the noise levels are below ambient noise levels and therefore considered to be **not significant**.

Noise and vibration from tunnel filling

9.6.7 Measurements taken during storm and non-storm events at operational drop structures in the United States, equivalent to those being considered for the Thames Tideway Tunnel, have been used to inform the assessment of noise and vibration during tunnel filling events. These studies (Jain, SC and Kennedy, JF., 1983)[6]are described in Volume 2.

The highest noise level measured on a mesh grille directly over a similar drop shaft, during this study, was 61dBL_{Aeq} during a severe storm event. Noise levels from the drop shaft reaching the receptors around the Putney Embankment Foreshore site would be considerably attenuated by distance, and would not be perceptible relative to the background noise levels.

9.6.8 These events are not typical and would only occur during severe rain storms. At the Putney Embankment Foreshore site, the drop shaft would be enclosed and any noise at the surface would be attenuated by the structure or the below ground carbon filters At the surface the noise level would be approximately 46dB$L_{Aeq,}$ which is less than the prevailing ambient noise level at this site.

9.6.9 The highest peak particle velocity (PPV) measured directly at the existing drop shaft sites used in the case studies as described in Volume 2 was 0.034mm/s. These measured PPV values are well below the levels for vibration to be just perceptible, according to the criterion given in Volume 2. Similarly, the levels are well below the transient and continuous vibration guideline criterion for building damage.

9.6.10 The noise and vibration from tunnel filling events would occur only occasionally during heavy rainfall events and, in any case, is predicted to be not perceptible/ less than the ambient noise level at the receptors. Therefore this is assessed as **not significant**.

Operational maintenance

9.6.11 As part of the operation of the tunnel, there would need to be routine but infrequent maintenance carried out at the site. Two cranes would be required for ten yearly shaft inspections. This would be carried out during normal working hours, using equipment which is likely to increase ambient noise levels. Given the infrequency of this operation, it is considered that a significant noise effect would not occur.

9.6.12 Routine inspections, lasting approximately half a day, would occur every three to six months and would not require heavy plant. As this would be carried out during the daytime with minimal noisy equipment operating over short periods of time, it is considered that further assessment of noise generated by this activity is not required.

9.6.13 As no impacts have been identified from the operation of the site, this is assessed as **not significant**.

Noise from operational traffic

9.6.14 Additional traffic associated with operation of the site would be limited to vehicles used by maintenance and inspection workers. This is likely to be a number of light commercial vehicles used during routine inspection visits every three to six months and shaft inspections approximately every ten years.

9.6.15 As a proportion of the existing traffic on the road network these vehicles would not contribute to the traffic noise level and the noise effects of these movements are assessed as **not significant**.

Sensitivity test for programme delay

9.6.16 For the assessment of noise and vibration effects during operation, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the assessment findings reported above for the existing and proposed receptors as the operational effects of the Thames Tideway Tunnel are considered to be not significant. Based on the development schedule (Vol 7 Appendix N), there would be no new receptors, within the assessment area, requiring assessment as a result of a one year delay.

9.7 Cumulative effects assessment

Construction effects

9.7.1 The 45-53 Putney High Street and 329-339 Putney Bridge Road development has been considered in the cumulative assessment as it is assumed to be under construction at the same time as the Putney Embankment Foreshore site.

9.7.2 It is located over 150m to the southeast of the Putney Embankment Foreshore site, screened by intervening buildings. Given the distance and degree of screening, and relatively high ambient noise levels around the Putney Embankment Foreshore site, construction noise from the other developments is unlikely to cause cumulative effects.

9.7.3 In the event that the programme for the Thames Tideway Tunnel is delayed by approximately one year, more of the 45-53 Putney High Street and 329-339 Putney Bridge Road development may be built and occupied which would lead to a corresponding reduced level of cumulative activity. Cumulative effects would therefore be no greater than described above.

Operational effects

9.7.4 None of the projects described in Section 9.3, are considered relevant to the operational cumulative assessment at Putney Embankment Foreshore site as due to their use they are not expected to generate significant noise or vibration levels during their operation. As such, no cumulative operational noise or vibration effects are identified. This would also be the case if the programme for the Thames Tideway Tunnel project was delayed by approximately one year.

9.8 Mitigation and compensation

Construction

9.8.1 The above assessment has concluded that there would be significant adverse noise effects during the construction phase on Star and Garter Mansions and public house staff accommodation, 10 Ruvigny Gardens and the houseboats at Putney Pier. However, no further practicable noise mitigation can be adopted in addition to those measures identified in the *CoCP*.

9.8.2 The noise levels predicted at Star and Garter Mansions and public house staff accommodation and 10 Ruvigny Gardens are rated as significant using the extended ABC and qualitative method (as discussed in Section 9.5 and Volume 2) however the levels would not exceed the noise insulation thresholds given in the *Thames Tideway Tunnel noise insulation and temporary re-housing policy* (see Schedule 2 of the *Statement of Reasons*, which accompanies this application) and as such would not be eligible for noise insulation under this policy.

9.8.3 The residents at Star and Garter Mansions and public house staff accommodation and 10 Ruvigny Gardens may be eligible to apply for compensation through the *Thames Tideway Tunnel compensation programme* (see Schedule 2 of the *Statement of Reasons*, which accompanies this application) which has been established to address claims of exceptional hardship or disturbance. The measures set out in the programme are not considered to be mitigation as there is no guarantee that the property in question would be eligible for compensation or that the compensation would be accepted by the affected party. Therefore residual effects reported in the ES for this receptor do not take the offsetting effect of the compensation programme into account

9.8.4 Although the noise insulation eligibility thresholds are exceeded for the houseboats, the standard noise insulation measures available would not be effective or appropriate for houseboats. The residents may be eligible for temporary re-housing (under special cases provisions) through the *Thames Tideway Tunnel noise insulation and temporary re-housing policy* (see Schedule 2 of the *Statement of Reasons*, which accompanies this application).

Operation

9.8.5 The above assessment has concluded that there are not likely to be any significant adverse effects during the operational phase that would require mitigation.

Monitoring

9.8.6 Monitoring of construction noise would be carried out as described in the *CoCP*. It is not anticipated that there would be any need for monitoring of operational noise.

9.9 Residual effects assessment

Construction effects

9.9.1 As discussed at para. 9.8.2 the noise levels at Star and Garter Mansions and public house staff accommodation and 10 Ruvigny Gardens are rated as significant using the extended ABC and qualitative method (as discussed in Section 9.5 and Volume 2) but do not exceed the thresholds for noise insulation set out in the *Thames Tideway Tunnel noise insulation and temporary re-housing policy*. These properties may, however, be eligible to apply for compensation under the *Thames Tideway Tunnel project compensation programme*. For the purpose of the assessment the residual effects reported in the ES do not take the offsetting effects of the compensation programme into account and therefore construction noise effects would remain as presented in Section 9.5.

9.9.2 As discussed at para. 9.8.4 the noise levels at the Putney Pier Houseboats do exceed the thresholds for noise insulation provided by the *Thames Tideway Tunnel noise insulation and temporary re-housing policy* however the standard noise insulation measures available would not be effective or appropriate for houseboats. These properties may, however, be eligible for temporary re-housing under the *Thames Tideway Tunnel noise insulation and temporary re-housing policy.* It must be recognised, however, that the residents may not wish to take up the offer of temporary re-housing and thus the residual construction noise effects remains as presented in Section 9.5. The effects of temporary re-housing on the residents of the houseboats have been assessed in Vol 7 Section 10 Socio-economics.

Operational effects

9.9.3 As no mitigation measures are proposed, the residual operational effects remain as presented in Section 9.6.

9.10 Assessment summary

Vol 7 Table 9.10.1 Noise – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Surface construction noise				
PE1 - Star & Garter, Mansions and public house staff accommodation	Noise	Significant	No further on site mitigation practicable	Significant, however properties may be eligible for compensation (see para. 9.9.1)
PE2 - 1-24 Kenilworth Court	Noise	Not significant	None	Not significant
PE3 - 31-78 Kenilworth Court	Noise	Not significant	None	Not significant
PE4 - St Mary's Church	Noise	Not significant	None	Not significant
PE5 - 1-67 Putney Wharf Tower	Noise	Not significant	None	Not significant
PE6 - Richmond Mansions	Noise	Not significant	None	Not significant
PE7 - Ruvigny Mansions	Noise	Not significant	None	Not significant
PE8 - Chas Newens Marine	Noise	Not significant	None	Not significant
PE9 - 10 Ruvigny Gardens	Noise	Significant	No further on site mitigation practicable	Significant, however properties may be eligible for compensation (see para. 9.9.1)
PE10 – Putney Pier Houseboats	Noise	Significant	No further on site mitigation practicable	Significant, however properties may be eligible for temporary re-housing. The effects of temporary re-housing on the

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
				residents of the houseboats have been assessed in Vol 7 Section 10 Socio-economics. See para. 9.9.2)
PE11 - Thai Square / Star & Garter public house	Noise	Not significant	None	Not significant
PE12 - Fulham High Street	Noise	Not significant	None	Not significant
PE13 – Café at 2 Putney High Street	Noise	Not significant	None	Not significant
Road-based construction traffic				
Residential and non-residential properties adjacent to the proposed vehicle route	Noise	Not significant	None	Not significant
River-based construction traffic				
PE3 - 31-78 Kenilworth Court	Noise	Not significant	None	Not significant
PE9 - 10 Ruvigny Gardens	Noise	Not significant	None	Not significant
PE10 - Putney Pier Houseboats	Noise	Not significant	None	Not significant

Vol 7 Table 9.10.2 Vibration – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
PE1 - Star & Garter, Mansions and public house staff accommodation	Vibration	Not significant	None	Not significant
PE2 - 1-24 Kenilworth Court	Vibration	Not significant	None	Not significant
PE3 - 31-78 Kenilworth Court	Vibration	Not significant	None	Not significant
PE4 - St Mary's Church	Vibration	Not significant	None	Not significant
PE5 - 1-67 Putney Wharf Tower	Vibration	Not significant	None	Not significant
PE6 - Richmond Mansions	Vibration	Not significant	None	Not significant
PE7 - Ruvigny Mansions	Vibration	Not significant	None	Not significant
PE8 - Chas Newens Marine	Vibration	Not significant	None	Not significant
PE9 - 10 Ruvigny Gardens	Vibration	Not significant	None	Not significant
PE10 - Putney Pier Houseboats	Vibration	Not significant	None	Not significant
PE11 - Thai Square / Star & Garter public house	Vibration	Not significant	None	Not significant
PE12 - Fulham High Street	Vibration	Not significant	None	Not significant
PE13 – Café at 2 Putney High Street	Vibration	Not significant	None	Not significant

Vol 7 Table 9.10.3 Noise – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
PE1 - Star & Garter, Mansions and public house staff accommodation	Noise	Not significant	None	Not significant
PE2 - 1-24 Kenilworth Court	Noise	Not significant	None	Not significant
PE3 - 31-78 Kenilworth Court	Noise	Not significant	None	Not significant
PE4 - St Mary's Church	Noise	Not significant	None	Not significant
PE5 - 1-67 Putney Wharf Tower	Noise	Not significant	None	Not significant
PE6 - Richmond Mansions	Noise	Not significant	None	Not significant
PE7 - Ruvigny Mansions	Noise	Not significant	None	Not significant
PE8 - Chas Newens Marine	Noise	Not significant	None	Not significant
PE9 - 10 Ruvigny Gardens	Noise	Not significant	None	Not significant
PE10 - Putney Pier Houseboats	Noise	Not significant	None	Not significant
PE11 - Thai Square / Star & Garter public house	Noise	Not significant	None	Not significant
PE12 - Fulham High Street	Noise	Not significant	None	Not significant
PE13 – Café at 2 Putney High Street	Noise	Not significant	None	Not significant

Vol 7 Table 9.10.4 Vibration – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
PE1 - Star & Garter, Mansions and public house staff accommodation	Vibration	Not significant	None	Not significant
PE2 - 1-24 Kenilworth Court	Vibration	Not significant	None	Not significant
PE3 - 31-78 Kenilworth Court	Vibration	Not significant	None	Not significant
PE4 - St Mary's Church	Vibration	Not significant	None	Not significant
PE5 - 1-67 Putney Wharf Tower	Vibration	Not significant	None	Not significant
PE6 - Richmond Mansions	Vibration	Not significant	None	Not significant
PE7 - Ruvigny Mansions	Vibration	Not significant	None	Not significant
PE8 - Chas Newens Marine	Vibration	Not significant	None	Not significant
PE9 - 10 Ruvigny Gardens	Vibration	Not significant	None	Not significant
PE10 - Putney Pier Houseboats	Vibration	Not significant	None	Not significant
PE11 - Thai Square / Star & Garter public house	Vibration	Not significant	None	Not significant
PE12 - Fulham High Street	Vibration	Not significant	None	Not significant
PE13 – Café at 2 Putney High Street	Vibration	Not significant	None	Not significant

References

[1] Defra. *National Policy Statement for Waste Water* (2012) Available at: http://www.defra.gov.uk/publications/files/pb13709-waste-water-nps.pdf. Accessed November 2012

[2] British Standards Institution. BS 4142 *Method for rating industrial noise affecting mixed residential and industrial areas*. British Standards Institution (1997).

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

[4] British Standards Institution, BS 8233 Code of Practice for Sound insulation and noise reduction for buildings, British Standards Institution (1999)

[5] Port of London Authority. *Draft Thames Freight Operations Vessel Standards.*

[6] Jain, SC and Kennedy, JF. *Vortex-Flow Drop Structures for the Milwaukee Metropolitan Sewerage District Inline Storage System*. Iowa Institute of Hydraulic Research. IIHR Report No 264 (Jul 1983).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 10: Socio-economics

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

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Thames Tideway Tunnel

Environmental Statement

Volume 7: Putney Embankment Foreshore site assessment

Section 10: Socio-economics

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10 Socio-economics

10.1 Introduction

10.1.1 This section presents the findings of the assessment of the likely significant socio-economic effects of the proposed development at the Putney Embankment Foreshore site (both the main site and the secondary site). At this site effects during construction are considered on users of the Thames Path National Trail and Right of Way (Thames Path) and National Cycle Route 4, users of Waterman's Green, users of the River Thames and the public drawdock/slipway, users of St Mary's Church, and on nearby businesses and residents.

10.1.2 As set out in Vol 7 Section 9 Noise and vibration, the noise insulation eligibility thresholds would be exceeded for the houseboats at Putney Pier. However, the standard noise insulation measures available would not be effective or appropriate for houseboats. Accordingly, residents of the houseboats at Putney Pier may be eligible for temporary re-housing during certain periods of the construction phase. For this reason, this assessment considers the effect of temporary re-housing on those residents.

10.1.3 During the operational phase, effects are considered on users of the Thames Path and the associated future public amenity space that would be created as a result of the project.

10.1.4 The likely significant project-wide socio-economic effects, including employment generation, stimulation of industry, and leisure and recreation related effects on users of the River Thames are described in Volume 3 Project-wide effects assessment. This includes consideration of effects during the operational phase on users of the River Thames including rowing and sailing clubs situated in the Barn Elms / Putney Embankment area.

10.1.5 The assessment of socio-economics presented in this section has considered the requirements of the National Policy Statement for Waste Water Sections 4.8 (land use) and 4.15 (socio-economic) (Defra, 2012)[1]. Further details of these requirements can be found in Volume 2 Environmental assessment methodology Section 10.3.

10.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 7 Putney Embankment Foreshore Figures).

10.1.7 This assessment has drawn on the findings of the air quality and odour, noise and vibration and townscape and visual assessments (Sections 4, 9 and 11 respectively within this volume).

10.2 Proposed development relevant to socio-economics

10.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to socio-economics are set out below.

Construction

10.2.2 The existing public drawdock/slipway at the main site would not be accessible to users during the construction works. It would become accessible again during the operational phase. A temporary slipway would be constructed upstream (to the northwest) of the main site (at what is termed the secondary site), providing replacement access to the river during the construction period.

10.2.3 The construction of a cofferdam within the foreshore would result in the take up of space within the river.

10.2.4 The construction works site would temporarily surround Waterman's Green public open space on its northern side with high hoardings. During the construction of other works (as shown on the Site parameter plan (see separate volume of figures – Section 1) the construction working area would also take up the central section of the Waterman's Green, thereby preventing access to approximately one third of the open space.

10.2.5 A short section of the Thames Path National Trail and Right of Way in this location would be temporarily diverted for the duration of the construction period.

10.2.6 Works at the site are expected to last approximately three and a half years. See Section 3.3 for further details of the construction working hours.

10.2.7 Construction related activities, including traffic and lorry movements, could result in amenity effects (caused by air quality impacts, construction dust, noise, vibration, and visual impacts) being experienced by a range of sensitive socio-economic receptors in proximity to the proposed activities (refer to Volume 2 Environmental assessment methodology for further information on the amenity assessment methodology). xxx

Direct employment creation on site

10.2.8 Construction is expected to require a maximum workforce of approximately 50 workers at any one time. The number and type of workers is shown in Vol 7 Table 10.2.1.

Vol 7 Table 10.2.1 Socio-economics – construction worker numbers

Contractor		Client
Staff*	**Labour****	**Staff*****
08:00-18:00	**08:00-18:00**	**08:00-18:00**
20	20	10

** Staff Contractor – engineering and support staff to direct and project manage the engineering work and site.*
***Labour – those working on site doing engineering, construction and manual work.*
****Staff – contract staff brought in to project manage the engineering work and site.*

Code of Construction Practice

10.2.9 Measures applicable to all sites incorporated into the *Code of Construction Practice* (*CoCP) Part A* to limit significant air quality, construction dust (Section 7), noise, vibration (Section 6), and visual impacts (Section 4) could also reduce socio-economic effects, particularly amenity effects.

10.2.10 The *CoCP Part A* (Section 5) commits to the contractor carrying out the works in such a manner as to limit undue inconvenience to the public and other river users arising from increased barge movements, as far as is reasonably practicable. It also states that a *River Transport Management Plan* would be produced which would include assessment of risks to recreational river users and consider the potential for mitigation measures that can be employed.

10.2.11 The *CoCP Part A* also details that all land, including highways, footpaths, public open spaces, river embankments / waterways, loading facilities or other land occupied temporarily would be made good to the satisfaction of Thames Water[i] and the local authority where required. This would be in accordance with the *Ecology and landscape management pla*n and the approved landscape design for the site (see Section 4 within the *CoCP Part A*).

10.2.12 Clear signage for any diversions and advance notice of any closures / diversions of the Thames Path would be provided wherever possible (see Section 5 within the *CoCP Part B*).

10.2.13 Further site-specific measures, which could reduce socio-economic effects and particularly amenity effects, are incorporated into the *CoCP Part B* (Section 4)*. See* the *CoCP* sections in the noise and vibration, and townscape and visual assessments (Sections 9.2 and 11.2 respectively within this volume) for details on the type of measures that would be employed.

10.2.14 The *CoCP Part B* also makes provisions for the existing public drawdock/slipway to be maintained until the temporary slipway is operational. Where appropriate, signage and warning systems would be

[i] Thames Water Utilities Ltd (TWUL). The Draft Development Consent Order (DCO) contains an ability for TWUL to transfer powers to an Infrastructure Provider (as defined in article 2(1) of the DCO) and/or, with the consent of the Secretary of State, another body.

installed to direct rowers and other river users around structures within the foreshore (see Section 4 within the *CoCP Part B*).

10.2.15 The University Boat Race would not be restricted by the works. The construction site would not be removed but construction would be temporarily suspended. Any barges associated with the works would be removed for the Boat Race day (see Section 5 within the *CoCP Part B*).

Operation

10.2.16 The proposed above ground structures in the operational phase is described in Section 3 of this volume, and would result in the extension of the existing river wall out into the River Thames. These structures would be within the parameter areas shown on the Site parameter plan (see separate volume of figures - Section 1). This would create a small new area of public amenity space at the same level as the existing Thames Path, which would be available for passive recreational use by the public.

Environmental design measures

10.2.17 Measures which have been incorporated into the design of the proposed development (described in the design principles) include:

a. minimisation of the depth of the main kiosk so as to be as narrow in depth as possible (i.e. to minimise the extent to which it protrudes off the existing wall) to maximise space on Waterman's Green

b. a kiosk on the foreshore structure that would be finished in a way that enhances the public realm with the inclusion of public art, possibly incorporating historic interpretive information on the area and maritime events, procured in close collaboration with the local authority's Arts Team

c. the use of an edge treatment of the foreshore structure that would facilitate the mooring of vessels, except immediately in front of the new CSO outfall where mooring is prohibited

d. the situation of the foreshore structure in line with the starting point of the University Boat Race.

10.3 Assessment methodology

Engagement

10.3.1 Vol 2 of this assessment documents the overall engagement process which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of socio-economics are presented here (Vol 7 Table 10.3.1).

Vol 7 Table 10.3.1 Socio-economics – stakeholder engagement

Organisation	Comment	Response
Greater London Authority – Response to Thames	Wherever possible the Thames Path and National Cycle Route should be kept open in a safe and attractive	Consideration of the impact of the proposed development at the site on users of the Thames Path and NCR4 has

Organisation	Comment	Response
Tideway Tunnel project, January 2011	way. Where diversion routes are necessary, these should be high quality.	been considered within this socio-economic assessment as appropriate.
Environment Agency, April 2011	It is considered that the use of foreshore sites is likely to lead to a number of detrimental effects in relation to flood risk management, biodiversity and recreation.	Consideration of the impact of the proposed development at the site on recreational facilities has been considered within this socio-economic assessment as appropriate.
LB of Wandsworth, May 2011	The impact of the realigned slipway in relation to its use during construction and operation needs to be considered.	The impact on the public drawdock/slipway during construction has been considered in the assessment.
LB of Wandsworth, May 2011	Consideration needs to be given to the planning permission for A3 use adjacent to the proposed Putney site and what impact the works here may have on that use.	This planning permission is included in the base case and considered within this assessment.
Infrastructure Planning Commission (IPC) – Section 51 Advice, May 2011	Consideration could be given to the potential effect on amenity of users of the River Thames, due to disturbance caused by the project.	Consideration of the impact of the proposed development on users of the River Thames has been included within this assessment.

Baseline

10.3.2 The baseline methodology follows the methodology described in Vol 2 Section 10. There are no site-specific variations for identifying the baseline conditions for this site.

Construction

10.3.3 For this site, the base case is the peak year of construction works. The assessment area is as set out in Vol 2 Section 10.5.

10.3.4 The assessment methodology for the construction phase follows that described in Vol 2 Section 10. There are no site-specific variations for undertaking the construction assessment of this site.

10.3.5 Section 10.5 details the likely significant effects arising from the construction at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on socio-economics within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

10.3.6 Of the developments listed in the site development schedule (see Vol 7 Appendix N), there are three which have been considered in the construction assessment as a receptor (i.e. forming part of the construction base case):

a. No. 2 Putney High Street, located adjacent to the site, which would involve the use of a portion of Waterman's Green (within the limits of land to be acquired or used – LLAU) for outdoor seating in association with a café / restaurant business.

b. No. 4 – 6 Putney High Street, located adjacent to the site, which would provide additional café floorspace.

c. 45-53 Putney High Street & 329-339 Putney Bridge Road, located approximately 170m southeast of the site, which would include residential floorspace.

10.3.7 These developments would result in the addition of two potentially sensitive business receptors adjacent to the site and the addition of a residential receptor within 250m of the site.

10.3.8 Of the remaining developments listed in the site development schedule (see Vol 7 Appendix N), none would result in the addition of potentially sensitive receptors within the relevant assessment areas.

10.3.9 Of the developments listed in the site development schedule (see Vol 7 Appendix N), there are none which would be under construction during the assessment year for the socio-economic assessment. Therefore, there would not be any cumulative effects.

Construction assessment area

10.3.10 As described in Vol 2 Section 10 the assessment area for amenity effects considers receptors up to a maximum of 250m from the site boundary based on professional judgement of the likelihood of significant effects. The assessment primarily concentrates on those receptors closest to the site (both the main construction site and the temporary slipway site) which would generally be most affected, rather than those further away which could be well screened by intervening buildings. Effects at more distant receptors beyond those closest to the site have been considered where necessary by reference to the impacts determined at the primary receptors.

Operation

10.3.11 The base case is Year 1 of operation. The assessment area is as set out in Vol 2 Section 10.5.

10.3.12 The assessment methodology for the operational phase follows that described in Vol 2 Section 10. There are no site-specific variations for undertaking the operational assessment of this site.

10.3.13 Section 10.6 details the likely significant effects arising from the operation of the proposed development at Putney Embankment Foreshore. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on socio-economics within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

10.3.14 Of the developments listed in the site development schedule (see Vol 7 Appendix N), there are none which would introduce new receptors into the operational base case over and above the development at No. 2 Putney High Street as detailed in para. 10.3.6, or significantly alter circumstances for those receptors covered in the operational assessment, or give rise to cumulative effects.

Assumptions and limitations

10.3.15 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 10. The assumptions specific to this assessment of this site are presented below.

Assumptions

10.3.16 Residents of the houseboats at Putney Pier who would be eligible for temporary re-housing would be re-housed only during those periods when noise levels exceed the thresholds given in the *Thames Tideway Tunnel noise insulation and temporary re-housing policy* (see Schedule 2 of the *Statement of Reasons*, which accompanies this application). It has been assumed that they would return to their houseboats between the intervening period. The effect of temporary re-housing would therefore be classed as short term.

10.3.17 It has been assumed that houseboat residents who take up the option of temporary re-housing would be re-housed on-land in rented flats or serviced apartments.

10.3.18 It has been assumed that houseboat residents who take up the option of temporary re-housing would be re-housed within walking distance (considered to be a search area of approximately 1,600m) of their current location.

10.3.19 It has been assumed for the purposes of this assessment that reasonable costs and expenditure incurred in association with relocation would be met by Thames Water, including but not limited to removal expenses and the costs of securing new accommodation, in accordance with the Thames Tideway Tunnel compensation programme (included within Schedule 2 of the *Statement of Reasons, which accompanies this application*).

Limitations

10.3.20 There are no limitations specific to the assessment of this site.

10.4 Baseline conditions

Current baseline

10.4.1 The following section sets out the baseline conditions for socio-economics within and around the site. Future baseline conditions (base case) are also described.

Local context

10.4.2 The River Thames forms the northern boundary of the site. The immediate area (within 250m) surrounding the site to the south of the river contains a mix of terraced and medium rise residential developments. Commercial, retail and restaurant related uses are located to the immediate south and west of the site on Putney Embankment and Putney High Street. St Mary's Church is located to the east of the site (see Vol 7 Figure 2.1.2 in separate volume of figures). A number of rowing clubhouses and a boatyard are located to the northwest of the site along Putney Embankment. The wider area (within 1km) contains further residential development and public open spaces on both sides of the river, as well as Putney Town Centre to the south, containing retail, restaurant commercial and leisure uses.

Community profile

10.4.3 A detailed community profile is outlined in Vol 7 Appendix H.1[ii]. The following points provide a summary of the community profile and provide context for this socio-economic assessment:

a. The resident population was approximately 2,825 within 250m of the site and approximately 29,275 within 1km of the site at the time of the last census for which data is available[iii].

b. The proportion of younger residents (ie, under 16 year olds) within 250m (10.3%) and 1km (13.7%) is lower than the borough wide level and significantly lower than the Greater London average (20.2%). In contrast, the proportion of over 65 year olds within 250m and 1km (both 11.4%) is only slightly lower than the Greater London proportion (12.4%).

c. Residents from Black and Minority Ethnic (BME) groups make up only around 10% of all residents within 250m and 1km (9.4% and 10.3% respectively). This is less than half the proportion recorded for both LB of Wandsworth (22.1%) and Greater London (28.8%).

d. Within 250m, there are fewer residents suffering from a long term limiting illness than at a Greater London level (11.2% compared to 15.5%). The proportion of residents who claim disability living allowance within 250m (2.5%) and 1km (2.2%) is somewhat lower than within the LB of Wandsworth (3.9%) and Greater London (4.5%).

e. General health is good within 250m and 1km of the site, with low levels of adult obesity recorded relative to Greater London. However, child obesity rates are higher than Greater London levels. At a borough level, a higher proportion of adult residents undertake physical exercise than Greater London as a whole. However, children within the LB of Wandsworth rank in the lowest quintile of children who undertake physical exercise.

[ii] Information sources are provided in the appendix.

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

f. Death rates caused by various major illnesses within the local area are relatively low relative to rates in Greater London overall. Male and female life expectancy also compares well to the rest of Greater London.

g. There is no recorded incidence of income deprivation or overall deprivation within 250m and 1km of the site. The incidence of income deprivation and overall deprivation within Greater London is considerably higher (30.8% and 24.5% respectively).

10.4.4 The community profile suggests that the local community is made up of residents who are predominantly White, who generally experience good health and have high life expectancy and experience effectively no measureable deprivation.

Economic profile

10.4.5 An economic profile (based on 2012 data) is presented in Vol 7 Appendix H.2. The following points provide a summary of the profile and provide context for this socio-economic assessment:

a. Within 250m of the site there are approximately 4,600 jobs and 700 businesses[iv].

b. The three largest sectors as measured by employment within approximately 250m are: Wholesale Retail and Trade / Repair of Motor Vehicles and Motorcycles; Accommodation and Food Service Activities; and Professional, Scientific and Technical Activities.

c. The three largest sectors as measured by number of businesses at locations / units within approximately 250m are: Professional and Technical Activities; Wholesale Retail and Trade / Repair of Motor Vehicles and Motorcycles; and Information and Communication.

d. At all geographical levels, most businesses fall within the micro size band (one to nine employees). However, within 250m of the site, micro businesses are slightly lower in proportion, and small businesses (ten to 24 employees) slightly higher in proportion, compared to within both the LB of Wandsworth and Greater London as a whole.

e. Businesses within the micro size band also account for the majority within each of the leading sectors within 250m. Within the Accommodation and Food Service Activities sector, a sizable minority (35%) are small businesses.

[iv] Source: Experian 2012. Data is aggregated for seven digit post-code units falling wholly or partially within a 250m boundary of the LLAU, including post code units on the opposite side of the River Thames if relevant. Employee data reflect a head count of workers on-site rather than Full Time Equivalent (FTE) jobs. The count of businesses relates to business 'locations' or 'units'; an enterprise may have a number of business locations / units. Businesses as defined here include private sector, public sector and voluntary / charitable entities.

Receptors

Public open space – Waterman's Green

10.4.6 Waterman's Green public open space is located on a narrow strip of land between the public drawdock/slipway and Lower Richmond Road. It is approximately 0.05ha in size and is categorised as a pocket park according to the London Plan's Open Space hierarchy. Open spaces of this size typically serve a catchment area of "less than 400m" (GLA, 2011)[2].

10.4.7 Vol 7 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.8 Waterman's Green comprises a lawn with a number of mature trees planted in a line running the length of the strip. There is a single access gate. The space offers limited opportunity for active and passive recreation due to its size. The space is largely overshadowed on its southern boundary by a retaining wall particularly at its eastern end (above which is the pavement and Lower Richmond Road.

10.4.9 The open space was not surveyed as part of the *Wandsworth Open Space Study 2007*, however LB of Wandsworth described the space as "little used" in a 2004 report discussing the future use of the open space (LB of Wandsworth, 2004)[3].

10.4.10 The usage surveys (see Vol 7 Appendix H.3) found that the space was either not used or lightly used both on weekdays and weekends. It was used by one to two people on three occasions out of the 11 survey periods. Users recorded were White, young adults (18 to 39 years old) and were using the space for passive recreation.

10.4.11 The main factor affecting the sensitivity of the users of Waterman's Green to any impacts which could arise from the proposed development is the availability of alternative open spaces. Relevant considerations to this are:

a. There are some areas within 400m of the space that are identified within LB of Wandsworth's Core Strategy as being deficient in open space because they are outside of a 400m catchment area of a local park larger than 2ha (LB of Wandsworth, 2010)[4].

b. The deficiency of provision of such types of spaces in nearby areas suggests that users of the open space would be sensitive to losses of open space. However, the size of Waterman's Green is such that it is considered too small to help address existing deficiency (as per the recognised deficiency threshold set out in both the *LB of Wandsworth Core Strategy* and *London Plan 2011*[)].

c. The nearest open spaces of local park size to the site are Fulham Palace Gardens / Bishop's Park (across the river in LB of Hammersmith and Fulham), Wandsworth Park and Leader's Gardens (in LB of Wandsworth). These spaces are approximately 500m, 600m and 650m walk from the site, respectively.

d. The neighbouring Thames Path and River Thames function together as a form of open space in so far as they provide for a publicly accessible area with wide, unencumbered vistas and a sense of openness for the area. People are able to sit on benches nearby on the promenade which is located immediately to the west of Waterman's Green and which stretches for over 800m to where it crosses into Barn Elms. This means that there are additional opportunities for sitting and viewing the river in the local area.

10.4.12 On the basis of these factors, the sensitivity of users to the temporary loss or disturbance to this area of open space is considered to be low.

Users of the River Thames

10.4.13 The River Thames at this point is approximately 200 m wide. In this location it is used primarily for recreational uses, although commercial users are also present. Recreational users of the river include canoeists, rowers and sailors, both affiliated to clubs (many of which are based along Putney Embankment) and casual users. Commercial users include a commuter service operated by Thames Executive Charters and Livett's Launches, which both operate services from the nearby Putney Pier.

10.4.14 Leisure events are held throughout the year on the river to the west of Putney Bridge including the University Boat Race, Heads of the River race series (rowing events) and the Winter Points races (sailing event).

10.4.15 The University Boat Race, which starts from a position close to the nearby Putney Pier, draws large crowds annually each spring. These crowds stretch past the site to the west as people make their way to and from viewing points further upstream along the river (see Vol 7 Appendix H.3 for more details).

10.4.16 Boat surveys undertaken to the west of the site along Putney Embankment (close to the junction of Festing Road) in Autumn 2011 and observations made from along Putney Embankment and at the Barn Elms site and Putney Embankment Foreshore site during usage survey visits to Waterman's Green and Barn Elms, indicate that there are periods of time when this section of the river experiences frequent and regular use by both recreational users (particularly rowers) on weekdays and weekends.

10.4.17 Data from the river usage survey carried out in May 2012 (Thames Tideway Tunnel project, 2012)[5] recorded a peak daily usage of 43 river craft per day during the week and 216 river craft per day at the weekend passing by Putney Pier which falls in between the main and secondary sites. The predominant vessels which use the river at this point are coxed and un-coxed rowers and motor dinghies. The survey identified that, on average, the number of river craft passing the survey point per hour in this stretch of the River Thames is very low, however in any one hour usage can be particularly high (dependant on the tide and use of the river by rowing clubs).

10.4.18 The main factors affecting the sensitivity of the users of the river space to any impacts arising from the proposed development are as follows:

a. The River Thames is relatively wide at this location. Instead of using the area of the river adjacent to the proposed development site, recreational users may be able to use the central river channel to the north, approximately 80m away from the foreshore. Space within the central channel is more navigable and unlike the space adjacent to the site its use is not affected by low tides or constrained by the Putney Pier. The central channel is therefore assumed to be more heavily used than the area of river at the site. It is understood however, that less experienced river users and smaller river craft (such as canoeists) make use of the foreshore area frequently and may be less able to use the central river channel.

b. The usage survey identified that Putney Pier and the area of the River Thames adjacent to the site is a location many rowers coming downstream use as a turning point to return upstream.

c. Putney Pier presents a permanent obstacle within the southern part of the river channel so it is assumed that commercial users will tend to use the central channel of the river.

d. The University Boat Race and Heads of the River races start in the centre of the watercourse north of the site.

10.4.19 On the basis of the factors considered above, the sensitivity of users of the river to impacts which could arise from the proposed development is considered to be medium.

Public drawdock / slipway

10.4.20 The public drawdock / slipway at the site is used by both leisure users and commercial businesses. The slipway configuration allows vehicles a convenient and direct approach to the river, without encountering difficulties in turning or parking on Putney Embankment. Although public, the slipway is understood to be used primarily by three different users, one for leisure (yachting) and two for business purposes (cargo deliveries and collections and private hire boat launching and landing). The slipway is accessed at varying times during the week dependent on tidal conditions. At lower tide levels the water level drops and a rocky river bed of approximately 20m is exposed preventing users of the public drawdock/slipway from launching boats.

10.4.21 Vol 7 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.22 The main factor affecting the sensitivity of users of the slipway to access restrictions is the availability of other slipways:

a. The nearest alternative slipway, Putney Embankment public slipway, is located to the west of the site. It does not however offer users the same capabilities, in terms of being able to reverse and launch longer boats / vehicles into the river, as the slipway at the site.

b. There is no other slipway available within a distance which is conveniently accessible to the slipway's regular users, and which provides similar opportunity for vehicles to directly approach the river itself.

10.4.23 On the basis of the above factors the sensitivity of users of the public drawdock/slipway to loss of its use is considered to be high.

Thames Path

10.4.24 The Thames Path is a recreational asset and national trail. It follows the river for almost its entire length, and in west and central London it runs on both sides of the river. At this location, the Thames Path is level with the road as it crosses over Putney Bridge and Putney High Street. It then runs along Lower Richmond Road and Putney Embankment.

10.4.25 The path itself, particularly to the west of the site, is a well maintained pedestrian promenade with mature trees and regularly placed seating, including two bench seats within 100m of the main site. The path provides direct views across the river.

10.4.26 Pedestrian and cycle surveys undertaken as part of the Section 12 of this volume recorded a peak two-way flow of 80 to 90 pedestrian movements in each direction (ie, 160 to 180 movements in total) on the Thames Path, during the AM peak hour. The Thames Path is therefore assessed as being moderately used at this location.

10.4.27 Vol 7 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.28 Factors affecting the sensitivity of users of the Thames Path to access restrictions and potential amenity impacts are as follows:

a. Alternative routes including the pavement on the other side of the Putney Embankment roadway exist within just a few metres of the current route and offer a very similar level of amenity.

b. For amenity effects, the main factor affecting the sensitivity of users is the duration of time they are likely to be in the vicinity of the proposed construction site. At this location users are only likely to be near the site for the time that it takes them to walk past (likely to be a few minutes for most users). Therefore, the duration for which users would experience any amenity effects would be limited.

10.4.29 Taking the above factors into account, it is considered that users of the Thames Path in this location would have a low level of sensitivity to a loss of access to the path or a loss of amenity.

Public amenity space (future) associated with the Thames Path

10.4.30 As described in para. 10.2.16, an area of public amenity space would be created as part of the proposed development.

10.4.31 In terms of the value of this space and the consequent sensitivity of users, the availability of alternative similar spaces is a key factor to consider:

a. There are some opportunities for passive recreation in the immediate vicinity of the proposed new amenity space, both along the rest of the Thames Path and also public open space within Waterman's Green, which would be similar to those offered by any new amenity space. There are also opportunities further afield in Barn Elms and on the opposite bank of the River Thames within Fulham Palace Gardens.

b. It is noted that the LB of Wandsworth Core Strategy identified areas within 400m to the west of the site as deficient in open space because they are outside of a 400m catchment area of a local park of size greater than 2ha (LB of Wandsworth, 2010).

10.4.32 On the basis of the above factors it is considered that the sensitivity of users of the future riverside public amenity space to the creation of additional public amenity space is likely to be low.

National Cycle Route 4

10.4.33 The NCR4 runs from Greenwich, through London along the River Thames, and on to Wales via Reading, Bath and Bristol. At this location, the NCR4 cycle route is divided separately into two distinct west to east and east to west routes. The west to east route is a clearly marked cycle lane running on its own immediately between the Thames Path and the Embankment road carriageway. It forms a narrow strip that is distinguished from both the Thames Path and road by slightly raised differentiated paving. In an east to west direction, the route is located within the Putney Embankment road carriageway.

10.4.34 Pedestrian and cycle surveys undertaken as part of the transport assessment (see Section 12 of this volume) recorded a peak usage of 62 westbound and 52 eastbound movements (ie, 114 movements in total), during the AM peak hour. The surveys noted that cyclists show a preference for using this route over the more trafficked Lower Richmond Road [B306]. On the basis of this data, it is concluded that the NCR 4 is moderately used at this location.

10.4.35 Additionally, there are 10 cycle racks located on the pavement between the Embankment roadway and the river foreshore, approximately three metres to the west of the entrance from the Embankment onto the public drawdock/slipway.

10.4.36 Vol 7 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.37 Factors affecting the sensitivity of users of the National Cycle Route to amenity effects are as follows:

a. With regards to the availability of alternative routes, the most obvious route is within the Putney Embankment roadway. Although this route is not traffic free, it is not heavily trafficked and traffic speeds are moderated by the nature and width of the pavement. Users would not incur longer journey times or significant inconvenience, and would continue to enjoy unencumbered views of the river.

b. There are further streets a short distance back from the river (approximately 150m) that run parallel to the Lower Richmond Road which could serve as alternative routes.

c. At this location users are only likely to be near the site for the time that it takes them to cycle past (likely to be less than a minute for most users). Therefore, the duration for which users would experience any amenity effects would be limited.

10.4.38 On the basis of the above factors the sensitivity of NCR4 users to reduction of amenity due to construction activities is likely to be low.

Businesses – cafés / restaurants

10.4.39 Business activity in the area surrounding the site comprises commercial, retail and restaurant premises, including the shop-front units on Putney High Street and Lower Richmond Road, and businesses along Putney Embankment to the west of the construction site.

10.4.40 There is one business which, due to its proximity to the site, could be sensitive to potential construction phase effects. This is a branch of the Thai Square restaurant chain which is situated directly to the west of the proposed construction site. The two storey restaurant lies less than 10m away from the boundary across the junction of Lower Richmond Road and Putney Embankment. The restaurant has extensive glazing allowing for views of the river from its inside dining area and a two metre wide decked outdoor seating area that wraps around the building's edge. Based on the nature of the business and the size of the unit it occupies, it is estimated that the number of jobs which Thai Square directly provides is equivalent to a small (ten to 49 employees) size enterprise.

10.4.41 To the immediate west of Thai Square is a further business which could also be sensitive to potential construction phase effects. This is the Star and Garter public house which is situated approximately 30m to the west of the proposed construction site across the Putney Embankment. The pub has glazing allowing for views of the river and patrons would have views to the north east over the proposed construction site. Based on the nature of the business and the size of the unit it occupies, it is also estimated that the number of jobs which the Star and Garter provides is equivalent to a small size enterprise.

10.4.42 It should be noted that, as set out in para. 10.4.56a below, there is a consented planning application for a café / restaurant business (café at 2 Putney High Street) to use a portion of Waterman's Green. If the planning application is implemented this business would also be sensitive to potential effects arising during the construction phase, due to its proximity to the site.

10.4.43 Vol 7 Figure 10.4.1 (see separate volume of figures) shows the location of these receptors.

10.4.44 The sensitivity of the businesses to potential changes in amenity resulting from construction activities is likely to depend on the type of business in question:

a. Restaurants / cafés may be more sensitive to changes in amenity than other types of businesses such as retail / service outlets, especially if they have outdoor seating areas that are likely to contribute to their appeal to customers in milder months. However, it should be noted that Thai Square has the majority of its seating inside and such areas are more sheltered from noise, dust and other impacts that affect the external environment.

b. In terms of the sensitivity of the businesses' employees, the hotel, catering and leisure industry typically employs high rates of part time staff and has one of the highest UK labour turnover rates (People1st, 2011)[6].

10.4.45 On the basis of the factors considered above the sensitivity of nearby businesses to disruption from amenity effects is considered to be medium.

Place of worship – St Mary's Church

10.4.46 St Mary's Church, a local landmark, is situated within the churchyard beyond Putney High Street to the east of the site, mostly surrounded by stone walls.

10.4.47 The church comprises worship facilities, as well as a café and community meeting space. As well as services it holds several religious and community groups including a crèche (which runs weekly every Thursday morning), children's and adult's choirs and social groups (St Mary's Church information, 2012)[7].

10.4.48 Vol 7 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.49 The main factors affecting the sensitivity of the church to amenity impacts are as follows:

a. The church is used at varying times of the week, including regularly as a place of worship (eg, for Sunday services), as well as for other activities (administrative activities, group activities, etc), services and ceremonies at other times of the week.

b. Users of the church would have limited opportunities to relocate to avoid any amenity impacts, if they were to occur.

10.4.50 On the basis of these factors, it is considered that the sensitivity of the staff, congregation and other users of the church would be medium.

Residents

10.4.51 There are existing residential developments near the proposed construction site, as identified in the air quality and odour, noise and vibration and townscape and visual assessments.

10.4.52 Existing nearby residential development is shown in the land use plan for this site, see Vol 7 Figure 2.1.2 (separate volume of figures).

10.4.53 It is considered that the sensitivity of nearby residents to overall amenity effects would vary by time of day, with residents being somewhat less sensitive to amenity effects, particularly noise, during the day and more sensitive to such effects during the evening and night.

10.4.54 Therefore, as outlined in the methodology for this socio-economic impact assessment (see Vol 2 Section 10) the sensitivity of nearby residential receptors to amenity impacts would be medium during the day and high during the evening and night. In respect of temporary re-housing of houseboat residents (see para. 10.1.2) it is considered that the sensitivity of residents to such effects would be high.

Summary

10.4.55 A summary of receptors as described in the baseline and their sensitivity is provided in Vol 7 Table 10.4.1.

Vol 7 Table 10.4.1 Socio-economics – receptor values / sensitivities

Receptor	Value / sensitivity and justification
Users of public open space - Waterman's Green	Low – alternative, better opportunities for passive recreation are available at neighbouring locations; site is lightly used according to usage surveys and 2004 LB of Wandsworth audit.
Users of the River Thames	Medium – reflects the level of usage by rowing and sailing clubs of this section of the Thames and by commercial operators of Putney Pier; regular occurrence of events on this section of the Thames; and availability of alternative routes within river space to the north.
Users of the public drawdock/slipway	High – no conveniently accessible alternative facilities providing the same functionality are available to current users.
Public amenity space (future users)	Low – there are a number of nearby existing amenity spaces (including the Thames Path promenade) offering similar functionality to the proposed new amenity space.
Users of the Thames Path	Low – an alternative route is available for users within 5m of the path's current route, and users would be near the construction site for a short duration.
Users of cycle route NCR4	Low – an alternative route is available for users within the road and users would be near the site for a very short duration.
Businesses – cafés / restaurants	Medium – it is likely that the businesses currently derive advantage from the relatively pleasant location adjacent to the River Thames; but they are not unique and employees' skills would be relatively transferable.
Users of the place of worship - St Mary's Church	Medium – the church hosts a range of community based uses at various times of the week. Users are unlikely to be able to access an alternative church facility.
Residents	Medium / High – residents would have limited opportunity to avoid effects. They would have medium sensitivity to amenity effects overall during the day but would have high sensitivity to amenity effects overall during the evening and night. Residents would also have high sensitivity to temporary re-housing if it were to occur.

Construction base case

10.4.56 The construction assessment year and area are as set out in para. 10.3.3. The base case in the peak year of construction, taking into account the development described in para. 10.3.6, would differ to the baseline in the following ways:

a. If the consented planning application is implemented, two additional café business (2 Putney High Street and 4-6 Putney High Street) would open up on to and potentially use a portion of Waterman's Green as an outdoor seating area and the size of this open space would reduce accordingly as a result.

b. The businesses would be additional business receptors in terms of the assessment of effects during construction. In terms of employment generation, it is estimated that the businesses would each be equivalent to small (ten to 49 employees) size enterprises.

c. There would be an addition residential receptor within 250m of the site.

10.4.57 Other than the above, it is assumed that the base case socio-economic conditions at the site would remain the same as the existing baseline conditions.

Operational base case

10.4.58 The operational assessment year and area are as set out in para. 10.3.11.

10.4.59 As described in para. 10.3.14, there are no developments relevant to the operational assessment within the assessment area that would alter the base case.

10.5 Construction effects assessment

Temporary restrictions on use of open space – Waterman's Green

10.5.1 During phase 3 of the construction works the hoarding line would be extended to take in the central portion of Waterman's Green and access would be temporarily restricted, preventing public access to, and use of, approximately one third of Waterman's Green, thereby restricting opportunities for passive recreation within that portion of the open space.

10.5.2 The magnitude of the impact is influenced by several factors:

a. At approximately 16 months, the restriction on access would be significantly less than the overall construction period, but would continue to constitute a medium term impact.

b. Given the usage survey findings (see Vol 7 Appendix H.3), the number of users that would be impacted is likely to be very few at most.

c. The availability of approximately two-thirds of Waterman's Green (divided roughly evenly between the eastern and western ends) and other alternative spaces, for example seating areas along Putney

Embankment, means that users would still have access to opportunities for comparable passive recreation.

d. Public access would still be available to the western section of the green via the existing access and also to the eastern section of the green by opening up the stairs which currently lead to the disused public toilets.

10.5.3 Taking account of the above factors, the impact magnitude arising from the temporary loss of open space at the site would be low.

10.5.4 Given the low magnitude of the impact and the low sensitivity of open space users the effect on users of the open space would be **negligible.**

Temporary take up of space within the river

10.5.5 The construction works would result in the temporary reduction of river space in the foreshore at the site for the duration of the construction works. This would potentially limit opportunities for using this stretch of the river, as part of a longer route or course, for activities such as rowing and sailing or by commercial operators.

10.5.6 The magnitude of the impact is influenced by the following factors:

a. At approximately three and a half years, it would be a medium term impact with the temporary construction area removed at the end of the construction phase (however, the permanent foreshore structure would remain).

b. The area of river affected would be relatively small, being restricted to the work area within the foreshore. This area is not always navigable due to tidal conditions and the nearby Putney Pier also creates a partial physical obstacle to usage of this area.

c. As outlined in the *CoCP Part B* (Section 4), the University Boat Race would not be restricted by the works. The construction site would not be removed but construction would be temporarily suspended. Any barges associated with the works would be removed for the Boat Race day.

10.5.7 Taking account of the above factors, the impact magnitude arising from the temporary loss of river space at the site is assessed as low.

10.5.8 Given the low magnitude of the impact and the medium sensitivity of river space users the overall effect on users of the river space is considered to be **minor adverse.**

Temporary closure of public drawdock / slipway

10.5.9 The construction works would result in the temporary closure of the existing public drawdock / slipway at the site. As part of the project, a temporary slipway offering similar characteristics in terms of functionality and capacity would be provided a short distance upstream. The alternative slipway would be available for use for the full duration of the closure of the existing public drawdock.

10.5.10 The magnitude of the impact is influenced by the following factors:

a. The impact would be medium term and temporary.

b. The temporary slipway would provide the similar functionality for users to the existing public drawdock.

10.5.11 Taking account of the above factors, the impact magnitude arising from the temporary closure of the public drawdock / slipway at the site is assessed as negligible.

10.5.12 Given the negligible magnitude of the impact and the high sensitivity of users the overall effect on users of the public drawdock / slipway is considered to be **negligible.**

Temporary diversion of the Thames Path

10.5.13 The Thames Path would be temporarily diverted at this location.

10.5.14 The magnitude of the impact is influenced by the following factors:

a. The impact would medium term and temporary.

b. The diversion would affect a moderate number of users.

c. The proposed diversion would be very minor in extent and deviation from the existing route. It would run on the opposite side of the same road, and would be of approximately the same length. Given the intention within the *CoCP Part A* (Section 5) to install adequate signage, the diversion route should not be disorientating for users and users would not experience any appreciable delay or inconvenience.

10.5.15 Taking account of the above factors, the impact magnitude arising from the diversion of the Thames Path is assessed as negligible.

10.5.16 Given the negligible magnitude of the impact and the low sensitivity of users the effect of the diversion on users of the Thames Path would be **negligible**.

Effect on the amenity of Thames Path and NCR4 users

10.5.17 Assessments have been undertaken to examine the likelihood of significant air quality, construction dust, noise, vibration, and visual effects of the project arising during construction. For further information, refer to the respective construction effects sections within this volume (Section 4 air quality, Section 9 noise and vibration, and Section 11 Townscape and visual). The following points summarise the residual effect findings of those assessments in relation to the Thames Path and NCR4:

a. Local air quality effects would be **negligible**. Construction dust effects would be **minor adverse**.

b. The Thames Path and NCR4 were not identified as receptors within the noise and vibration (human response) impact assessments.

c. Visual effects would be **major adverse** at two of the five viewpoints (viewpoints 2.1 and 2.5) **moderate adverse** at one of the viewpoints (viewpoint 2.7) and **minor adverse** at the remaining two viewpoints (viewpoints 2.4 and 2.6).

10.5.18 In assessing the overall magnitude of impact, the above findings have been taken into consideration together with the following factors that are considered relevant to the receptor's overall experience of amenity at this site:

a. Given the three and a half year construction programme, the effects noted above would be likely to be experienced over a medium term period.

b. The moderate use of the Thames Path at this site means that any impacts would affect a moderate number of users.

c. Given that the Thames Path, in terms of its function as a recreational asset, is mostly used for walking, jogging and cycling, the time taken to pass by the site would be a relatively short period of time (eg, up to five minutes) for most users.

10.5.19 On the basis of the above findings and factors, it is considered that the magnitude of impact would be medium.

10.5.20 Taking account of the medium impact magnitude and low sensitivity, it is considered that the effect on the amenity of Thames Path and NCR4 users would be **minor adverse**.

Effect on the amenity of Waterman's Green users

10.5.21 Assessments have been undertaken to examine the likelihood of significant air quality, construction dust, noise, vibration, and visual effects of the project arising during construction. For further information, refer to the respective construction effects sections within this volume (Section 4, Section 9 and Section 11). The following points summarise the residual effect findings of those assessments on Waterman's Green:

a. Waterman's Green was not identified as a receptor within the local air quality and construction dust impact assessments. However, at a recreational assessment point on the Thames Path a short distance to the west of the park, it has been assessed that local air quality effects would be negligible and construction dust effects would be minor adverse.

b. Waterman's Green was not identified as a receptor within the noise and vibration (human response) impact assessments.

c. Waterman's Green was not identified as a receptor within the visual impact assessment. However, at a recreational viewpoint along the Thames Path a few metres to the west of the park, it has been assessed that visual effects would be major adverse (viewpoint 2.5).

10.5.22 In assessing the overall magnitude of impact, the above findings have been taken into consideration together with the following factors that are considered relevant to the receptor's overall experience of amenity at this site:

a. Given the three and a half year construction programme, the effects noted above would be likely to be experienced over a medium term period.

b. The very light (and often observed non-existent) use of the open space means that any impacts would affect a small number of users.

10.5.23 On the basis of the above findings and factors, it is considered that the magnitude of impact would be low.

10.5.24 Taking account of the low impact magnitude and the low sensitivity of the receptor, it is considered that the effect on the amenity of public open space users would be **negligible**.

Effect on businesses (cafés / restaurants) due to construction activity

10.5.25 If customers were deterred from dining at nearby restaurants and cafes, including Thai Square, the Star and Garter public house, and the base case café businesses at 2 Putney High Street and 4 – 6 Putney High Street, by amenity related impacts arising as a result of the project during construction, these businesses could in turn suffer a deterioration in trade. For this reason effects on environmental amenity, as they would be experienced by people visiting nearby businesses, are considered below.

10.5.26 Assessments have been undertaken to examine the likelihood of significant air quality, construction dust, noise and vibration effects of the project arising during construction. For further information refer to the respective construction effects sections within this volume (see Section 4, Section 9 and Section 11). The following points summarise the residual effect findings of those assessments on nearby businesses (specifically Thai Square / Star and Garter public house, the cafés at 2 Putney High Street and at 4-6 Putney High Street):

a. Local air quality effects and construction dust effects would be **minor adverse** at the three commercial (retail/restaurant) receptors identified (2 Putney High Street, at 4-6 Putney High Street, and at Thai Square).

b. Noise effects would be **not significant** at the two receptors identified (Thai Square / Star and Garter public house and 2 Putney High Street). Vibration (human response) would be **not significant**.

c. Viewpoints from within the nearby restaurants were not assessed however viewpoints were identified for assessment very close by to the restaurant receptors. For instance, adverse effects were identified at three nearby viewpoints along the Thames Path to both the north and the south (viewpoints 2.4, 2.5, and 2.7, which were recorded as **minor adverse**, **major adverse** and **moderate adverse** respectively). These indicate that views towards the construction site would be adversely affected, and at the closest points significantly so.

10.5.27 In assessing the overall magnitude of impact, the above findings have been taken into consideration together with the following factors that are considered relevant to the overall experience of amenity:

a. Given the three and a half year construction programme, the effects noted above would be likely to be experienced over a medium term period. The local air quality effects may not be minor adverse over the whole construction period as the assessment is based on the peak construction year and these effects may be negligible in other years.

b. The visual effects outlined above are recreational viewpoints, however these are still likely to be representative of the type of effects which may be experienced at the businesses. It is considered that there is a risk that significant visual effects could deter people from choosing to dine at the nearby businesses. This could occur even in the absence of any other significant amenity related effects such as construction dust or noise because of customers' perceptions of the severity of the potential decline in amenity. In such circumstances, this could lead to deterioration in trading conditions for the businesses.

c. It is likely that the riverside location is important in attracting customers, particularly during the lighter summer months when views can be enjoyed into the evening. As a result, the visual impacts could significantly impair the businesses' ability to attract and retain customers during the construction period.

d. Although restaurant diners may not know about the works in advance, it is possible that customer visits and bookings, particularly those generated by repeat and word of mouth business, could suffer during the works and for a period of time after the construction work has been completed and the effects have subsided.

10.5.28 It is considered possible that the businesses could experience a fall in patronage during construction due to perceived and actual drop in amenity and in particular due to adverse visual effects.

10.5.29 It is therefore considered that the magnitude of impact on the businesses from a potential downturn in trade due to construction activities on the site could be high.

10.5.30 Given a high magnitude of impact and the medium sensitivity of the businesses, the effect on the café / bar / restaurant businesses would be likely to be **major adverse**.

10.5.31 This assessment relates primarily to those café / restaurant receptors that would experience adverse local air quality, construction dust and visual effects and which are likely to depend on views of the river to attract and retain customers. For business receptors not subject to these effects and/or which would not critically depend on views of the river to attract and retain customers, it is considered that there would be a lower, and possibly negligible, effect on their business. The commitment within the *CoCP* to work with business owner(s) to develop a high quality site hoarding and to consider the use of transparent hoardings (if agreed by relevant stakeholders) may also help to reduce the effect for businesses.

10.5.32 To the west of the businesses considered above lie other businesses on Putney Embankment, including the Duke's Head and the Constitution Club. The Constitution Club and the Duke's Head were assessed with regard to air quality and construction dust effects, and potential effects were identified as being minor adverse. However these were not identified as receptors for the noise, vibration or visual effects assessments. These businesses are closer to and more able to overlook the secondary site of the temporary slipway rather than the main site. As such, they would not be exposed to the same visual impacts as Thai Square and the cafés at 2 and 4 - 6 Putney High Street and the duration of works would be considerably lower at this site than at the main site. These factors, as well as the additional distance from the main construction site, would mean the effects experienced at these businesses would be well below that which could be experienced at Thai Square and at the cafés at 2 and 4–6 Putney High Street. As such, the effect at this business is judged to be minor adverse.

Effect on the amenity of St Mary's Church and its users

10.5.33 Assessments have been undertaken to examine the likelihood of significant air quality, noise and vibration, and visual effects of the project arising during construction. For further information, refer to the respective construction effects sections within this volume (see Section 4, Section 9 and Section 11). The following points summarise the residual effect findings of those assessments in relation to St Mary's Church:

a. Local air quality effects and construction dust effects would be **minor adverse**.

b. Noise effects and vibration effects would be **not significant**.

c. Visual effects are would be **minor adverse** from viewpoint 2.4 outside of St Mary's Church.

10.5.34 In assessing the overall magnitude of impact, the above findings have been taken into consideration together with the following factors that are relevant to the receptor's overall experience of amenity at this site:

a. Given the three and a half year construction programme, the effects noted above would be likely to be experienced over a medium term period. The exception is that local air quality effects may not be minor adverse over the whole construction period as the assessment is based on the peak construction year and these effects may be negligible in other years.

b. Given the proposed working hours at the site (see Section 3.3 of this volume), weekday users of the church could be potentially exposed to amenity impacts arising during workings hours; however evening, Saturday afternoon and Sunday users of the church would typically not be exposed, except during occasional periods of continuous working. The minor adverse visual effect would not impact on people within the church and so this assessment considers that visual impacts would be unlikely to affect users of the church at most times. It is also not considered likely that visual impacts would act as a substantial deterrent to people visiting the church, even though they may have to pass the construction site on their way to the church.

10.5.35 Taking account of the above findings and factors, it is considered that the magnitude of impact on users of St Mary's Church would be low.

10.5.36 Given the low impact magnitude and the medium sensitivity, it is considered that the overall effect on the amenity of St Mary's Church users would be **minor adverse**.

Effect on the amenity of residents

10.5.37 Assessments have been undertaken to examine the likelihood of significant air quality, construction dust, noise, vibration, and visual effects of the project arising during construction. For further information, refer to the respective construction effects sections within this volume (see Section 4, Section 9 and Section 11). The following points summarise the residual effect findings of those assessments in relation to nearby residential receptors:

a. Local air quality effects would be **minor adverse** at two receptors and **negligible** at the remaining six receptors identified. Construction dust effects would be **minor adverse** at four receptors and **negligible** at the remaining four receptors identified.

b. Noise effects on residents would be **significant** at three of the nine receptors identified (Star and Garter Mansions and public house staff accommodation; 10 Ruvigny Gardens, and the Putney Pier Houseboats). This finding reflects the fact that construction noise levels would exceed the potential significance criteria for a residential receptor during the day at Star and Garter Mansions for two months; at 10 Ruvigny Gardens for two months; and at the Houseboats for 15 months. No exceedances at residential receptors during the evening or night are estimated. In regard to road-based and river-based construction traffic, the noise assessment found that the additional numbers of HGVs and barge movements would cause negligible change to the traffic and river noise levels and the effects have been assessed as **not significant** at residential receptors. Vibration (human response) effects would be **not significant** at each of the nine receptors.

c. Visual effects would be **major adverse** at one viewpoint on the same side of the river, within 250m of the site (viewpoint 1.2 from residences in Kenilworth Court, fronting on to Lower Richmond Road).

10.5.38 In assessing the overall magnitude of impact, the above findings have been taken into consideration together with the following factors that are considered relevant to the receptor's overall experience of amenity at this site:

a. Given the three and a half year construction programme, the effects noted above would be likely to be experienced over a medium term period. The exceptions are:

   i Local air quality effects may not be minor adverse over the whole construction period as the assessment is based on the peak construction year and these effects may be negligible in other years.

   ii For noise, the significant adverse assessment result is based on an estimated noise exceedence lasting for two months at two receptors, and for 15 months at the other receptor, meaning the effects would be short term at two receptors and medium term at the other.

b. While it is estimated that there would be a major adverse visual effect on Kenilworth Court, it is considered that views from a residential property form one of many elements that contribute to the quality of a residential environment. Many of the dwellings at the receptors represented by this viewpoint are also likely to have views in other directions that are either not as severely affected or not affected at all. Furthermore, there are a limited number of dwellings which directly overlook the site and which would be subject to the major adverse visual impacts.

c. The noise and vibration residual effect assessment findings concluded that there would not be significant effects during the night at any of the residential receptors.

10.5.39 Taking account of the above findings and factors, it is considered that the magnitude of impact would be medium.

10.5.40 Given the medium impact magnitude and medium sensitivity during the day, it is considered that the effect on the amenity of a limited number of residential receptors closest to the site would be **moderate adverse**.

10.5.41 This assessment relates primarily to those residential receptors that would experience adverse air quality, construction dust, noise and visual effects. For residential receptors not subject to these effects, it is considered that there would be a negligible effect on their amenity. These findings also present a peak year scenario. At times when the above noted effects are not occurring, the effect significance would be likely to be lower.

Effect on residents who take up the option of temporary re-housing

10.5.42 The magnitude of the impact is influenced by several factors (see Section 10.3 for assumptions relating to this assessment):

a. There are two houseboats and correspondingly, it is estimated that there are two households.

b. It is possible that some residents who would be relocated would work from home and so the temporary re-housing would also affect them in terms of the place of work as well as their place of residence.

c. The duration of time when residents of the houseboats may be eligible for temporary re-housing is estimated to be a total of approximately two months during the construction and removal of the cofferdam. These two periods are not continuous. The assessment is based on temporary re-housing for the two periods only, with residents relocating back to the houseboats in the intervening period.

d. Although costs and expenditure associated with temporary re-housing would be met, the effect on residents of relocating twice is likely to be disruptive, however, the relatively short duration of each relocation is likely to limit the severity of the temporary dislocation.

10.5.43 On the basis of the above, it is considered that the magnitude of impact would be high.

10.5.44 Given the high magnitude of impact and the high sensitivity of residents (two households) to temporary re-housing, the effect on those residents who take up the option of temporary re-housing during part of the construction period would be **major adverse**.

10.5.45 For those residents who take up temporary re-housing, during the period when they reside in temporary accommodation they would not experience the major adverse effect on their residential amenity noted in para. 10.5.40.

10.6 Operational effects assessment

Permanent gain of public amenity space

10.6.1 The creation of a permanent foreshore structure would result in the provision of an area of pleasantly landscaped and functional public amenity space measuring approximately 592m^2 in size.

10.6.2 The magnitude of the impact is influenced by the following factors:

a. The new amenity space would offer a small area of functional, pleasantly landscaped space ideally suited to passive recreation, along this section of the Thames Path. It would serve as an additional space for observing river events and help mark the starting line for the boat race, a landmark nationally significant event held adjacent to the site.

b. The new amenity space would also be in an area of recognised deficiency with respect to public open space (although it would not be sufficiently large to formally constitute public open space, as defined by LB of Wandsworth and the *London Plan 2011* for the purpose of identifying deficiency areas).

c. The impact would be long term and permanent.

d. Given the moderate numbers of people that use this section of the Thames Path at most times of day, the new space is likely to benefit a number of users, including local residents and workers.

10.6.3 Taking account of the above factors it is considered that the impact magnitude would be medium.

10.6.4 Given the medium impact magnitude and the low sensitivity of users it is considered that the new public amenity space would have a **minor beneficial** effect.

10.7 Cumulative effects assessment

Construction effects

10.7.1 As described in Section 10.3, no developments would be under construction at the same time as the Thames Tideway Tunnel project at this site. Therefore, there would no cumulative effects requiring consideration and the effects on socio-economics would remain as described in Section 10.5.

Operational effects

10.7.2 As described in Section 10.3, there are no developments that would have the same type of effect as that considered in Section 10.6. Therefore, there would be no cumulative effects requiring consideration and the effects on socio-economics would remain as described in Section 10.6.

10.8 Mitigation and compensation

Mitigation

Construction effects

10.8.1 The above assessment has concluded that there is a potential for major adverse effects to arise in relation to amenity impacts on nearby residents and café / restaurant businesses.

10.8.2 The assessment relating to amenity effects is based on the residual findings of the air quality, construction dust, noise, vibration and visual effect assessments. Where practicable and applicable, embedded measures have been included and no further practicable measures or mitigation could be adopted above those methods identified in the *CoCP Part A*.

10.8.3 In relation to the temporary re-location of the houseboat residents, this measure has been identified as a means to offset significant adverse noise effects (identified in Vol 7 Section 9.5) however the consequence of the relocation process is to give rise to a significant adverse socio-economic effect from the physical relocation. There are no further practicable mitigation measures that can be adopted.

Operational effects

10.8.4 The above assessment has concluded that operational effects would be beneficial and therefore mitigation is not needed.

Compensation

Construction effects

10.8.5 A compensation programme has been established (see Schedule 2 of the *Statement of Reasons*, which accompanies the application) relating to construction disturbance - for example, noise, dust, vibration, and / or light disturbance from worksites at night. The programme has been established to address claims of exceptional hardship or disturbance.

10.8.6 In relation to the effects on businesses (cafés / restaurants) due to construction activity (see para. 10.5.25 to para. 10.5.31), the businesses would be entitled to submit a claim for compensation in accordance with the *Thames Tideway Tunnel compensation programme*. The programme measures are considered to be mitigation. Therefore the residual effects reported in this *Environmental Statement* take the offsetting effects of these measures into account. Further information is contained in the Thames Tideway Tunnel Compensation Programme (see Schedule 2 of the *Statement of Reasons*, which accompanies this application).

10.8.7 In relation to the effects on residential amenity, the *Thames Tideway Tunnel compensation programme* measures are not considered to be mitigation as there is no guarantee that the properties in question would be eligible for compensation or that the compensation would be accepted by the affected party. The residual effects reported in this *Environmental Statement* do not therefore take the offsetting effects of these measures into account. Further information is contained in the Thames Tideway

Tunnel Compensation Programme (see Schedule 2 of the *Statement of Reasons*, which accompanies this application).

10.9 Residual effects assessment

Construction effects

10.9.1 In relation to those businesses (café / restaurants) that may experience significantly adverse effects, as compensation is considered to mitigate (ie, reduce) the significant adverse effect, the effect due to construction activity would be rated as **minor adverse**.

10.9.2 As discussed in para. 10.8.7, the residual effects reported in this *Environmental Statement* do not take the offsetting effects of compensation into account as there is no guarantee that the properties in question would be eligible for compensation or that the compensation would be accepted by the affected party. As a result of residual amenity effects would remain as described in Section 10.5.

10.9.3 In relation to the residents of the houseboats, as there are no further practicable mitigation measures that can be adopted residual effects would remain as described in Section 10.5.

10.9.4 All residual effects are presented in Section 10.10.

Operational effects

10.9.5 As no mitigation measures are proposed, the residual operational effects remain as described in Section 10.6.

10.9.6 All residual effects are presented in Section 10.10.

10.10 Assessment summary

Vol 7 Table 10.10.1 Socio-economics – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect	Comments
Users of public open space - Waterman's Green	Temporary loss of use of open space – Waterman's Green	Negligible	None	Negligible	
Users of the river space	Temporary loss of space within the river	Minor adverse	None	Minor adverse	
Users of the s public drawdock / slipway	Temporary closure of a public drawdock / slipway	Negligible	None	Negligible	
Users of the Thames Path	Temporary diversion of the Thames Path	Negligible	None	Negligible	
Users of the Thames Path and NCR4	Effect on the amenity of Thames Path and NCR4 users	Minor adverse	None	Minor adverse	
Users of public open space - Waterman's Green	Effect on the amenity of Waterman's Green users	Negligible	None	Negligible	
Businesses	Effect on businesses (cafés / restaurants) due to construction activity	Major adverse	No further on site mitigation practicable*	Minor adverse	Compensation measures available for amenity related disturbance during the construction phase
Users of St Mary's Church	Effect on the amenity of St Mary's Church and its	Minor adverse	None	Minor adverse	

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect	Comments
	users				
Residents	Effect on the amenity of residential receptors (see para. 10.5.40 to para. 10.5.41 for detail)	Moderate adverse	No further on site mitigation practicable	Moderate adverse	Compensation mechanisms available for amenity related disturbance during the construction phase
Residents (of the houseboats who may be eligible for temporary re-housing)	Effect on residents who may be eligible for and take up the option of temporary re-housing	Major adverse	No further on site mitigation practicable	Major adverse	Reasonable costs and expenditure associated with temporary re-housing would be met.

** In this assessment, compensation has been considered as mitigation for businesses but not for households (see section 10.8 and Vol 2 Section 3.2.10)*

Vol 7 Table 10.10.2 Socio-economics – summary of operation assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Public amenity space (associated with Thames Path)	Permanent gain of public amenity space	Minor beneficial	None	Minor beneficial

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 11: Townscape and visual

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

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Thames Tideway Tunnel

Environmental Statement

Volume 7: Putney Embankment Foreshore site assessment

Section 11: Townscape and visual

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11 Townscape and visual

11.1 Introduction

11.1.1 This section presents the findings of the assessment of the likely significant effects of the proposed development on townscape and visual amenity at the Putney Embankment Foreshore site. The assessment considers effects arising from both the Putney Embankment Foreshore main site and secondary site. The assessment describes the current conditions found within and around the site – the nature and pattern of buildings, streets, open space and vegetation and their interrelationships within the built environment – and the changes that would be introduced as a result of the proposed development during construction and operation.

11.1.2 The effects of these changes during construction and operation are assessed. The assessment includes effects on townscape character areas, and visual effects during daytime for the peak construction year, and Year 1 and Year 15 of operation. The assessment also identifies mitigation measures where appropriate.

11.1.3 Effects arising from lighting during the construction and operational phases have not been assessed. This is on the basis that there would not be any significant effects (this is further explained in para. 11.3.11 for construction and para. 11.3.20 for operation).

11.1.4 Each section of the assessment is structured so that townscape aspects are described first, followed by visual.

11.1.5 The assessment of the likely significant townscape and visual effects of the project has considered the requirements of the National Policy Statement (NPS) for Waste Water (Defra, 2012)[1]. In line with these requirements, the townscape and visual assessment considers effects during construction and operation on townscape components, townscape character and visual receptors. The construction and design of the proposed development also takes account of townscape and visual considerations in line with the NPS recommendations. Vol 2 Section 11 provides further details on the methodology.

11.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 7 Putney Embankment Foreshore Figures).

11.1.7 A separate but related assessment of effects on the setting of heritage assets is included in Section 7 of this volume.

11.2 Proposed development relevant to townscape and visual

11.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to the townscape and visual assessment are set out below.

Construction

11.2.2 The specific construction works which may give rise to effects on townscape character and visual receptors are listed as follows, with the activities likely to give rise to the most substantial townscape and visual effects described first:

a. construction of a temporary cofferdam using a piling rig, and an optional cofferdam at the secondary site

b. use of cranes during shaft sinking and secondary lining of the Putney Bridge connection tunnel

c. provision of welfare facilities, assumed to be a maximum of three storeys in height

d. installation of 2.4m high hoardings around the boundary of the construction site

e. construction of a temporary slipway.

Code of Construction Practice

11.2.3 Measures incorporated into the *Code of Construction Practice* (*CoCP*)[i] *Part A* to reduce townscape and visual impacts include:

a. protection of existing trees in accordance with *BS5837 'Trees in Relation to Construction – Recommendations'* (Section 10)

b. protection of listed structures (Section 12)

c. the installation of well-designed visually attractive hoardings (Section 4)

d. the use of appropriate capped and directional lighting when required (Section 4).

11.2.4 Measures incorporated into the *CoCP Part B* (Section 4) to reduce townscape and visual impacts include:

a. provision for incorporating suitable art work and viewing windows on public facing sections of the hoarding

b. working with the café businesses in the vaults along Waterman's Green to develop acceptable high quality hoarding proposals

c. protection of the public drawdock/slipway during construction

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[i] The *Code of Construction Practice (CoCP)* is provided in Vol 1 Appendix A. It contains general requirements (*Part A*), and site specific requirements for this site (*Part B*).

d. removal, storage and reinstatement of localised areas of cobbles

e. protection of the University Boat Race starting stone

f. removal, protection and reinstatement of the listed bollards.

Operation

11.2.5 The particular components of importance to this topic include the:

a. design and materials used for the interception chamber underneath Putney Bridge

b. design and materials used for the river wall

c. design, siting and materials used for the ventilation columns and electrical and control kiosks, and the zones within which these above ground structures may be located

d. reinstatement of the existing public drawdock/slipway close to Putney Bridge and reinstatement in the area of the temporary slipway when it is removed at the end of construction

e. design, layout and materials used in the public realm including the choice of railings and lighting (shown on the Site parameter plan, separate volume of figures – Section 1).

Environmental design measures

11.2.6 Figures illustrating the proposed development during operation are contained in a separate volume of figures (Volume 7 Putney Embankment Foreshore Figures). Where photomontages have been prepared to assist the assessment of effects, these are referenced in the appropriate viewpoint in Section 11.6.

11.2.7 Measures which have been incorporated into the design of the proposed development include (see *Design Principles* report in Vol 1 Appendix B):

a. the interception chamber would remain below the ‘springing point’ on Putney Bridge and set back from the main bridge elevations as far as possible to minimise adverse effects on the character of the bridge

b. use of a high quality concrete finish to the interception chamber to complement the natural stone of Putney Bridge (PWH1X.2)

c. integrating the main electrical and control kiosk onto Waterman’s Green by cladding the structure in materials that match the surrounding bridge abutment wall and making the structure as narrow as possible

d. use of high quality materials for the kiosk on the foreshore structure with inclusion of public art and/or historic interpretive information

e. a commitment to a high quality design for the ventilation columns

f. the interception ventilation column would be in keeping with the character of the surrounding street furniture

g. the layout of the permanent works would minimise the visual and physical effects on/alterations to the existing public drawdock/slipway

h. use of high quality natural stone finish with vertical timber fenders for the river wall.

11.3 Assessment methodology

Engagement

11.3.1 Volume 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of townscape and visual effects are presented here.

11.3.2 Following the scoping process, the London Borough (LB) of Wandsworth, LB of Richmond upon Thames (located upstream from the site), LB of Hammersmith & Fulham (located on the opposite side of the river) and English Heritage have been consulted on the detailed approach to the townscape and visual impact assessment, including the number and location of viewpoints. The LB of Wandsworth (March 2011) requested an additional viewpoint from Lower Richmond Road and an additional verifiable photomontage from the Grade II* listed St Mary's Church. Both of these have been included in the visual assessment. English Heritage (May 2011) have confirmed acceptance of the proposed viewpoints. The LB of Richmond upon Thames and LB of Hammersmith & Fulham have not commented on the proposed viewpoints.

11.3.3 In March 2011 English Heritage and the Environment Agency were consulted on the scope of the townscape and visual and ecology assessments through a site visit. English Heritage provided feedback on the proposed design in relation to the design of the interception chamber and also in support of moving the permanent foreshore structure further from Putney Bridge. English Heritage also indicated their agreement of the proposed visual assessment viewpoints prior to their formal acceptance (described in para. 11.3.2 above).

11.3.4 The stakeholders were also consulted on proposed changes to the viewpoints following the preliminary assessment findings, including removing some viewpoints from the operational assessment. The LB of Wandsworth have confirmed acceptance of the proposed changes (October 2012). The LB of Richmond upon Thames, LB of Hammersmith & Fulham and English Heritage have not commented on the proposed viewpoints.

11.3.5 The LB of Wandsworth have confirmed (May 2012) that an operational phase night time assessment is not required for this site, on the basis that only low level lighting would be provided in line with the generic lighting design principles.

11.3.6 A description of how the on-site alternatives to the proposed approach have been considered and the main reasons why these alternatives have not been adopted is included in Section 3.6 of this volume.

Baseline

11.3.7 The baseline methodology follows the methodology described in Vol 2 Section 11. In summary the following surveys have been undertaken to establish baseline data for this assessment:

a. Preliminary site visit to check the zone of theoretical visibility (ZTV), establish the extents of townscape character areas and identify locations for visual assessment viewpoints (March 2011)

b. Photographic surveys of townscape character areas (August 2011, September 2011 and June 2012)

c. Winter photographic surveys of the view from each visual assessment viewpoint (December 2011 and March 2012)

d. Summer photographic surveys of the view from visual assessment viewpoints considered in the operational assessment (August 2011 and June 2012)

e. Verifiable photography (March 2011) and verifiable surveying (March 2011) for the viewpoints requiring a photomontage to be produced, as agreed with the stakeholders (described in para. 11.3.2).

11.3.8 With specific reference to the Putney Embankment Foreshore site, baseline information on open space distribution and type, conservation areas and townscape character has been gathered through a review of:

a. The *Core Strategy for the LB of Wandsworth* (LB of Wandsworth, 2010)[2]

b. The *Core Strategy for the LB of Hammersmith and Fulham* (LB of Hammersmith & Fulham, 2011)[3]

c. The *Core Strategy for the LB of Richmond upon Thames* (LB of Richmond upon Thames, 2009)[4]

d. *Putney Embankment, Landford Road, Charlwood Road and Lifford Street, Oxford Road, Parkfields and Deodar Road Conservation Area Appraisal and Management Strategies*, produced by the LB of Wandsworth (LB of Wandsworth, no date)[5]

e. Bishops Park (LB of Hammersmith & Fulham, 1998)[6], Fulham Reach (LB of Hammersmith & Fulham, 1997)[7], Fulham Park Gardens (LB of Hammersmith & Fulham, 2001)[8] and Putney Bridge (LB of Hammersmith & Fulham, 1999)[9] Conservation Area Character Profiles, produced by the LB of Hammersmith and Fulham

f. The Thames Strategy: Kew to Chelsea (Atkins, 2002)[10].

Construction

11.3.9 The assessment methodology for the construction phase follows that described in Vol 2 Section 11. Site-specific variations are described below.

11.3.10 With reference to the Putney Embankment Foreshore site, the peak construction phase relevant to this topic would be during Site Year 2 of construction, when the shaft would be under construction. Cranes would be present at the site and material would be taken away by road. This has therefore been used as the assessment year for townscape and visual effects. The intensity of construction activities would be similar during the secondary lining of the Putney Bridge connection tunnel (also in Site Year 2 of construction), involving the import of materials by road.

11.3.11 No assessment of effects on night time character is made for this site during construction on the basis that:

a. the site would generally only be lit in the early evening during winter, except for short durations of 24 hour working during the construction of the Putney Bridge connection tunnel

b. all site lighting would have minimal spill into the wider area due to the measures set out in the *CoCP Part A and Part B* (Section 4)

c. the surrounding area is lit in the early evening by street lighting and by light spill from surrounding buildings

d. visual receptors have limited sensitivity to additional lighting in the early evening.

11.3.12 The assessment area, defined using the methodology set out in Vol 2 Section 11, is indicated in Vol 7 Figure 11.4.6 for townscape and Vol 7 Figure 11.4.7 for visual (see separate volume of figures). The scale of the townscape assessment area has been set by the maximum extents of all character areas located partially or entirely within the construction phase ZTV, except in those locations downstream of the site where the construction works would be obscured by Putney Bridge and Putney Railway Bridge, and upstream of the site where the construction works would be barely perceptible. The scale of the visual assessment area has been set by the maximum extent of the construction phase ZTV, except in those locations downstream of the site where the construction works would be obscured by Putney Bridge and Putney Railway Bridge, and upstream of the site where the construction works would be barely perceptible. All visual assessment viewpoints are located within the ZTV.

11.3.13 Section 11.5 details the likely significant effects arising from the construction at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on townscape and visual amenity within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are included in this assessment.

11.3.14 For the construction base case for the assessment of effects arising from the proposed development at Putney Embankment Foreshore, the development of the vaults adjacent to the site into café use (No. 2 Putney High Street) including formation of openings in the listed river wall at No. 4-6 Putney High Street is reflected in the base case. No other developments that meet the criteria for inclusion in the base case have been identified within the construction phase assessment areas. Therefore, no other developments are reflected in the base case for the construction phase.

11.3.15 As detailed in the site development schedule (Vol 7 Appendix N) no schemes have been identified within 1km of the site during the peak year of construction which meet the criteria for inclusion in the cumulative assessment. Therefore no assessment of cumulative effects has been undertaken for effects on Putney Embankment Foreshore in the construction phase.

11.3.16 The assessment of construction effects also considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Operation

11.3.17 The assessment methodology for the operational phase follows that described in Vol 2 Section 11. Site-specific variations are described below.

11.3.18 Three verifiable photomontages have been prepared for this site to assist the assessment of operational effects. These are shown in Vol 7 Figure 11.6.1 to Vol 7 Figure 11.6.3 (see separate volume of figures).

11.3.19 The operational phase assessment has been undertaken for Year 1 of operation and Year 15 of operation.

11.3.20 The operational scheme would have no substantial lighting requirements apart from low level lighting associated with the area of public realm. Therefore, no assessment of effects on night time character is made for this site during operation.

11.3.21 The assessment area, defined using the methodology set out in Vol 2 Section 11, is indicated in Vol 7 Figure 11.4.6 for townscape and Vol 7 Figure 11.4.7 for visual (see separate volume of figures). The scale of the townscape assessment area has been set by the maximum extents of all character areas located partially or entirely within the operational phase ZTV, except in those locations downstream of the site where the proposed development would be obscured by Putney Bridge and Putney Railway Bridge, and upstream of the site where the proposed development would be barely perceptible. The scale of the visual assessment area has been set by the maximum extent of the operational phase ZTV, except in those locations downstream of the site where the proposed development would be obscured by Putney Bridge and Putney Railway Bridge, and upstream of the site where the proposed development would be barely perceptible. All visual assessment viewpoints are located within the ZTV.

11.3.22 Section 11.6 details the likely significant effects arising from the operation of the scheme at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on townscape and visual amenity within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

11.3.23 In terms of the operational base case for the assessment of effects on Putney Embankment Foreshore, no further developments within the operational phase assessment area have been identified over and above that described in para. 11.3.14 that meet the criteria for inclusion in the base case. Therefore, no other developments are reflected in the base case for the operational phase.

11.3.24 As detailed in the site development schedule (Vol 7 Appendix N) no schemes have been identified within 1km of the site which meet the criteria for inclusion in the cumulative assessment. Therefore no assessment of cumulative effects has been undertaken for effects on Putney Embankment Foreshore in the operational phase.

11.3.25 As with construction (para. 11.3.16), the assessment of operational effects also considers the extent to which the assessment findings would be likely to be materially different, should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Assumptions and limitations

11.3.26 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 11. Site specific assumptions and limitation are detailed below.

Assumptions

11.3.27 For the purposes of the construction phase assessment, it is assumed that the construction activities and plant, site hoardings, welfare facilities and access points would be in the location shown on Construction phases – phase 2 plan (see separate volume of figures – Section 1). The assessment of effects would be no worse if these elements of the proposed development were in different locations within the maximum extent of working area (shown on Construction phase plans in separate volume of figures – Section 1), with the permanent structures under construction located within the zones shown on the Site works parameter plan (see separate volume of figures – Section 1).

11.3.28 For the purposes of the operational phase assessment, it is assumed that the above ground structures are in the location shown on the proposed landscape plan (see separate volume of figures – Section 1). The assessment of effects would be no worse if these elements of the proposed development were in different locations within the zones shown on the Site works parameter plan (see separate volume of figures – Section 1).

Limitations

11.3.29 There are no limitations specific to the assessment of this site.

11.4 Baseline conditions

11.4.1 The following section sets out the baseline conditions for the townscape and visual assessment within and around the site as follows:

a. Information on the physical elements that make up the overall townscape character of the assessment area (topography, land use, development patterns, vegetation, open space and transport routes), which inform the identification of townscape character areas. These form the receptors for the townscape assessment.

b. Information on the townscape character (including setting), condition, tranquillity, value and sensitivity of the site and each townscape character area.

c. Information on the nature of the existing views towards the site at daytime from all visual assessment viewpoints, during both winter and summer where relevant. This is ordered beginning with the most sensitive receptors through to the least sensitive.

d. Future baseline conditions (base case) are also described.

Current baseline

Townscape baseline

Physical elements

11.4.2 The physical elements of the townscape in the assessment area are described below. The assessment area includes a number of conservation areas, which are shown on Vol 7 Figure 11.4.1 (see separate volume of figures).

Topography

11.4.3 The site is located on a relatively flat plateau along Embankment, with no notable topographic features in the assessment area. To the south, the ground rises away from the river.

Land use

11.4.4 In the vicinity of the site, the southern bank of the river is characterised by residential areas with a prominent linear band of commercial and retail premises forming Putney High Street that runs south. Along the riverfront there are intermittent leisure and retail uses, including boat houses, restaurants and pubs. On the northern bank of the river, land use along the river is dominated by the large open space of Bishops Park. Land further away from the river is predominantly residential, with the exception of a small cluster of retail units around Fulham High Street.

Development patterns and scale

11.4.5 Vol 7 Figure 11.4.2 (see separate volume of figures) illustrates the pattern and scale of development and building heights within the assessment area.

11.4.6 The southern bank of the river is characterised by relatively dense residential development, comprising two to three storey terraces inland from the river and three to six storey properties along the river frontage. The streets are generally narrow and laid out on a grid formation, aligned approximately with Putney High Street. East of Putney Bridge, on Brewhouse Street, a 20 storey residential block forms a dominant element fronting onto the river.

11.4.7 On the northern bank of the river, opposite the site, the residential development away from the river reflects the pattern on the southern bank. The streets are generally aligned to Bishops Park and Hurlingham Park, and are also influenced by the District Line railway which runs overground near the site.

Vegetation patterns and extents

11.4.8 Vol 7 Figure 11.4.3 (see separate volume of figures) illustrates the pattern and extent of vegetation, including tree cover, within the assessment area.

11.4.9 There are few street trees within the assessment area on the southern bank of the river, although the riverfront is intermittently lined with mature London plane trees. These trees increase in density towards Barn Elms upstream of the site, where there is also greater diversity of species. Gaps in this tree line occur where there are active river uses associated with the boat houses along Embankment.

11.4.10 In contrast, mature tree cover is a key characteristic of the townscape on the northern bank of the river, opposite the site. Bishops Park is characterised by extensive mature tree cover.

Open space distribution and type

11.4.11 Vol 7 Figure 11.4.4 (see separate volume of figures) illustrates the distribution of different open space types within the assessment area, indicating all relevant statutory, non-statutory and local plan designations.

11.4.12 Most of the surrounding townscape is characterised by dense residential development, with few significant public or private open spaces apart from back gardens. However, this is offset by the presence of several large public and private open spaces. A number of these open spaces are designated as Metropolitan Open Land and Historic Parks and Gardens. These are described in more detail in Vol 7 Table 11.4.1 below.

Vol 7 Table 11.4.1 Townscape – open space type and distribution

Open space	Distance from site	Character summary
South bank	0m west (south of river)	A 4-5m wide hard surfaced linear space along the riverfront, characterised by an intermittent single avenue of London plane trees.
Bishops Park	200m north (north of river)	Large public park along the riverfront, characterised by open grassland, mature tree cover, including a riverfront avenue and sports pitches. Designated Grade II Registered Historic Park and Garden. Designated Metropolitan Open Land.
Prior Bank Gardens	200m north (north of river)	Formally arranged open space, integral to Bishops Park, characterised by planting beds and a riverfront seating area adjacent to Putney Bridge. Designated Grade II Registered Historic Park

Open space	Distance from site	Character summary
		and Garden. Designated Metropolitan Open Land.
All Saints Churchyard	300m north (north of river)	Fenced courtyard to All Saints Church, characterised by dense mature tree cover. Designated Grade II Registered Historic Park and Garden. Designated Metropolitan Open Land.
Leaders Gardens	800m northwest (south of river)	Small public park alongside Embankment, characterised by open grassland, scattered mature trees and play equipment.

Transport routes

11.4.13 Vol 7 Figure 11.4.5 (see separate volume of figures) illustrates the transport network within the assessment area, including cycleways, footpaths and Public Rights of Way.

11.4.14 The site is located immediately adjacent to Lower Richmond Road and the junction with Putney High Street, both of which are characterised by high levels of traffic. The wider road network in the assessment area is generally residential in nature and in comparison has relatively limited volumes of traffic.

11.4.15 East of the site, the townscape is bisected by the District Line railway, running overground in a north-south direction.

11.4.16 The Thames Path runs along both banks of the river, diverting away from the river to the east of the site where the riverside is characterised by private residential frontages.

11.4.17 There is a public pier to the west of the site which is a Transport for London water bus stop.

Site character assessment

11.4.18 The site (which collectively refers to the main and secondary sites) is located within Putney Embankment Conservation Area in the LB of Wandsworth, west of the Grade II listed Putney Bridge. The majority of the site is located within an area of foreshore on the River Thames, with the remainder located partially on a stretch of pavement along Embankment, and including the historic slipway and part of a linear green space at the foot of Putney Bridge known as Waterman’s Green.

11.4.19 The public drawdock/slipway, surfaced with granite setts and marked with vertical fenders along the riverward edge, represents an important historic component of the townscape character of the wider area. Waterman’s Green is a small area of open grassland with a short avenue of semi-mature trees, culminating in a large London plane tree at the junction of Lower Richmond Road and Embankment. The eastern part of the site is bounded to the south by the Grade II listed wall which forms part of Putney

Bridge, and which creates a visual extension of Putney Bridge along the slipway connecting with Lower Richmond Road.

11.4.20 The river in this location is characterised by a relatively wide area of foreshore. The character of the site is illustrated by Vol 7 Plate 11.4.1 and the components of the site are described in more detail in Vol 7 Table 11.4.2.

Vol 7 Plate 11.4.1 Character of the site

Date taken: 29th June 2012. 35mm lens.

Vol 7 Table 11.4.2 Townscape – site components

ID	Component	Description	Condition
01	Trees within Waterman's Green	Short avenue of semi-mature and mature trees of good to moderate value along Waterman's Green open space at the foot of Putney Bridge	Good condition
02	Retaining wall to public drawdock/slipway	Ashlar stone and London brick retaining wall between the slipway and Waterman's Green, with ornamental railings on top to provide safe access to the open space	Fair condition
03	Public drawdock/slipway	Historic slipway surfaced with granite setts and sawn finish cart treads	Good condition
04	Upright timber	Series of fenders along the riverward edge of the public	Fair

ID	Component	Description	Condition
	fenders	drawdock/slipway, protruding above the ground level.	condition
05	Grade II listed bollards	Victorian painted cast iron bollards to mark the beginning/end of Embankment. In need of some repair and repainting.	Fair condition
06	River wall	Vertical river wall with white and blue painted railings on top along Embankment.	Good condition
07	Statue	Sculpture located outside the restaurant junction of Lower Richmond Road and The Embankment.	Good condition
08	Putney Pier	A covered pier with two houseboat moorings.	Good condition

11.4.21 The condition of the townscape within the site is good, with the majority of townscape components well maintained.

11.4.22 Despite the site’s location close to the interchange of Putney High Street, Putney Bridge and Lower Richmond Road, which is dominated by heavy traffic, the riverside location has moderate levels of tranquillity. This is due to the enclosure provided by the Putney Bridge abutment wall behind Waterman’s Green . The wall is elevated above the level of the site and strengthens the site’s continuity with the river. In addition, the river is mainly used for leisure uses at this location, rather than being used by high levels of commercial river traffic.

11.4.23 The site is located within a nationally significant historical and cultural stretch of the River Thames, experienced by large numbers of people, particularly during events such as the annual Oxford and Cambridge boat race. Although the character of the site is locally common within the assessment area, it is nationally valued as part of the wider character of the River Thames.

11.4.24 Due to the good condition and national significance of the site’s character, the site has a high sensitivity to change.

Townscape character assessment

11.4.25 The townscape character areas surrounding the site are identified in Vol 7 Figure 11.4.6 (see separate volume of figures). They are ordered beginning with the river reaches, then to the north of the site and continuing around the site in a clockwise direction. Each area is described below.

River Thames – Putney and Fulham Palace Reach TCA

11.4.26 This reach of the River Thames extends from Beverley Brook and Bishops Park in the west, to Wandsworth Park and Hurlingham Gardens in the east. The reach is largely characterised by riverfront residential and leisure uses set amongst the extensive Bishops Park open space.

11.4.27 The river itself is characterised by numerous incursions and setbacks along the river wall, including jetties, slipways, stepped river access and brook inlets. Both banks have a relatively wide area of foreshore at low tide. The reach is crossed by Putney Bridge and Putney Railway Bridge. The character of this area is illustrated by Vol 7 Plate 11.4.2.

Vol 7 Plate 11.4.2 River Thames – Putney and Fulham Palace Reach TCA

Date taken: 12 August 2011. 18mm lens.

11.4.28 The jetties, river walls and bridges are generally well maintained. The overall townscape condition is good.

11.4.29 Due to the surrounding residential character, the dominance of vegetation and open spaces, and the relatively light levels of river traffic, this area has a high level of tranquillity.

11.4.30 This reach is a regionally valued stretch of the river, providing the setting to a number of conservation areas on both sides of the river.

11.4.31 Due to the good condition and regional value of the townscape, this character area has a high sensitivity to change.

Bishops Park TCA

11.4.32 This area comprises Bishops Park, the grounds of Fulham Palace and the Warren, together forming a large open space designated as Metropolitan Open Land and a Grade II Registered Historic Park and Garden. The TCA sits within the larger Bishops Park Conservation Area designation. The character area extends along the River Thames from Fulham football club in the west to Putney Bridge in the east.

11.4.33 Bishops Park comprises five distinct areas providing a variety of formal and informal recreational spaces, including:

a. a formal riverside linear park characterised by mature trees

b. an area of amenity grassland

c. a play area

d. sports pitches

e. a hard surfaced riverside promenade.

11.4.34 Fulham Palace Grounds and the Warren are a Scheduled Ancient Monument set alongside the Grade I listed Fulham Palace. The townscape is characterised by mature specimen trees and rare botanical species, including on ornamental garden, an 18th century walled garden and an orchard.

11.4.35 The character area is almost entirely surrounded by residential development, apart from the long river frontage. The character of this area is illustrated by Vol 7 Plate 11.4.3.

Vol 7 Plate 11.4.3 Bishops Park TCA

Date taken: 9 August 2011. 18mm lens.

11.4.36 A baseline description of Bishops Park Conservation Area as a heritage asset is provided in Section 7.4 of this volume.

11.4.37 The landscape, buildings and structures within the area are well maintained. The overall townscape condition is good.

11.4.38 Due to the extensive areas of green open space, the widespread presence of mature planting and the seclusion afforded from the dense urban development surrounding the character area, this area has a high level of tranquillity.

11.4.39 By virtue of the Metropolitan Open Land and Historic Park and Garden designations, this area is regionally valued.

11.4.40 Due to the good condition of the townscape, its regional value, and high levels of tranquillity, this character area has a high sensitivity to change.

Putney Bridge Conservation Area TCA

11.4.41 This area is broadly defined by the Putney Bridge Conservation Area boundary, but also incorporates All Saints Church which has a direct architectural relationship with Putney Bridge and St Mary's Church on the opposite side of the river. All Saints Church falls within the Bishops Park Conservation Area. The area is characterised by residential uses located between Putney Bridge and Putney Railway Bridge to the east, partially built around a small inlet. This residential area is known as Carrara Wharf. The character of this area is illustrated by Vol 7 Plate 11.4.4.

Vol 7 Plate 11.4.4 Putney Bridge Conservation Area TCA

Date taken: 6th September 2011. 18mm lens.

11.4.42 A baseline description of Putney Bridge Conservation Area as a heritage asset is provided in Section 7.4 of this volume.

11.4.43 The buildings and public realm within the area are generally well maintained. The overall townscape condition is good.

11.4.44 Tranquillity within the area is reduced by the high levels of vehicular and pedestrian traffic, particularly along Putney Bridge and Fulham High Street, combined with a lack of street trees and open spaces.

11.4.45 The area is valued at the borough level by virtue of the conservation area designations.

11.4.46 Due to the good condition and borough value of the townscape, this area has a high sensitivity to change.

Putney Embankment Conservation Area TCA

11.4.47 This area is defined by the Putney Embankment Conservation Area boundary and is characterised by a linear band of residential and leisure uses fronting onto Embankment and the River Thames. The area is dominated by its close relationship with the character of the river and the visual connectivity with Putney Bridge, along a gentle bend in the River Thames. The eastern extent of the character area is marked by the Grade II* listed landmark of St Mary's Church, adjacent to Putney Bridge. Further west, six storey high 19th century residential properties give way to active leisure uses associated with the river, including numerous boat houses. Apart from the frontages formed by these active uses, Embankment is lined with an avenue of mature London plane trees. The character of this area is illustrated by Vol 7 Plate 11.4.5.

Vol 7 Plate 11.4.5 Putney Embankment Conservation Area TCA

Date taken: 12 August 2011. 18mm lens.

11.4.48 A baseline description of Putney Embankment Conservation Area as a heritage asset is provided in Section 7.4 of this volume.

11.4.49 The buildings and public realm within the area are generally well maintained. The overall townscape condition is good.

11.4.50 Despite relatively high levels of pedestrian use, associated with active riverfront uses, the riverfront residential character of the area and limited levels of vehicular traffic means this area has a moderate level of tranquillity.

11.4.51 The area is valued at the borough level by virtue of the conservation area designations.

11.4.52 Due to the good condition and borough value of the townscape, this area has a high sensitivity to change.

Leaders Gardens TCA

11.4.53 This character area comprises Leaders Gardens, a small public park on the riverfront, and the Beverley Brook corridor. Part of the area falls within Putney Embankment Conservation Area. Leaders Gardens is a Victorian riverside park, characterised by open amenity grassland, a network of paths and mature tree planting. The Beverley Brook corridor is heavily vegetated with mature tree cover and is characterised by a series of sluice and weir structures. In the vicinity of the tidal sluice, the Environment Agency (EA) has recently undertaken tree clearance works to increase the ecological value of the watercourse and encourage more marginal vegetation. The character area is bounded to the south and west by residential properties, to the north by Barn Elms playing fields and to the east by the River Thames. The Thames Path crosses a small pedestrian bridge at the mouth of the Beverley Brook. The character of this area is illustrated by Vol 7 Plate 11.4.6.

Vol 7 Plate 11.4.6 Leaders Gardens TCA

Date taken: 9 August 2011. 18mm lens.

11.4.54 The buildings and public realm within the area are well maintained. The overall townscape condition is good.

11.4.55 Due to the dominance of green open space, the widespread presence of mature planting, the riverside location and the seclusion afforded from the dense urban development surrounding the character area, this area has a high level of tranquillity.

11.4.56 The area is valued at the borough level by virtue of its conservation area designation that occupies the majority of the area.

11.4.57 Due to the good condition of the townscape, its borough value, and high levels of tranquillity, this character area has a high sensitivity to change.

Visual baseline

11.4.58 Vol 7 Figure 11.4.7 (see separate volume of figures) indicates the location of the viewpoints referenced below. All residential and recreational receptors have a high sensitivity to change and transport receptors have a medium sensitivity to change. For each viewpoint, the first part of the baseline description relates to the view during winter, while the second part relates to the summer views, for viewpoints included in the operational assessment.

Residential

11.4.59 Residential receptors have a high sensitivity to change, as attention is often focused on the townscape surrounding the property rather than on another focused activity (as would be the case in predominantly employment or industrial areas). The visual baseline for residential receptors (represented by a series of viewpoints, agreed with consultees) is described below.

Viewpoint 1.1: View southwest from residences in Carrara Wharf

11.4.60 This viewpoint is representative of the view from riverside residential properties in Carrara Wharf on the northern bank of the River Thames, east of Putney Bridge.

Vol 7 Plate 11.4.7 Viewpoint 1.1: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.61 The view (illustrated in Vol 7 Plate 11.4.7) from this location is focused on Putney Bridge, with residential and commercial premises on the south bank visible beyond. St Mary's Church is visible at the southern end of Putney Bridge, alongside residences along Putney's riverfront including Kenilworth Court. Views towards the site are largely obstructed by the arches of Putney Bridge.

Vol 7 Plate 11.4.8 Viewpoint 1.1: Summer view

Date taken: 12 August 2011. 18mm lens.

11.4.62 In summer, the view towards the site (illustrated in Vol 7 Plate 11.4.8) is largely unchanged.

Viewpoint 1.2: View north from residences in Kenilworth Court

11.4.63 This viewpoint is representative of the direct view from residential properties in Kenilworth Court on Lower Richmond Road, adjacent to the site.

Vol 7 Plate 11.4.9 Viewpoint 1.2: Winter view

Date taken: 29 June 2012. 18mm lens

11.4.64 The winter photo (illustrated in Vol 7 Plate 11.4.9) is not focused towards the proposed site location in operation, due to changes in the location following phase two consultation, and therefore after the winter months, meaning it was not possible to rephotograph the view in winter. The baseline description is based on professional judgement with reference to previous survey work during winter.

11.4.65 Lower Richmond Road dominates the foreground of the view, with trees in Waterman's Green visible beyond. Putney Bridge and the river frontage of Bishops Park are visible in the background of the view. Views of the site from ground level are largely obscured by the wall at the rear of Waterman's Green. Views of the site from upper storeys are largely unobscured.

Vol 7 Plate 11.4.10 Viewpoint 1.2: Summer view

Date taken: 29 June 2012. 18mm lens.

11.4.66 In summer, the view towards the site (illustrated in Vol 7 Plate 11.4.10) is partially screened by mature trees along Embankment.

Recreational

11.4.67 Recreational receptors (apart from those engaged in active sports) generally have a high sensitivity to change, as attention is focused on enjoyment of the townscape. Tourists engaged in activities whereby attention is focused on the surrounding townscape also have a high sensitivity to change. The visual baseline in respect of recreational receptors, including tourists, is discussed below.

Viewpoint 2.1: View southwest from Putney Bridge

11.4.68 This viewpoint is representative of the typical view that pedestrians experience when crossing Putney Bridge on the western foot way.

Vol 7 Plate 11.4.11 Viewpoint 2.1: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.69 The view (illustrated in Vol 7 Plate 11.4.11) is characterised by the Kenilworth Court residential development on the south bank, trees within Waterman's Green and large mature trees along Embankment. The historic public drawdock/slipway forms a key component of the view in front of the river wall. Views of the site are unobstructed from this location. The winter photo shows a slightly different frame of view to the summer photo (illustrated in Vol 7 Plate 11.4.12), due to changes in the location of the proposed development occurring after phase two consultation. The baseline description is based professional judgement with reference to previous survey work during winter.

Vol 7 Plate 11.4.12 Viewpoint 2.1: Summer view

Date taken: 12 August 2011. 18mm lens.

11.4.70 In summer, the view towards the site (illustrated in Vol 7 Plate 11.4.12) is largely unchanged.

11.4.71 A baseline description of the Grade II listed Putney Bridge as a heritage asset is provided in Section 7.4 of this volume.

Viewpoint 2.2: View west from Wandsworth Park

11.4.72 This viewpoint is representative of the typical view for recreational users of the Thames Path at the western extent of Wandsworth Park.

Vol 7 Plate 11.4.13 Viewpoint 2.2: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.73 The linear view (illustrated in Vol 7 Plate 11.4.13) up the river is focused on Putney Railway Bridge, with Putney Bridge intermittently visible in the background. The view is framed to the south (left) by the rear gardens of residential properties along Deodar Road. Views towards the site are largely obscured by the arches of Putney Railway Bridge and Putney Bridge.

Viewpoint 2.3: View north from Putney High Street

11.4.74 This viewpoint is representative of the typical view for pedestrians along the eastern side of Putney High Street.

Vol 7 Plate 11.4.14 Viewpoint 2.3: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.75 The linear view (illustrated in Vol 7 Plate 11.4.14) along Putney High Street is characterised by busy vehicular and pedestrian traffic along the road. The view is framed by commercial and retail frontages along both sides of the road. Views towards the site are obscured from this viewpoint as it is set at a lower level than Putney High Street and the Lower Richmond Road leading to Putney Bridge. Views towards the site are also partially blocked by residential buildings along Putney High Street and Lower Richmond Road.

Viewpoint 2.4: View northwest from Putney High Street outside St Mary's Church

11.4.76 This viewpoint is representative of the typical view for pedestrians along the eastern side of Putney High Street.

Vol 7 Plate 11.4.15 Viewpoint 2.4: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.77 The view (illustrated in Vol 7 Plate 11.4.15) is dominated by the road junction with the Lower Richmond Road and Putney High Street at the southern end of Putney Bridge. Mature trees lining Embankment and Bishop's Park form the middle and background of the view. The site is obscured from this viewpoint as it is set at a lower level than the road junction.

Vol 7 Plate 11.4.16 Viewpoint 2.4: Summer view

Date taken: 12 August 2011. 18mm lens.

11.4.78 In summer, the view towards the site (illustrated in Vol 7 Plate 11.4.16) is largely unchanged.

11.4.79 A baseline description of the Grade II* listed St Mary's Church as a heritage asset is provided in Section 7.4 of this volume.

Viewpoint 2.5: View east from the eastern end of Embankment

11.4.80 This viewpoint is representative of the typical view for recreational users of the Thames Path along Embankment, adjacent to the existing public drawdock/slipway at the site.

Vol 7 Plate 11.4.17 Viewpoint 2.5: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.81 The view (illustrated in Vol 7 Plate 11.4.17) is primarily focused on the historic public drawdock/slipway with Putney Bridge in the background of the view. The viewpoint represents the most westerly in a sequence of views focused on Putney Bridge along the route of Embankment. Views of the site are unobstructed from this location.

Vol 7 Plate 11.4.18 Viewpoint 2.5: Summer view

Date taken: 12 August 2011. 18mm lens.

11.4.82 In summer, the view towards the site (illustrated in Vol 7 Plate 11.4.18) is largely unchanged.

Viewpoint 2.6: View east from Lower Richmond Road outside the Star and Garter restaurant

11.4.83 This viewpoint is representative of the typical view for pedestrians along Lower Richmond Road outside the Star and Garter restaurant.

Vol 7 Plate 11.4.19 Viewpoint 2.6: Winter view

Date taken: 29 March 2012. 50mm lens.

11.4.84 The linear view (illustrated in Vol 7 Plate 11.4.19) along Lower Richmond Road is focused on the approach to Putney Bridge in the background of the view. The view is framed to the north (left of the image) by the Star and Garter restaurant, which obscures the majority of the site, and to the south (right of the image) by residential frontages.

Viewpoint 2.7: View southeast from Embankment outside the Dukes Head

11.4.85 This viewpoint is representative of the typical view for recreational users of the Thames Path along Embankment, adjacent to The Dukes Head public house.

Vol 7 Plate 11.4.20 Viewpoint 2.7: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.86 The view (illustrated in Vol 7 Plate 11.4.20) is an open panorama across the river towards Putney Bridge in the background of the view. Views of the site are largely unobstructed from this location, apart from by Putney Pier immediately adjacent to the site.

Vol 7 Plate 11.4.21 Viewpoint 2.7: Summer view

Date taken: 12 August 2011. 18mm lens.

11.4.87 In summer, mature trees along Embankment partially screen views towards the site (illustrated in Vol 7 Plate 11.4.21).

Viewpoint 2.8: View southeast from Embankment outside Leaders Gardens

11.4.88 This viewpoint is representative of the typical view for recreational users of the Thames Path along Embankment, outside Leaders Gardens.

Vol 7 Plate 11.4.22 Viewpoint 2.8: Winter view

Date taken: 22 December 2011. 35 mm lens.

11.4.89 The linear view (illustrated in Vol 7 Plate 11.4.22) down the river is focused on Putney Bridge and Putney Wharf residential development, which form the background of the view. Views of the site are largely unobstructed from this location, with the exception of Putney Pier which slightly obstructs visibility.

Vol 7 Plate 11.4.23 Viewpoint 2.8: Summer view

Date taken: 12 August 2011. 35mm lens.

11.4.90 In summer, mature trees along Embankment partially screen views towards the site (illustrated in Vol 7 Plate 11.4.23).

Viewpoint 2.9: View southeast from Leaders Gardens

11.4.91 This viewpoint is representative of the typical view for recreational users of Leaders Gardens.

Vol 7 Plate 11.4.24 Viewpoint 2.9: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.92 The foreground of the view (illustrated in Vol 7 Plate 11.4.24) is dominated by mature tree planting within the park and along Embankment, which filter wider panoramic views of the river towards Putney Bridge and the site. Bishop’s Park forms the background of the view. Buildings along Embankment, and Putney Pier further obscure views towards the site.

Viewpoint 2.10: View southeast from Embankment at Beverley Brook

11.4.93 This viewpoint is representative of the typical view for recreational users of the Thames Path along Embankment, on the bridge across the mouth of Beverley Brook.

Vol 7 Plate 11.4.25 Viewpoint 2.10: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.94 The linear view (illustrated in Vol 7 Plate 11.4.25) down the river is framed by mature trees along Embankment on the south bank (right) and the frontage of Bishops Park on the north bank (left). Putney Bridge is visible in the background of the view. Views of the site are largely unobstructed from this location, apart from Putney Pier which slightly obstructs visibility in the background of the view.

Viewpoint 2.11: View southeast from the western extent of Bishops Park

11.4.95 This viewpoint is representative of the typical view for recreational users of the Thames Path on the northern bank of the river in Bishop's Park.

Vol 7 Plate 11.4.26 Viewpoint 2.11: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.96 The view (illustrated in Vol 7 Plate 11.4.26) is an open panorama over the River Thames, characterised in the foreground by the green frontage of Bishop's Park and in the background by the mixed residential and active leisure uses fronting onto Embankment. The site forms the background of the view down the river, in the left of the image. Views of the site from this location are unobstructed.

Viewpoint 2.12: View southeast from Bishops Park close to Bishops Avenue

11.4.97 This viewpoint is representative of the typical view for recreational users of the Thames Path on the northern bank of the river in Bishops Park, close to Bishops Avenue.

Vol 7 Plate 11.4.27 Viewpoint 2.12: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.98 The view (illustrated in Vol 7 Plate 11.4.27) is an open panorama over the River Thames, characterised in the foreground by the green frontage of Bishop's Park and in the background by the mixed residential and active leisure uses fronting onto Embankment. The site forms the background of the view down the river, in the left of the image. Views of the site from this location are unobstructed, apart from by Putney Pier, adjacent to the site.

Vol 7 Plate 11.4.28 Viewpoint 2.12: Summer view

Date taken: 12 August 2011. 18mm lens.

11.4.99 In summer, mature trees along the river frontage partially screen views towards the site (illustrated in Vol 7 Plate 11.4.28).

Viewpoint 2.13: View southeast from Fulham Palace

11.4.100 This viewpoint is representative of the view for recreational users of Bishop's Park in the vicinity of Fulham Palace.

Vol 7 Plate 11.4.29 Viewpoint 2.13: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.101 The foreground of the view (illustrated in Vol 7 Plate 11.4.29) is characterised by mature tree planting within Bishops Park, which heavily screen views towards the river. Views towards the site are therefore also obscured by this planting.

Viewpoint 2.14: View southeast from Bishops Park riverside

11.4.102 This viewpoint is representative of the typical view for recreational users of the Thames Path on the northern bank of the river in Bishops Park.

Vol 7 Plate 11.4.30 Viewpoint 2.14: Winter view

Date taken: 22 December 2011. 18mm lens.

11.4.103 The view (illustrated in Vol 7 Plate 11.4.30) is characterised by Putney Bridge, Putney Wharf and the mixed residential and active leisure uses frontage of Putney Embankment Conservation Area. Views of the site from this location are unobstructed, with partial screening from Putney Pier.

Vol 7 Plate 11.4.31 Viewpoint 2.14: Summer view

Date taken: 12 August 2011. 18mm lens.

11.4.104 In summer, mature trees along the Bishops Park riverside are noticeably more prominent and act to frame the view across the river towards the site (illustrated by Vol 7 Plate 11.4.31).

Viewpoint 2.15: View south from Prior Gardens Bank

11.4.105 This viewpoint is representative of the typical view for recreational users of the Thames Path on the northern bank of the river in Priors Garden Bank.

Vol 7 Plate 11.4.32 Viewpoint 2.15: Winter view

Date taken: 22 December 2011. 35mm lens.

11.4.106 The view (illustrated in Vol 7 Plate 11.4.32) across the River Thames to Embankment is characterised by residences in Kenilworth Court. Putney Bridge forms the eastern extent of the view. Views of the site from this location are unobstructed.

Vol 7 Plate 11.4.33 Viewpoint 2.15: Summer view

Date taken: 12 August 2011. 35mm lens.

11.4.107 In summer, the view towards the site is largely unchanged (illustrated by Vol 7 Plate 11.4.33).

Transport

11.4.108 Travel through an area is often the means by which the greatest numbers of people view the townscape. Such receptors generally have a medium sensitivity to change.

Viewpoint 3.1: View south from the junction of Fulham High Street and New Kings Road

11.4.109 This viewpoint is representative of the typical view from people travelling towards the site along Fulham High Street.

Vol 7 Plate 11.4.34 Viewpoint 3.1: Winter view

Date taken: 22 December 2011. 35mm lens.

11.4.110 The linear view (illustrated in Vol 7 Plate 11.4.34) along Fulham High Street is framed by commercial premises to the east (left) and mature trees in Bishops Park to the west (right). Views of the site are largely obscured by Putney Bridge in the background of the view.

Construction base case

11.4.111 For the purposes of the construction phase assessment, it is assumed that there would be no substantial change in the townscape and visual baseline between 2012 and Site Year 2 of construction, apart from the opening and development of the vaults adjacent to the site into café use. Therefore the base case for the assessment of construction effects is as per the current baseline presented in Section 11.4.

Operational base case

11.4.112 The operational phase assessment has been undertaken for Year 1 of operation and Year 15 of operation. For the purposes of the Year 1 assessment, it is assumed there would be no further changes in the townscape and visual baseline (beyond that described in para. 11.4.111 above) between 2012 and Year 1 of operation.

11.4.113 For the purposes of the Year 15 assessment, it is assumed there would be no further substantial change in the townscape and visual baseline between 2012 and Year 15 of operation.

11.5 Construction effects assessment

11.5.1 The following section details the likely significant effects arising from construction at Putney Embankment Foreshore.

11.5.2 Due to the scale of the construction activities proposed across what are, in many cases, prominent locations in London, construction works would be highly visible. In policy terms, the NPS for waste water (Defra, 2012)[11] recognises that nationally significant infrastructure projects are likely to take place in mature urban environments, with adverse construction effects on townscape and visual receptors likely to arise. In addition, construction works are a commonplace feature across London, and therefore the following assessment should be viewed in this context. It should also be noted that construction effects are temporary in nature and relate to the peak construction year defined in Section 11.3. Effects during other phases of works are likely to be less due to fewer construction plant being required at the time and a reduced intensity of construction activity.

11.5.3 Illustrative plans of the possible layout of the site during construction are contained in a separate volume of figures (see Construction phase plans, separate volume of figures – Section 1).

Site character assessment

11.5.4 Direct effects on the character of the site would arise from works to the river wall, installation of site hoardings and welfare facilities, construction of a temporary slipway and construction activity associated with the construction of the cofferdam, shaft and ventilation equipment, and secondary lining of the tunnel. The impacts on specific components of the site are described in Vol 7 Table 11.5.1 below.

Vol 7 Table 11.5.1 Townscape – impacts on existing site components during construction

ID	Component	Impacts
01	Trees within Waterman's Green	Existing trees would be retained and protected (with the exception of a holly tree which would be removed); pruning would be required to facilitate access during construction.
02	Retaining wall to public	Retained and protected.

ID	Component	Impacts
	drawdock/slipway	
03	Public drawdock/slipway	Sections of existing pedestrian footway and upper sections of slipway would be removed during construction. Existing paving slabs would be removed and stored.
04	Upright timber fenders	Retained and protected.
05	Grade II listed bollards	Removed during construction and stored for later reinstatement.
06	River wall	Retained and protected.
07	Statue	The statue would be temporarily relocated if required.
08	Putney pier	The pier would be retained throughout construction. One houseboat would be temporary relocated on the opposite side of the pier.

11.5.5 The moderate levels of tranquillity in the site would be substantially altered due to introduction of construction vehicles, plant equipment and high levels of activity in a part of the river and Thames Path not currently intensively used.

11.5.6 Due to the introduction of intense construction activity within the river corridor, affecting the character and tranquillity of the site, the magnitude of change is considered to be high.

11.5.7 The high magnitude of change, assessed alongside the high sensitivity of the site to change, would result in **major adverse** effects.

Townscape character areas assessment

River Thames – Putney and Fulham Palace Reach TCA

11.5.8 The proposed site is located adjacent to this reach of the river. The proposed development would introduce high levels of construction activity within the river corridor, in an area currently characterised by open space and leisure uses associated with the public drawdock/slipway and Waterman's Green.

11.5.9 The area has high levels of tranquillity at present, which would be affected by intense levels of construction activity at the site.

11.5.10 Due to the substantial changes to the setting and tranquillity of the area, the magnitude of change is considered to be high.

11.5.11 The high magnitude of change, assessed alongside the high sensitivity of this character area, would result in **major adverse** effects.

Bishops Park TCA

11.5.12 The proposed site forms a direct part of the riverside setting of this character area. The presence of the site cofferdam, construction activity, construction plant and welfare facilities would affect the riverside setting of this area, a key element of the area's character. Construction associated with the temporary slipway on Embankment would also affect the riverside setting.

11.5.13 The high levels of tranquillity in the area would be affected to a limited extent by construction activity at the site, including piling.

11.5.14 Due to the substantial change to the riverside setting of this area, the magnitude of change is considered to be high.

11.5.15 The high magnitude of change, assessed alongside the high sensitivity of this character area, would result in **major adverse** effects.

11.5.16 The assessment of specific effects on the setting of Bishops Park Conservation Area as a heritage asset is set out in Section 7 of this volume. The historic environment assessment identifies a minor adverse effect on the setting of this asset as the proposed development does not contribute to the setting of a number of the key heritage assets within the conservation area, which is also much larger (and hence less affected) than the TCA.

Putney Bridge Conservation Area TCA

11.5.17 The proposed site forms a distinct component of the riverside setting of this character area, albeit set beyond Putney Bridge. The presence of the site cofferdam, construction activity, construction plant, welfare facilities and the construction of the interception chamber would affect part of the riverside setting of this area.

11.5.18 The low levels of tranquillity in the area would be largely unaffected by construction activity at the site.

11.5.19 Due to changes in part of the area's riverside setting, the magnitude of change is considered to be low.

11.5.20 The low magnitude of change, assessed alongside the high sensitivity of this character area, would result in **minor adverse** effects.

11.5.21 The assessment of specific effects on the setting of Putney Bridge Conservation Area as a heritage asset is set out in Section 7 of this volume.

Putney Embankment Conservation Area TCA

11.5.22 The proposed site forms a direct part of the riverside setting of this character area, in close proximity to Putney Bridge, a key component of the character of the area. The presence of the site cofferdam, construction activity, construction plant, welfare facilities and road transport would substantially affect the riverside setting of this area. Construction associated with the temporary slipway on Embankment would also affect the setting.

11.5.23 The moderate levels of tranquillity in the area would be substantially altered by construction activity at the site.

11.5.24 Due to changes in the immediate riverside setting and levels of tranquillity, the magnitude of change is considered to be high.

11.5.25 The high magnitude of change, assessed alongside the high sensitivity of this character area, would result in **major adverse** effects.

11.5.26 The assessment of specific effects on the setting of Putney Embankment Conservation Area as a heritage asset is set out in Section 7 of this volume. The historic environment assessment identifies a moderate adverse effect on the setting of this asset as the effect on the conservation area as a whole would be reduced by the localised nature of the proposed development. Therefore, much of the setting of the conservation area would be largely unchanged, as opposed to the substantial change apparent on the townscape of this area.

Leaders Gardens TCA

11.5.27 The proposed site forms a component of the wider riverside setting of this character area. The presence of the site cofferdam, construction activity and construction plant in the distance would affect the wider riverside setting to a limited extent. The setting would also be affected to a limited extent by construction activity associated with the temporary slipway along Embankment. However, the majority of the riverside setting of this character area would remain unaffected by the proposed construction at the site.

11.5.28 The area has high levels of tranquillity at present, which would be likely to remain largely unchanged.

11.5.29 Therefore, the magnitude of change is considered to be low.

11.5.30 The low magnitude of change, assessed alongside the high sensitivity of this character area, would result in **minor adverse** effects.

Townscape – sensitivity test for programme delay

11.5.31 For the assessment of townscape effects during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely materially to change the assessment findings reported above (paras. 11.5.4 to 11.5.30). This is on the basis that there are no known schemes that would change the sensitivity to change of the townscape character areas already presented (paras. 11.4.2 to 11.4.57).

Visual assessment

11.5.32 The visual assessment for the construction phase has been undertaken during winter, in line with best practice guidance, to ensure a robust assessment. However, in some cases, visibility of construction activities may be reduced during summer when vegetation, if present in a view, would be in leaf.

Residential

Viewpoint 1.1: View southwest from residences in Carrara Wharf

11.5.33 Views from residential properties towards the site would encompass construction works at the CSO interception site, and tall construction plant and cranes at the remainder of the site above Putney Bridge in the background of the view. The remainder of construction activities and the site cofferdam would be obscured by Putney Bridge. Therefore, the magnitude of change is considered to be low.

11.5.34 The low magnitude of change, assessed alongside the high sensitivity of the receptor would result in **minor adverse** effects.

Viewpoint 1.2: View north from residences in Kenilworth Court

11.5.35 Views from residences towards the site would be affected during construction by the foreground visibility of construction activities. The construction of the shaft would be set directly in front of the properties, restricting views of Putney Bridge, the river and the green frontage of Bishops Park on the north bank. The foreground of the view would be characterised by site hoardings, welfare facilities, construction activity and the presence of construction plant. From the lower storeys, interception works at Putney Bridge would be partially screened by the level change between Lower Richmond Road and the site. The retention of mature trees along Waterman’s Green and Embankment would also help to partially filter views of the site from lower storeys. However, from upper storeys there would be a direct view of all the main site and interception works. Construction traffic would also be highly visible. Therefore, the magnitude of change is considered to be high.

11.5.36 The high magnitude of change, assessed alongside the high sensitivity of the receptor would result in **major adverse** effects.

Recreational

Viewpoint 2.1: View southwest from Putney Bridge

11.5.37 Due to the elevated location of the viewpoint on Putney Bridge, construction activity within the site would be clearly visible within the hoardings at the site boundary. Construction plant and welfare facilities would partially obscure views of the historic building façade along Lower Richmond Road, although the main activity (at the shaft) would be set in front of the more recent restaurant unit on the riverfront. Works associated with the CSO interception on Putney Bridge would also form part of the view. Construction activities associated with the temporary slipway further along Embankment would be visible in the background of the view. Therefore, the magnitude of change is considered to be high.

11.5.38 The high magnitude of change, assessed alongside the high sensitivity of the receptor would result in **major adverse** effects.

11.5.39 The assessment of specific effects on the Grade II listed Putney Bridge as a heritage asset is set out in Section 7 of this volume. The historic environment assessment identifies a moderate adverse effect on the setting of this asset as the setting is wider than the field of view experienced by a pedestrian crossing the bridge in this location. Therefore, part of the setting of the bridge would be unchanged, as opposed to the substantial change visible from this specific viewpoint.

Viewpoint 2.2: View west from Wandsworth Park

11.5.40 Construction activity at the shaft would largely be obscured by the arches of Putney Bridge and Putney Railway Bridge in views from this location, although the cranes would be visible in the background of the linear view up the river. Interception works at Putney Bridge would be intermittently visible, but largely obscured by Putney Railway Bridge and less visually intrusive in nature than the main site works. Therefore, the magnitude of change is considered to be negligible.

11.5.41 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor would result in a **negligible** effect.

Viewpoint 2.3: View north from Putney High Street

11.5.42 Views from this location would be affected to a limited extent during construction due to the introduction of tall construction plant and cranes in the background of the view. The majority of the works at the site would be screened by the level change between the viewpoint and the site and the buildings along the west side of Putney High Street. Therefore, the magnitude of change is considered to be negligible.

11.5.43 The negligible magnitude of change assessed alongside the high sensitivity of the receptor would result in a **negligible** effect.

Viewpoint 2.4: View northwest from Putney High Street outside St Mary’s Church

11.5.44 Views from this location would be affected during construction by the visibility of tall construction plant, cranes and construction traffic, partially obscured by intervening traffic lights, lighting columns and mature trees. Due to the level change between the viewpoint and the site, lower level works such as storage of materials and general activity would be largely obscured. The retention of mature trees along Waterman’s Green would further help to screen views towards the site particularly in summer months. Therefore, the magnitude of change is considered to be low.

11.5.45 The low magnitude of change, assessed alongside the high sensitivity of the receptor would result in **minor adverse** effects.

11.5.46 The assessment of specific effects on the Grade II* listed St Mary’s Church as a heritage asset is set out in Section 7 of this volume.

Viewpoint 2.5: View east from the eastern end of Embankment

11.5.47 The construction of the site cofferdam and shaft would be set directly in the foreground of the view, which would restrict views of Putney Bridge and the river. The view would be characterised by site hoardings, welfare facilities, construction activity and construction plant. Construction activity associated with the temporary slipway would also be visible beyond Putney Pier in the view west. Therefore, the magnitude of change is considered to be high.

11.5.48 The high magnitude of change, assessed alongside the high sensitivity of the receptor would result in **major adverse** effects.

Viewpoint 2.6: View east from Lower Richmond Road outside the Star and Garter restaurant

11.5.49 Views from this location would be affected to a limited extent during construction. Tall construction plant and cranes in the eastern part of the site would be visible at the termination of the linear view along Lower Richmond Road. Construction activity, focused around the shaft, would be largely obscured by the riverside restaurant. Construction traffic entering and exiting the site would be visible in the background of the view. Therefore, the magnitude of change is considered to be low.

11.5.50 The low magnitude of change, assessed alongside the high sensitivity of the receptor would result in **minor adverse** effects.

Viewpoint 2.7: View southeast from Embankment outside the Dukes Head

11.5.51 Construction activity at the main site would be visible in the middle ground of the view, partially obscuring views of Putney Bridge. The view would be characterised by the site cofferdam, construction activity, construction plant and welfare facilities. Construction traffic would also be highly visible. Views would be partially obscured by Putney Pier, which would remain throughout the works, along with the line of mature London plane trees along Embankment. The wider panorama of the river would be largely unaffected, although construction activity associated with the temporary slipway would also be visible. Therefore, the magnitude of change is considered to be medium.

11.5.52 The medium magnitude of change, assessed alongside the high sensitivity of the receptor would result in **moderate adverse** effects.

Viewpoint 2.8: View southeast from Embankment outside Leaders Gardens; and Viewpoint 2.10: View southeast from Embankment at Beverley Brook

11.5.53 Construction activity at the main site would be set in the background of the view, restricting views of the southern end of Putney Bridge. The distant view would be characterised by the presence of the tall construction plant, welfare facilities and cranes. Views would be partially obscured by Putney Pier, which would remain throughout the works, and the avenue of mature London plane trees along Embankment. Construction activity associated with the temporary slipway would also be visible in the middle ground of the view. The wider panorama of the river would be largely unaffected. Therefore, the magnitude of change is considered to be low.

11.5.54 The low magnitude of change, assessed alongside the high sensitivity of the receptor would result in **minor adverse** effects.

Viewpoint 2.9: View southeast from Leaders Gardens

11.5.55 Views from this location towards the site would be largely obscured by mature tree planting within the park, buildings along Embankment and Putney Pier. Construction plant at the site would form a relatively indistinct component of the wider filtered view of the river. Therefore, the magnitude of change is considered to be negligible.

11.5.56 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor would result in a **negligible** effect.

Viewpoint 2.11: View southeast from the western extent of Bishops Park

11.5.57 Distant views from this location towards the site and Putney Bridge would be largely obscured by mature tree planting along the river frontage of Bishops Park and by Putney Pier. The site cofferdam would form a relatively indistinct component in the background of the view. The distant view would be characterised by the presence of the tall construction plant and cranes. The wider panorama of the river, which is the main focus of the view, would be unaffected, apart from construction activity associated with the temporary slipway. Therefore, the magnitude of change is considered to be negligible.

11.5.58 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor would result in a **negligible** effect.

Viewpoint 2.12: View southeast from Bishops Park close to Bishops Avenue

11.5.59 The background of the view from this location would be characterised by the presence of the site cofferdam, construction activity, construction plant and welfare facilities. Views would be partially obscured by Putney Pier (that would remain throughout the works), and the line of mature London plane trees along Bishops Park riverside. The wider panorama of the river would be largely unaffected, although construction activity associated with the temporary slipway would be highly visible although not overly visually intrusive. Therefore, the magnitude of change is considered to be low.

11.5.60 The low magnitude of change, assessed alongside the high sensitivity of the receptor would result in **minor adverse** effects.

Viewpoint 2.13: View southeast from Fulham Palace

11.5.61 Views from this location towards the site would be largely screened by Putney Pier and by mature tree planting within the park and along the riverfront. Construction plant at the main site would form a relatively indistinct component of the wider filtered view of the river. Therefore, the magnitude of change is considered to be negligible.

11.5.62 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor would result in a **negligible** effect.

Viewpoint 2.14: View southeast from Bishops Park riverside

11.5.63 The middle ground of the view from this location would be characterised by the presence of the site cofferdam, construction activity, construction plant and welfare facilities. Views would be partially obscured by Putney Pier, and the line of mature London plane trees along Bishops Park riverside. The wider panorama of the river would be largely unaffected, although construction activity associated with the temporary slipway would be highly visible although not overly visually intrusive. Therefore, the magnitude of change is considered to be medium.

11.5.64 The medium magnitude of change, assessed alongside the high sensitivity of the receptor would result in **moderate adverse** effects.

Viewpoint 2.15: View south from Prior Gardens Bank

11.5.65 The foreground of the view across the river from this location would be characterised by the presence of the site cofferdam, construction activity, construction plant and welfare facilities. Construction activity at the site would partially obscure views of the historic facade along Lower Richmond Road. Construction activity associated with the temporary slipway would also be highly visible. Therefore, the magnitude of change is considered to be high.

11.5.66 The high magnitude of change, assessed alongside the high sensitivity of the receptor would result in **major adverse** effects.

Transport

Viewpoint 3.1: View south from the junction of Fulham High Street and New Kings Road

11.5.67 Views from this location would be affected to a limited extent during construction due to the visibility of tall construction plant and cranes at the site. The majority of the works at the site would be screened by the level change between the viewpoint and the site, the structure of Putney Bridge and buildings and vegetation along the western edge of Fulham High Street. Therefore, the magnitude of change is considered to be negligible.

11.5.68 The negligible magnitude of change assessed alongside the medium sensitivity of the receptor would result in a **negligible** effect.

Visual effects – sensitivity test for programme delay

11.5.69 For the assessment of visual effects during construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely materially to change the assessment findings reported above (paras. 11.5.33 to 11.5.68). This is on the basis that there are no known schemes within the assessment area that would introduce new visual receptors, or alter visibility of the proposed development from the viewpoints described in paras. 11.4.59 to 11.4.110.

11.6 Operational effects assessment

11.6.1 The following section details the likely significant effects arising during the operational phase at Putney Embankment Foreshore.

11.6.2 Effect on tranquillity is one factor which informs the overall assessment of effects on townscape character. Since the operational scheme would have little activity associated with it, apart from infrequent maintenance visits, it is considered that the proposed development would have a negligible effect on tranquillity for all townscape character areas. This is therefore not stated again for each character area discussed below.

11.6.3 For the site, all surrounding townscape character areas and all viewpoints, adverse effects would be minimised by the commitment to a high quality design as detailed in the design principles summarised in para. 11.2.6. Where specific measures are of particular relevance to the effect on a receptor, these are described under the relevant townscape character area or viewpoint.

11.6.4 Illustrative plans of the proposed development during operation are contained in a separate volume of figures (see Permanent works layout 1 and 2, separate volume of figures – Section 1) and design principles describing the environmental design measures are set out in Vol 1 Appendix B. Where photomontages have been prepared to assist the assessment of effects, these are referenced in the appropriate viewpoint below.

Operational effects Year 1

Site character assessment

11.6.5 The proposed development would have a permanent effect on the character of the site. The permanent layout would result in the creation of a new area of public realm along Putney Embankment that would project into the river by approximately 15m. This projection would introduce a new rectangular structure into the river beyond the line of the river wall, in a stretch of river characterised by a consistent sweep with few incursions apart from Putney Pier immediately adjacent to the site. The river wall surrounding the foreshore structure would be finished in natural stone with vertical timber fenders on the outer face and horizontal fenders on the upstream and downstream faces. The design intent for the river wall is illustrated on the Typical river wall design intent figure (see separate volume of figures – Section 1).

11.6.6 A 4-8m high quality ventilation column and a 2.5m high electrical and control kiosk would be located on the foreshore structure, introducing new structures within the river corridor. The design intent for the ventilation column (which would be the project signature design) is illustrated on the Ventilation columns design intent figure – type A (see separate volume of figures – Section 1). An indicative drawing of the design intent for the electrical and control kiosk is shown on the Foreshore kiosk design intent figure (see separate volume of figures – Section 1). A further 3m high electrical and control kiosk would be located in Waterman’s Green set against the Lower Richmond Road retaining wall and clad to visually integrate with the existing stonework. An indicative drawing of the design intent for this kiosk is shown on the Proposed listed structure interface – kiosk figure (see separate volume of figures – Section 1). A further 6m high narrow ventilation column for the interception chamber would be located on the pavement in front of St Mary’s Church on Putney High Street. However, this would appear similar in character to existing lamp columns and other street furniture along the pavement.

11.6.7 There would additionally be a new foreshore structure at the CSO interception site under Putney Bridge, which would be set beneath the springing point of the bridge and back from the main bridge elevations.

This structure would have a high quality concrete finish to complement the natural stone of Putney Bridge.

11.6.8 The historic public drawdock/slipway and other land based areas of the construction site would be returned to their original condition at completion of construction. The temporary slipway located close to Ruvigny Gardens to the west of the site, would be entirely removed upon completion. While the permanent foreshore structure would provide an area of high quality public space alongside Embankment, it also introduces a new structure into a highly sensitive stretch of the River Thames foreshore. The impacts on specific components of the site are described in Vol 7 Table 11.6.1 below.

Vol 7 Table 11.6.1 Townscape – impacts on baseline components in Year 1 of operation

ID	Component	Impacts
01	Trees within Waterman's Green	The holly tree removed during construction would be replaced with another tree at a location to be agreed with the local authority.
02	Retaining wall to public drawdock/slipway	No operational impacts.
03	Public drawdock/slipway	Sections of existing pedestrian footway, public drawdock/slipway and paving slabs would be reinstated.
04	Upright timber fenders	Partially retained in the original position and partially removed along the length of the permanent encroachment into the river.
05	Grade II listed bollards	Restored and relocated on site.
06	River wall	Partially obscured behind a new river wall
07	Statue	This would be reinstated to its original position following construction.
08	Putney pier	The houseboat would be reinstated in its original position.

11.6.9 Due to the introduction of a foreshore structure projecting into the river but broadly in keeping with the existing townscape character, the magnitude of change is considered to be low.

11.6.10 The low magnitude of change, assessed alongside the high sensitivity of the site, would result in **minor adverse** effects.

Townscape character areas assessment

11.6.11 This section describes effects arising from the proposed development in operation on townscape character areas surrounding the site. No assessment of townscape effects has been made for Leaders Gardens

TCA, as the components of the operational scheme would not alter the setting of the area.

River Thames – Putney and Fulham Palace Reach TCA; and Bishops Park TCA

11.6.12 The proposed development would result in changes to the direct riverside setting of these character areas, due to the presence of the foreshore structure projecting into the river, interrupting the current sweep along the southern bank and introducing built structures into the river corridor. Furthermore, the interception chamber underneath Putney Bridge would alter the character of the southern end of the bridge to a limited extent. However, the magnitude of change is considered to be low due to the design of the river wall, interception chamber and above ground structures, which would tie in with the existing townscape character on the southern bank.

11.6.13 The low magnitude of change, assessed alongside the high sensitivity of these character areas would result in **minor adverse** effects.

Putney Bridge Conservation Area TCA

11.6.14 The proposed development would result in changes to the wider riverside setting of this character area, due to the presence of the interception chamber under Putney Bridge. The interception chamber would be intermittently visible at low tide only and has been designed to be located below the springing point of the bridge, making it barely perceptible in the wider setting. Furthermore, the majority of the setting of the character area would be unaffected. Therefore, the magnitude of change is considered to be negligible.

11.6.15 The negligible magnitude of change, assessed alongside the high sensitivity of this character area would result in a **negligible** effect.

11.6.16 The assessment of specific effects on the setting of Putney Bridge Conservation Area as a heritage asset is set out in Section 7 of this volume. The historic environment assessment identifies a minor adverse effect on the setting of this asset due to differences between the townscape and visual, and historic environment methodologies.

Putney Embankment Conservation Area TCA

11.6.17 The proposed development would result in changes to the direct riverside setting of this character area, due to the presence of the foreshore structure projecting into the river, interrupting the current sweep along the southern bank and introducing built structures into the river corridor. Furthermore, the interception chamber at Putney Bridge would alter the character of the southern end of the bridge to a limited extent. However, the magnitude of change is considered to be low due to the design of the river wall, interception chamber and above ground structures, which would tie in with the existing townscape character on the southern bank.

11.6.18 The low magnitude of change, assessed alongside the high sensitivity of this character area would result in **minor adverse** effects.

11.6.19 The assessment of specific effects on the setting of Putney Embankment Conservation Area as a heritage asset is set out in Section 7 of this volume.

Townscape – sensitivity test for programme delay

11.6.20 For the assessment of townscape effects during operation, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely materially to change the assessment findings reported above (paras. 11.6.5 to 11.6.19). This is on the basis that there are no known schemes that would change the sensitivity to change of the townscape character areas already presented (paras. 11.4.2 to 11.4.57).

Visual assessment

11.6.21 For each viewpoint, an assessment of the visual effects during Year 1 of operation has been made. In each instance, the first part of the assessment relates to visual effects during winter, while the second part relates to visual effects during summer.

11.6.22 No assessment of visual effects has been made for the following viewpoints, as the components of the operational scheme would either not be visible or would be barely perceptible in the background of the view:

a. Viewpoint 2.2: View west from Wandsworth Park

b. Viewpoint 2.3: View north from Putney High Street

c. Viewpoint 2.6: View east from Lower Richmond Road outside the Star and Garter restaurant

d. Viewpoint 2.9: View southeast from Leaders Gardens

e. Viewpoint 2.10: View southeast from Embankment at Beverley Brook

f. Viewpoint 2.11: View southeast from the western extent of Bishops Park

g. Viewpoint 2.13: View southeast from Fulham Palace

h. Viewpoint 3.1: View south from the junction of Fulham High Street and New Kings Road.

Residential

Viewpoint 1.1: View southwest from residences in Carrara Wharf

11.6.23 Views from residences towards the main foreshore structure and ventilation column would be obscured by the arches of Putney Bridge, although the interception chamber under Putney Bridge would be intermittently visible at low tide. The majority of the view would remain unchanged. Due to the design of the chamber, located below the springing point on the bridge and with a high quality finish, the magnitude of change is considered to be negligible.

11.6.24 The negligible magnitude of change, assessed alongside the high sensitivity of this receptor would result in a **negligible** effect.

11.6.25 There would be no change to the assessment during summer.

Viewpoint 1.2: View north from residences in Kenilworth Court

11.6.26 Views from residences towards the site would be affected by the design of the public realm, above ground structures and interception chamber under Putney Bridge. The new site and structures would form new components in the foreground of the view, altering views across the river and towards Putney Bridge. The form of the foreshore structure, projecting into the river, would alter views of the existing sweep of river wall. However, due to the high quality design of the site, in keeping with the existing townscape character of the area, the magnitude of change is considered to be low.

11.6.27 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

11.6.28 During summer, views of the foreshore structure, interception chamber and above ground structures would be heavily filtered by the line of mature trees along Embankment and within Waterman's Green. Therefore, the magnitude of change is considered to be negligible, which would result in a **negligible** effect.

Recreational

Viewpoint 2.1: View southwest from Putney Bridge

11.6.29 Views towards the site from this location would be affected by the design of the river wall and above ground structures. The new site and structures would form highly visible components in the foreground of the view. The form of the foreshore structure, projecting into the river, would alter views of the existing sweep of river wall. The view of the proposed development from this viewpoint is illustrated in Vol 7 Plate 11.6.1 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 7 Figure 11.6.1 (see separate volume of figures). The layout of the proposed development illustrated in this photomontage may change within the zones shown on the Site works parameter plan (see separate volume of figures – Section 1), however the assessment of effects would be no worse than that described here.

Vol 7 Plate 11.6.1 Viewpoint 2.1 – illustrative operational phase photomontage

Date taken: 15 March 2011. 50mm lens.

11.6.30 However, due to the high quality design of the site, in keeping with the existing townscape character of the area, the magnitude of change is considered to be low.

11.6.31 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

11.6.32 There would be no change to the assessment during summer.

11.6.33 The assessment of specific effects on the setting of the Grade II listed Putney Bridge as a heritage asset is set out in Section 7 of this volume.

Viewpoint 2.4: View northwest from Putney High Street outside St Mary's Church

11.6.34 Views of the site from this location would be almost entirely obscured by the level change between the viewpoint and the site. Views of the ventilation column on Embankment and the interception ventilation column on Putney Bridge would be largely screened by the density of street furniture and other structures along Putney High Street and Lower Richmond Road. The view of the proposed development from this viewpoint is illustrated in Vol 7 Plate 11.6.2 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 7 Figure 11.6.2 (see separate volume of figures). The layout of the proposed development illustrated in this photomontage may change within the zones shown on the Site works parameter plan (see separate volume of figures – Section 1), however the assessment of effects would be no worse than that described here.

Vol 7 Plate 11.6.2 Viewpoint 2.4 – illustrative operational phase photomontage

Date taken: 15 March 2011. 50mm lens.

11.6.35 Due to the degree of screening, the magnitude of change is considered to be negligible.

11.6.36 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor would result in a **negligible** effect.

11.6.37 During summer, mature trees along Waterman's Green would further obscure views towards the site, and therefore effects would remain **negligible**.

11.6.38 The assessment of specific effects on the setting of the Grade II* listed St Mary's Church as a heritage asset is set out in Section 7 of this volume. The historic environment assessment identifies a minor adverse effect on the setting of this asset due to differences between the townscape and visual, and historic environment methodologies.

Viewpoint 2.5: View east from the eastern end of Embankment; and Viewpoint 2.7: View southeast from Embankment outside The Dukes Head

11.6.39 Views towards the site from these locations would be affected by the design of the river wall, above ground structures and the interception chamber under Putney Bridge. The proposed development would form a new component in the foreground of the views, partially obscuring views of Putney Bridge. The view of the proposed development from viewpoint 2.7 is illustrated in Vol 7 Plate 11.6.3 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 7 Figure 11.6.3 (see separate volume of figures). The layout of the proposed development illustrated in this photomontage may change within the zones shown on the Site works parameter plan (see separate volume of figures – Section 1), however the assessment of effects would be no worse than that described here.

Vol 7 Plate 11.6.3 Viewpoint 2.7 – illustrative operational phase photomontage

Date taken: 15 March 2011. 50mm lens.

11.6.40 However, due to the high quality design of the site, in keeping with the existing townscape character of the area, the magnitude of change is considered to be low.

11.6.41 The low magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **minor adverse** effects.

11.6.42 There would be no change to the assessment during summer.

Viewpoint 2.8: View southeast from Embankment outside Leaders Gardens

11.6.43 Views towards the site from this location would be affected to a limited extent by the design of the river wall and ventilation column. The foreshore structure and other above ground structures would form components visible in the background of the view, although partially obscured by Putney Pier. However, due to the high quality design of the site, in keeping with the existing townscape character of the area, the magnitude of change is considered to be negligible.

11.6.44 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor would result in a **negligible** effect.

11.6.45 There would be no change to the assessment during summer.

Viewpoint 2.12: View southeast from Bishops Park close to Bishops Avenue; Viewpoint 2.14: View southeast from Bishops Park riverside; and Viewpoint 2.15: View south from Prior Gardens Bank

11.6.46 Views towards the site from these locations would be affected by the design of the river wall, above ground structures and the interception chamber under Putney Bridge. The foreshore structure and other above ground structures would form components in the view across the river, although not set in front of Putney Bridge. The form of the foreshore structure, projecting into the river, would alter views of the existing sweep of river wall. The wider panorama of the river would be unaffected. Due to the high quality design of the site, in keeping with the existing townscape character of the area, the magnitude of change is considered to be low.

11.6.47 The low magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **minor adverse** effects.

11.6.48 There would be no change to the assessment during summer.

Visual effects – sensitivity test for programme delay

11.6.49 For the assessment of visual effects during operation, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely materially to change the assessment findings reported above (paras. 11.6.22 to 11.6.48). This is on the basis that there are no known schemes within the assessment area that would introduce new visual receptors, or alter visibility of the proposed development from the viewpoints described in paras. 11.4.59 to 11.4.110.

Operational effects Year 15

11.6.50 Operational effects for all townscape and visual receptors identified would remain unchanged in Year 15 compared to Year 1, due to the fact that the proposed development would not include additional planting that would alter effects with maturity. Effects would also remain the same given the limited changes anticipated in the surrounding area in the Year 15 base case. This would also apply in the event of a programme delay to the Thames Tideway Tunnel project of approximately one year.

11.7 Cumulative effects assessment

11.7.1 As detailed in the site development schedule (Vol 7 Appendix N) no schemes have been identified within 1km of the site which meet the criteria for inclusion in the cumulative assessment during Site Year 2 of construction or Year 1 of operation. Therefore no assessment of cumulative effects has been undertaken. This would also apply in the event of a programme delay to the Thames Tideway Tunnel project of approximately one year.

11.8 Mitigation

11.8.1 All measures embedded in the proposed scheme and *CoCP* of relevance to the townscape and visual assessment are summarised in Section 11.2. No further mitigation during construction is possible due to the highly visible nature of the construction activities.

11.8.2 A process of iterative design and assessment has been employed to reduce adverse effects during operation. No further mitigation is required as no significant adverse effects are predicted for the operational phase.

11.9 Residual effects assessment

Construction effects

11.9.1 As no mitigation measures are proposed, the residual construction effects remain as described in Section 11.5. All residual effects are presented in Section 11.10.

Operational effects

11.9.2 As no mitigation measures are proposed, the residual operational effects remain as described in Section 11.6. All residual effects are presented in Section 11.10.

11.10 Assessment summary

Vol 7 Table 11.10.1 Townscape – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
The site	Change to character due to construction of the site cofferdam, hoardings, welfare facilities, temporary slipway and intensity of construction activity.	Major adverse	No mitigation possible	Major adverse
River Thames – Putney and Fulham Palace Reach TCA	Change to setting due to the high levels of construction activity in this stretch of the river.	Major adverse	No mitigation possible	Major adverse
Bishops Park TCA	Change to riverside setting due to the presence of the site cofferdam, construction activity, construction plant and welfare facilities.	Major adverse	No mitigation possible	Major adverse
Putney Bridge Conservation Area TCA	Change to part of the riverside setting due to the presence of the site cofferdam, construction activity, construction plant and welfare facilities, partially obscured by Putney Bridge.	Minor adverse	None	Minor adverse
Putney Embankment Conservation Area TCA	Change to riverside setting due to the presence of the site cofferdam, construction activity, construction plant, welfare facilities, traffic and installation of the temporary slipway.	Major adverse	No mitigation possible	Major adverse
Leaders Gardens TCA	Change to wider setting due to the background presence of construction activity at the main site and secondary site.	Minor adverse	None	Minor adverse

Vol 7 Table 11.10.2 Visual – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential				
Viewpoint 1.1: View southwest from residences in Carrara Wharf	Visibility of construction activity at the CSO interception site, and tall construction plant at the main site.	Minor adverse	None	Minor adverse
Viewpoint 1.2: View north from residences in Kenilworth Court	Foreground visibility of site hoardings, welfare facilities, construction activity and construction plant.	Major adverse	No mitigation possible	Major adverse
Recreational				
Viewpoint 2.1: View southwest from Putney Bridge	Foreground visibility of the site cofferdam, construction activity and construction plant.	Major adverse	No mitigation possible	Major adverse
Viewpoint 2.2: View west from Wandsworth Park	Oblique intermittent visibility of cranes and works at the CSO interception chamber.	Negligible	None	Negligible
Viewpoint 2.3: View north from Putney High Street	Intermittent visibility of tall construction plant and cranes in the background of the view.	Negligible	None	Negligible
Viewpoint 2.4: View northwest from Putney High Street outside St Mary's Church	Visibility of tall construction plant, cranes and road transport.	Minor adverse	None	Minor adverse
Viewpoint 2.5: View east from the eastern end of Embankment	Foreground visibility of site hoardings, welfare facilities, construction activity and construction plant.	Major adverse	No mitigation possible	Major adverse
Viewpoint 2.6: View east from Lower Richmond Road outside the Star and	Background visibility of tall construction plant, cranes and road transport.	Minor adverse	None	Minor adverse

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Garter				
Viewpoint 2.7: View southeast from Embankment outside The Dukes Head	Visibility of the site cofferdam, construction activity, construction plant and welfare facilities.	Moderate adverse	No mitigation possible	Moderate adverse
Viewpoint 2.8: View southeast from Embankment outside Leaders Gardens	Background visibility of tall construction plant, welfare facilities and cranes.	Minor adverse	None	Minor adverse
Viewpoint 2.9: View southeast from Leaders Gardens	No significant visibility of construction activities.	Negligible	None	Negligible
Viewpoint 2.10: View southeast from Embankment at Beverley Brook	Background visibility of tall construction plant, welfare facilities and cranes.	Minor adverse	None	Minor adverse
Viewpoint 2.11: View southeast from the western extent of Bishops Park	No significant visibility of construction activities.	Negligible	None	Negligible
Viewpoint 2.12: View southeast from Bishops Park close to Bishops Avenue	Background visibility of the site cofferdam, construction activity, construction plant and welfare facilities.	Minor adverse	None	Minor adverse
Viewpoint 2.13: View southeast from Fulham Palace	No significant visibility of construction activities.	Negligible	None	Negligible
Viewpoint 2.14: View southeast from Bishops Park riverside	Middle ground visibility of the site cofferdam, construction activity, construction plant and welfare facilities.	Moderate adverse	No mitigation possible	Moderate adverse
Viewpoint 2.15: View south from Prior Gardens Bank	Foreground visibility of the site cofferdam, construction activity, construction plant and welfare facilities.	Major adverse	No mitigation possible	Major adverse
Transport				

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Viewpoint 3.1: View south from the junction of Fulham High Street and New Kings Road	No significant visibility of construction activities.	Negligible	None	Negligible

Vol 7 Table 11.10.3 Townscape – summary of Year 1 and Year 15 operational assessment[ii]

Receptor[iii]	Effect	Significance of effect	Mitigation	Significance of residual effect
The site	Change in character through the introduction of a new public realm and above ground structures in an area previously part of the river.	Minor adverse	None	Minor adverse
River Thames – Putney and Fulham Palace Reach TCA	Change to setting through the introduction of a new public realm and above ground structures in an area previously part of the river.	Minor adverse	None	Minor adverse
Bishops Park TCA	Change to setting through the introduction of a new public realm and above ground structures in an area previously part of the river.	Minor adverse	None	Minor adverse
Putney Bridge Conservation Area TCA	Change to wider riverside setting due to the interception chamber at Putney Bridge	Negligible	None	Negligible
Putney Embankment Conservation Area TCA	Change to immediate riverside setting due to the foreshore structure projecting into the river and the presence of above ground structures.	Minor adverse	None	Minor adverse

[ii] Operational effects have been assessed to be the same in both Year 1 and Year 15 of operation
[iii] Townscape character areas not assessed during operation (refer to para. 11.6.11) are not included in the summary table

Vol 7 Table 11.10.4 Visual – summary of Year 1 and Year 15 operational assessment[iv]

Receptor[v]	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential				
Viewpoint 1.1: View southwest from residences in Carrara Wharf	Intermittent visibility of the interception chamber, partially obscured by Putney Bridge.	Winter – Negligible	Winter – None	Winter – Negligible
		Summer – Negligible	Summer – None	Summer – Negligible
Viewpoint 1.2: View north from residences in Kenilworth Court	Foreground visibility of the above ground structures, new foreshore structure and interception chamber.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Negligible	Summer – None	Summer – Negligible
Recreational				
Viewpoint 2.1: View southwest from Putney Bridge	Foreground visibility of the new river wall, above ground structures and public realm projecting into the river.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Minor adverse	Summer – None	Summer – Minor adverse
Viewpoint 2.4: View northwest from Putney High Street outside St Mary's Church	Intermittent visibility of the ventilation column, largely obscured by intervening street furniture	Winter – Negligible	Winter – None	Winter – Negligible
		Summer –	Summer –	Summer –

[iv] Operational effects have been assessed to be the same in both Year 1 and Year 15 of operation

[v] Visual receptors not assessed during operation (refer to para. 11.6.22) are not included in the summary table

Receptor[v]	Effect	Significance of effect	Mitigation	Significance of residual effect
		Negligible	None	Negligible
Viewpoint 2.5: View east from the eastern end of Embankment	Foreground visibility of the new river wall, above ground structures and public realm projecting into the river.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Minor adverse	Summer – None	Summer – Minor adverse
Viewpoint 2.7: View southeast from Embankment outside The Dukes Head	Foreground visibility of the new river wall, above ground structures and public realm projecting into the river.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Minor adverse	Summer – None	Summer – Minor adverse
Viewpoint 2.8: View southeast from Embankment outside Leaders Gardens	Background visibility of the new river wall and above ground structures	Winter – Negligible	Winter – None	Winter – Negligible
		Summer – Negligible	Summer – None	Summer – Negligible
Viewpoint 2.12: View southeast from Bishops Park close to Bishops Avenue	Visibility of the new river wall and above ground structures located on the foreshore structure projecting into the river.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Minor adverse	Summer – None	Summer – Minor adverse
Viewpoint 2.14: View southeast from Bishops Park riverside	Visibility of the new river wall and above ground structures located on the foreshore structure projecting into the river.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Minor adverse	Summer – None	Summer – Minor adverse
Viewpoint 2.15: View south from Prior	Visibility of the new river wall and	Winter –	Winter –	Winter –

Receptor[v]	Effect	Significance of effect	Mitigation	Significance of residual effect
Gardens Bank	above ground structures located on the foreshore structure projecting into the river.	Minor adverse	None	Minor adverse
		Summer – Minor adverse	Summer – None	Summer – Minor adverse

References

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

[2] LB of Wandsworth. *LDF Core Strategy* (October 2010).

[3] LB of Hammersmith & Fulham. *LDF Core Strategy* (October 2011).

[4] LB of Richmond upon Thames. *LDF Core Strategy* (April 2009).

[5] LB of Wandsworth. *Conservation Area Appraisal and Management Strategies* (no date).

[6] LB of Hammersmith & Fulham. *Bishops Park Conservation Area Character Profile* (November 1998).

[7] LB of Hammersmith & Fulham. *Fulham Reach Conservation Area Character Profile* (September 1997).

[8] LB of Hammersmith & Fulham. *Fulham Park Gardens Conservation Area Character Profile* (August 2001).

[9] LB of Hammersmith & Fulham. *Putney Bridge Conservation Area Character Profile* (February 1999).

[10] Atkins. *The Thames Strategy: Kew to Chelsea* (June 2002).

[11] Department of Environment, Food and Rural Affairs (2012). See citation above.

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 12: Transport

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

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Thames Tideway Tunnel

Environmental Statement

Volume 7: Putney Embankment Foreshore site assessment

Section 12: Transport

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12 Transport

12.1 Introduction

12.1.1 This section presents the findings of the assessment of the likely significant transport effects of the proposed development at the Putney Embankment Foreshore site. The project-wide transport effects are described in Volume 3 Project-wide effects assessment.

12.1.2 Construction of the proposed development at the site (both main site and secondary site) has the potential to affect the following transport elements:

a. pedestrian routes

b. cycle routes

c. bus routes and patronage

d. London Underground and National Rail services

e. river passenger services and river navigation

f. car parking

g. highway layout, operation and capacity.

12.1.3 The assessment considers the effects on each of these elements during construction, as well as effects on specific receptors including residents of houseboats and nearby properties and users/occupiers of nearby businesses.

12.1.4 The operation of the Putney Embankment Foreshore site has the potential to affect highway layout and operation and therefore effects on these are considered within the operational assessment.

12.1.5 The assessment of transport presented in this section has considered the requirements of the National Policy Statement for Waste Water (Defra, 2012)[1] section 4.13. Further details of these requirements can be found in Vol 2 Section 12.3.

12.1.6 Additionally, a separate *Transport Assessment* has been produced which provides an assessment of the effects on the transport network as a result of the construction and operational phases at the Putney Embankment Foreshore site. The *Transport Assessment* will accompany the application.

12.1.7 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 7 Putney Embankment Foreshore figures).

12.1.8 The separate but related assessments of effects of transport on air quality and noise and vibration are contained in Vol 7 Sections 4 and 9 respectively.

12.2 Proposed development relevant to transport

12.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to transport are set out below.

Construction

12.2.2 The construction site is located in the southern foreshore of the River Thames to the west of Putney Bridge within the London Borough (LB) of Wandsworth.

12.2.3 During construction it is anticipated that the elements listed under para. 12.1.2 may be affected as a result of:

a. construction traffic associated with works in the main and secondary sites at Putney Embankment Foreshore and other Thames Tideway Tunnel project construction sites with construction routes along Lower Richmond Road (B306)

b. pedestrian and cycle diversions along Embankment

c. cycle stand relocation

d. temporary suspension of parking bays on Embankment

e. changes in highway layout and operation on Embankment

12.2.4 The existing public slipway located within the main site would be suspended during construction. For this reason a temporary slipway would be built at the secondary site, prior to phase one of construction, to ensure a public slipway facility at this location on the River Thames is maintained during the construction works. This would be located approximately 150m to the west of the main site on Embankment. The works to construct the temporary slipway would last for approximately three months prior to construction commencing on the main site. The temporary slipway would be removed once the public drawdock/slipway is reinstated at the end of the construction works.

12.2.5 Details of the peak year of construction, anticipated lorry and barge movements and the activities which would generate these movements are provided inVol 7 Table 12.2.1.

Vol 7 Table 12.2.1 Transport – construction details

Description	Assumption
Assumed peak period of construction lorry movements	Site Year 2 of construction
Assumed average peak daily construction lorry vehicle movements (in peak month of Site Year 2 of construction)	42 movements per day (21 vehicle trips)
Assumed peak period of construction barge	Site Year 3 of construction

Description	Assumption
movements	
Assumed average peak daily construction barge movements (in peak month of Site Year 3 of construction)	4 movements per day (2 barge trips)
Types of lorry requiring access (comprising rigid-bodied, flatbed and articulated vehicles)	Excavated material lorries Ready-mix concrete lorries Steel reinforcement lorries Temporary construction materials including formwork lorries Plant and equipment lorries Office and general delivery lorries Imported fill lorries

Note: a movement is a construction vehicle/barge moving either to or from a site. A Site Year is a 12 month period, one in a series of Site Years; Site Year 1 commences at the start of construction

12.2.6 During construction cofferdam fill (both import and export), shaft and other excavated material would be transported by barge. For the transport assessment it has been assumed that 90% of these materials are taken by river. This allows for periods that the river is unavailable and material unsuitable for river transport. All other material would be transported by road.

12.2.7 The proposed working hours are set out in the *CoCP*[i] (Section 4) and vehicle movements would take place during the standard day shift of ten hours on weekdays (08:00 to 18:00) and five hours on Saturdays (08:00 to 13:00) with up to one hour before and after these hours for mobilisation and demobilisation of staff. It would only be in exceptional circumstances that HGV and abnormal load movements could occur up to 22:00 on weekdays for large concrete pours and later at night by agreement with the LB of Wandsworth.

Construction traffic routing

12.2.8 The access plan and highway layout during construction plans (see separate volume of figures – Section 1) present the highway layout during construction at the Putney Embankment Foreshore site.

12.2.9 The Putney Embankment Foreshore site would be accessed via a new vehicle access point close to the junction of Embankment and Lower Richmond Road (B306).

[i] The Code of Construction Practice (CoCP) is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B).

12.2.10 Vol 7 Figure 12.2.1 (see separate volume of figures) shows the construction traffic routes for access to/from the Putney Embankment Foreshore site. Construction routes have been discussed with both Transport for London (TfL) and the Local Highway Authority (LHA), LB of Wandsworth for the purposes of the assessment.

12.2.11 The construction vehicle route for vehicles approaching from the west would utilise Upper Richmond Road (A205) and then Putney High Street (A219) and Lower Richmond Road (B306). Vehicles arriving from the east would route through the Wandsworth Gyratory and Putney Bridge Road, then Putney High Street (A219) and Lower Richmond Road (B306). Putney High Street (A219) forms part of the Strategic Road Network (SRN) while Upper Richmond Road (A205) forms part of the Transport for London Road Network (TLRN).

12.2.12 A short length of the existing one way arrangement on Embankment between the new site access and the junction with Lower Richmond Road (B306) would be converted to two way operation during the construction period of the main site works. This would be achieved by suspending a small section of on-street parking on the eastern end of Embankment. This would enable construction vehicles to exit the site directly via the Embankment / Lower Richmond Road (B306) junction and minimise construction vehicles travelling westbound along Embankment. Construction vehicles would then travel away from the site following the same routes as described in para. 12.2.11.

12.2.13 The secondary site (constructed prior to phase one of construction at the Putney Embankment Foreshore site) would be located within the southern foreshore of the River Thames and accessed directly from Embankment via a new temporary access point, approximately 150m west of the main site.

12.2.14 Construction vehicles to the secondary site would arrive and depart from Lower Richmond Road (B306) using the same routes as for the main site. Vehicles would then approach via Glendarvon Street and Embankment and exit back onto Lower Richmond Road (B306) via Thames Place.

12.2.15 Temporary traffic management, including suspension of parking, would be required along a short stretch of Embankment (approximately 80m in length) at the site access point as Embankment would be reduced to a single lane during the slipway construction. Signed priority would be given to westbound vehicles which would include HGVs exiting the site via Thames Place. This would also reduce the amount of on-street parking that would need to be suspended on this stretch of Embankment.

12.2.16 During the construction of the secondary site a small section of on-street parking at the southern end of Glendarvon Street would also be suspended to facilitate the turning movement of construction vehicles.

Construction workers

12.2.17 The construction site is expected to require a maximum workforce of approximately 50 workers at any one time. The number and type of workers is shown in Vol 7 Table 12.2.2.

Vol 7 Table 12.2.2 Transport – maximum construction worker numbers

Contractor		Client
Staff*	**Labour****	**Staff*****
08:00-18:00	**08:00-18:00**	**08:00-18:00**
20	20	10

** Contractor Staff – engineering and support staff to direct and project manage the engineering work and site.*
*** Contractor Labour – those working on site doing engineering, construction and manual work.*
**** Staff Client – engineering and support staff managing the project and supervising the Contractor.*

12.2.18 At the Putney Embankment Foreshore site there would be no parking provided within the site boundary for workers. As parking on surrounding streets would also be restricted, and measures to reduce car use would be incorporated into the site-specific Travel Plan (prepared by the contractor in accordance with the overall aims and objectives of the *Draft Project Framework Travel Plan*), it is highly unlikely that workers would travel by car. It is therefore assumed that construction workers would access the site by other modes of transport, further details of which are provided in Vol 7 Table 12.5.1.

Code of Construction Practice

12.2.19 Measures incorporated into the *Code of Construction Practice (CoCP) Part A* (Section 5) to reduce transport impacts include:

a. site specific *Traffic Management Plans* (TMP): to set out how vehicular access to the site would be managed so as to minimise impact on the local area and communicate this with the local borough and other stakeholders. This includes any works on the highway, diversion or temporary closure of the highway or public right of way

b. HGV management and control: to ensure construction vehicles use appropriate routes to the sites and the vehicle fleet and/or drivers meet current safety and environmental standards

c. site specific *River Transport Management Plans* (RTMP) are to be produced for each relevant worksite. As with the TMP's this would set out how river access to site would be managed so as to minimise impact on the river and communicate this with the PLA, local borough and other stakeholders.

12.2.20 In addition to the above general measures within the *CoCP Part A*, the following measures have been incorporated into the *CoCP Part B* (Section 5), relating to the Putney Embankment Foreshore site:

a. the existing public slipway/drawdock is to be maintained until the secondary site is operational. The secondary site would be maintained until reinstatement of the public slipway/drawdock.

b. emergency egress points for vaults located beneath Lower Richmond Road (B306), egress across Waterman’s Green to be maintained during the majority of the construction period, and their use should remain unaffected should existing planning permission into cafes or restaurants be implemented.

c. access across Watermans Green would be restricted during the later stages of construction. During this period, pedestrian access to the eastern end of the Green would be available by utilising the existing stairway located adjacent to the disused public convenience.

d. access to Putney Pier would be maintained for the duration of the construction works. The contractor would liaise with the pier owner and TfL (London River Services).

e. the site would be accessed from Putney High Street (A219) via Putney Bridge Road, traffic would then turn left onto Lower Richmond Road (B306) and right into the site from the Embankment.

f. during the construction of the secondary site construction traffic would access the site by turning right from Lower Richmond Road (B306) into Glendarvon Street and turning right into Embankment. Construction vehicles would then stop at a designated location on Embankment adjacent to the site to load/unload. When leaving the site construction vehicles would route east along Embankment and turn right into Thames Place then left turn into Lower Richmond Road (B306).

Main site:

g. it is proposed to change the operation of Embankment between the new site access and the junction with Lower Richmond Road to two-way for construction vehicles only during the main site works. A minimum carriageway width of 3.25m would be retained in each direction.

h. two-way flow on Embankment at THE secondary site construction to be maintained for general traffic using a priority traffic management system as required.

i. construction vehicles associated with the main construction site would not use Glendarvon Street.

j. small section of on-street parking to be suspended on the eastern end of Embankment where Embankment would operate as two-way for construction vehicles.

Secondary site:

k. construction vehicles associated with either the construction or subsequent dismantling of the secondary site would only access via Glendarvon Street between the hours of 10:00 and 15:00 Monday to Friday. Construction vehicles would not be permitted to use Glendarvon Street outside this period.

l. suspension of the majority of on-street parking on Embankment between Thames Place and Glendarvon Street during construction of slipway and subsequent removal.

m. suspension of a small section of parking on the southern end of Glendarvon Street to facilitate the passing of vehicles during construction of the slipway and subsequent removal.

n. parking bays located at the southern end of Glendarvon Street to facilitate construction vehicle movements would be replaced (subject to agreement with LB of Wandsworth) with parking restrictions, such that local residents may park during evenings/overnight when the parking restrictions are inactive.

o. a traffic marshal would be in place if large vehicles are required to reverse out of the site onto Embankment.

p. traffic management plan to address potential conflict between construction vehicles and other large vehicles such as vehicles transporting boats at Glendarvon Street junction with Embankment by measures such as timed deliveries, traffic marshals or priority signage.

q. construction vehicle drivers to be aware of the restricted road width along Glendarvon Street and to look out for potential conflicts with oncoming vehicles.

r. cycle stands on Embankment would be relocated approximately 20m west along Embankment.

12.2.21 The effective implementation of the *CoCP Part A* and *Part B* measures is assumed within the assessment.

12.2.22 Based on current travel planning guidance including TfL's 'Travel planning for new development in London' (Tf L, 2011)[2], this development falls within the threshold for producing a Strategic Framework Travel Plan. A *Draft Project Framework Travel Plan* has been prepared based on the TfL ATTrBuTE guidance[3]; this will accompany the application. The *Draft Project Framework Travel Plan* addresses project-wide travel planning measures and CoCP Part B addresses site-specific measures including the need for a project-wide Travel Plan Manager, initial travel surveys during construction and a monitoring framework. It also contains requirements and guidelines for the site-specific travel plans to be prepared by the site contractors. The site-specific travel planning requirements of relevance to the *Draft Project Framework Travel Plan* are as follows:

a. information on existing transport networks and travel initiatives for the Putney Embankment Foreshore site

b. a mode split established for the Putney Embankment Foreshore site construction workers to establish and monitor travel patterns

c. site-specific targets and interim targets based on the mode share which would link to objectives based on local, regional and national policy

d. a nominated person with responsibility for managing the Travel Plan monitoring and action plans specifically for this site.

Other measures during construction

12.2.23 Embedded design measures which are not outlined in the CoCP but are of relevance to the transport assessment at the Putney Embankment Foreshore site include the widening of the Embankment/Lower Richmond Road (B306) junction to accommodate construction vehicle movements and the new site access. This would be achieved via the removal of a traffic island rather than any kerb or footway modifications.

Operation

12.2.24 During operation maintenance vehicles would enter the site via the new access point (same vicinity as the main site construction site access point) from Embankment via the Lower Richmond Road (B306), as set out in the Putney Embankment Foreshore design principles report (see Vol 1 Appendix B). Access would be required for a light commercial vehicle on a three to six monthly maintenance schedule. Additionally there would be more substantive maintenance visits at approximately ten year intervals which would require access to enable two mobile cranes and associated support vehicles to be brought to the site, which would require temporary suspension of on-street parking in the vicinity of the site.

12.3 Assessment methodology

Engagement

12.3.1 Vol 2 Section 12 documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of traffic and transport are presented in Vol 7 Table 12.3.1.

12.3.2 It is noted that it was reported in the *Scoping Report* that operational traffic effects for the project as a whole were scoped out of the *Environmental Statement*. However, while the environmental effects associated with transport for the operational phase are not expected to be significant or adverse, the assessment of transport effects in the *Environmental Statement* examines relevant aspects of the operational phase in order to satisfy the relevant stakeholders that technical issues have been addressed.

Vol 7 Table 12.3.1 Transport – stakeholder engagement

Organisation	Comment	Response
LB of Wandsworth, phase two consultation, February 2012	Details of traffic generation for all sites during operational and construction phases should be provided.	This is provided in the assessment (see Sections 12.5 and 12.5.62e).
LB of	Both individual and cumulative	The assessment addresses

Organisation	Comment	Response
Wandsworth, phase two consultation, February 2012	impacts should be considered where necessary.	both site-specific and project-wide transport effects in Vols 3-27. The assessments include consideration of other developments in the vicinity of each site.
English Heritage, phase two consultation, February 2012	EH note that the relationship between the Grade II* listed St Mary's Church and the River Thames is already affected by traffic congestion, and additional congestion is likely to create an impact on the historic environment at this location.	St Mary's Church is included as a receptor in the assessment, in terms of effects on users of the church accessing it by all modes of transport. Results are contained in Section 12.5. Other effects are assessed in the Historic Environment assessment in Vol 7 Section 7.
Transport for London, consultation workshop, June 2011	The feasibility of operating two-way movement on a section of Embankment should be investigated.	Vehicle tracking has been carried out to test feasibility. This is included within the design to include two-way working between the site access on Embankment and the junction with Lower Richmond Road (B306) during the main construction works. A short period of traffic management would also be required for the construction of the temporary slipway.
Transport for London, consultation workshop, June 2011	Consideration should be given to whether bus stops on Lower Richmond Road require relocation.	Discussions have been held with TfL regarding buses and vehicle tracking undertaken. This has shown that bus stop removal or relocation would not be required.
Transport for London, consultation workshop, June 2011	Consideration should be given to whether parking bays on Embankment require suspension. If so, relocation must be considered.	The construction routings and the proposed short-term traffic management proposals are designed to minimise parking suspensions. Relocation of suspended bays has been considered but no suitable locations have been identified.

Organisation	Comment	Response
LB of Wandsworth, consultation workshop, April 2011	The EIA should consider noise, pollution, access and working times related to the transport arrangements.	The assessment addresses these issues where directly relevant to the topic.
LB of Wandsworth, consultation workshop, January 2011	If construction vehicles cannot turn within the site area it would be preferable for construction vehicles to reverse into the site and exit in forward gear.	Vehicle tracking has been carried out to test feasibility. This preferred movement can be undertaken by most vehicles entering the site. Full analysis can be found within the *Transport Assessment*.
LB of Wandsworth, consultation workshop, January 2011	The statue at the Embankment / Lower Richmond Road (B306) junction should be avoided if at all possible.	The site has been designed to avoid moving the statue.
LB of Wandsworth, consultation workshop, January 2011	A safe crossing point will need to be provided on Embankment while a section of footpath leading to the existing crossing point is closed.	The site design no longer requires the existing crossing point to be closed so no replacement crossing point is required.
LB of Wandsworth, consultation workshop, January 2011	The cycle stands currently located close to the proposed site access could be relocated between the trees to the west on Embankment.	This is included in the design and has been assessed accordingly, with the cycle stands to be relocated approximately 20m west along Embankment.
LB of Wandsworth, consultation workshop, January 2011	There are Borough plans to upgrade and improve Embankment	It is understood that these plans have been put on hold. Therefore, the upgrade/ improvements have not been assessed.
LB of Wandsworth, consultation workshop, January 2011	The cycle route along Embankment will need to be maintained.	This has been allowed for in the site design and assessed accordingly with the cycle path being maintained.
LB of Wandsworth,	If effective vehicle marshalling were put in place at the	Vehicle marshalling forms part of the CoCP Part B as

Organisation	Comment	Response
consultation workshop, January 2011	temporary slipway site and on the approach from Lower Richmond Road the Borough is satisfied kerb realignment works on Thames Place would not be required.	detailed in para. 12.2.20.
LB of Wandsworth, consultation workshop, January 2011	Maximise the quantity of materials transported by barge to minimise HGV movements in relatively constrained local roads.	The use of barges for the import and export of cofferdam fill material and export of shaft and other excavated material is proposed at this site.

Baseline

12.3.3 The baseline methodology follows the methodology described in Vol 2 Section 12. There are no site specific variations for identifying the baseline conditions for this site.

Construction

12.3.4 The assessment methodology for the construction phase follows that described in Vol 2 Section 12. There are no site specific variations for undertaking the construction assessment of this site.

12.3.5 The effect of all other Thames Tideway Tunnel project sites on the area surrounding Putney Embankment Foreshore has been taken into account within the assessment of the peak year of construction at this site.

12.3.6 As indicated in the site development schedule (see Vol 7 Appendix N) all of the other developments identified within 1km of the Putney Embankment Foreshore site would be complete and operational by Site Year 2 of construction and therefore form part of the base case. This means that there are no cumulative effects to assess, although it is noted that the TfL Highway Assignment Models (HAMs) have been developed using GLA employment and population forecasts, which are based on the employment and housing projections set out in the London Plan (GLA, 2011)[4]. As a result, the assessment inherently takes into account a level of future growth and development across London.

Construction assessment area

12.3.7 The assessment area for the Putney Embankment Foreshore site includes the site access on Embankment, the junction between Embankment and Lower Richmond Road (B306) and the junction of Lower Richmond Road (B306) / Putney High Street (A219) / Putney Bridge Road (A219). It also includes the Glendarvon Street and Thames Place junctions on Embankment and Lower Richmond Road (B306).

12.3.8 These roads and junctions have been assessed for highway, cycle and pedestrian impacts. The Thames Path has been included within the assessment due to its proximity to the development site. Effects on local bus services within 640m and rail services within 960m of the Putney Embankment Foreshore site have also been assessed[ii].

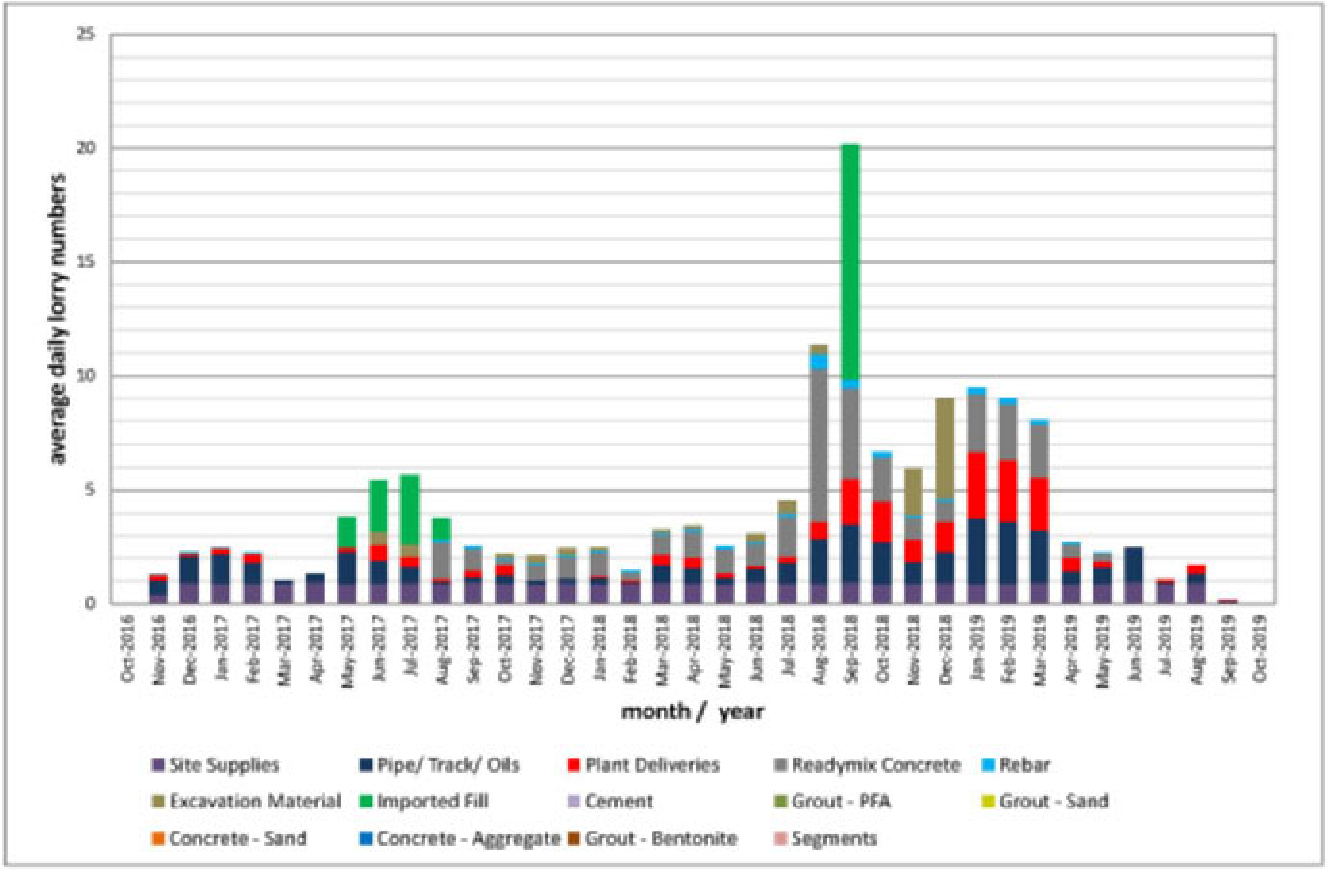
Construction assessment years

12.3.9 Site-specific peak construction assessment years have been identified. The histograms in Vol 7 Plate 12.3.1 and Vol 7 Plate 12.3.2 show that the peak site-specific activity at the Putney Embankment Foreshore site would occur in Site Year 2 of construction for construction lorries, and in Site Year 3 for construction barges.

12.3.10 The assessment of construction effects also considers the extent to which the assessment findings would be likely to be materially different should the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

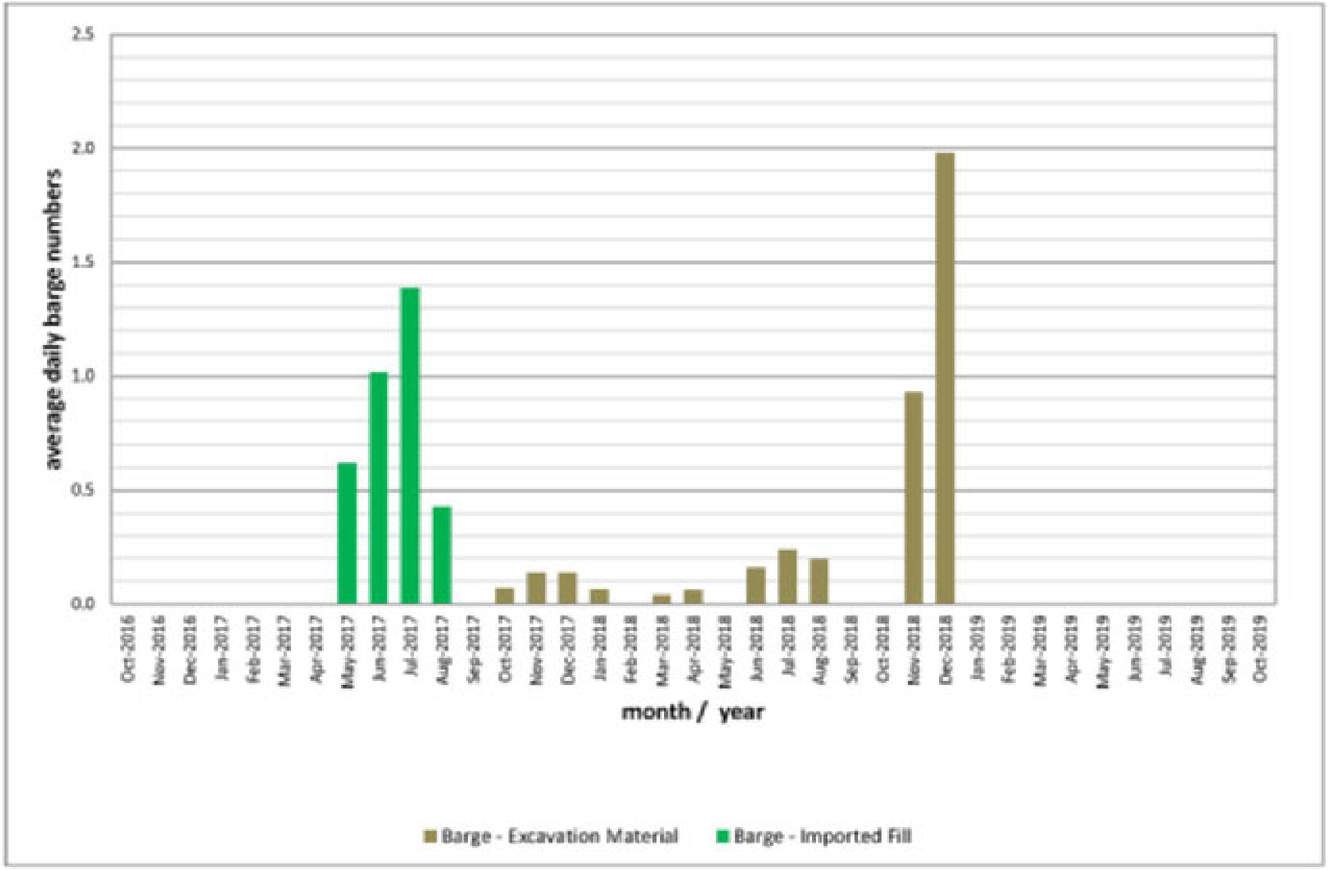
[ii] Distances derived from the Public Transport Accessibility Level (PTAL) methodology described in Volume 2.

Vol 7 Plate 12.3.1 Transport – estimated construction lorry profile



Note: Plate shows approximate volumes and number of lorry trips based upon assumed timings for the works. It is not a programme and remains subject to change.

Vol 7 Plate 12.3.2 Transport – estimated construction barge profile



Note: Plate shows approximate volumes and number of barge trips based upon assumed timings for the works. It is not a programme and remains subject to change.

Operation

12.3.11 The assessment methodology for the operational phase follows that described in Vol 2 Section 12. There are no site specific variations for undertaking the operational assessment of this site.

12.3.12 Once the Thames Tideway Tunnel project is operational it is not expected that there would be any significant effects on the transport infrastructure and operation within the local area because maintenance trips to the site would be infrequent and short-term. On this basis it is not necessary to assess the effects on all the elements listed at para. 12.1.2. The only elements considered are:

a. effects on car parking

b. effects on highway layout and operation

12.3.13 These elements are considered qualitatively (as described in Vol 2 Section 12) because the minimal effect on the highway network means that a quantitative assessment is not required. The scope of this analysis has been discussed with the LB of Wandsworth and TfL.

12.3.14 Also, given the local impact of the transport activity associated with the Thames Tideway Tunnel project during the operational phase, impacts from other Thames Tideway Tunnel project sites would not have operational impacts on the Putney Embankment Foreshore site. Therefore only the localised transport effects around the site are assessed (ie, other Thames Tideway Tunnel project sites are not considered).

12.3.15 With regard to other developments in the vicinity of the site (as detailed in the site development schedule Vol 7 Appendix N), all the other developments within 1km of the site would be complete and operational by Year 1 of operation. As a result, these developments have been included within the operational base case which takes into consideration the effects on highway layout, operation and parking. There are no operational cumulative effects requiring assessment.

Operational assessment area

12.3.16 The assessment area for the operational assessment remains the same as for the construction assessment as set out in paras. 12.3.7-12.3.8.

Operational assessment year

12.3.17 As outlined in Vol 2 Section 12, the operational assessment year has been taken as Year 1 of operation. As the number of vehicle movements associated with the operational phase is low, there is no requirement to assess any other year beyond that date.

12.3.18 As with construction, the assessment of operational effects also considers the extent to which the assessment findings would be likely to be materially different should the programme for the Thames Tideway Tunnel project (and hence opening year) be delayed by approximately one year.

Assumptions and limitations

12.3.19 The general assumptions and limitations associated with this assessment are presented in Vol 2 Section 12.

Assumptions

12.3.20 Local junction modelling for the construction base and development cases at this site has incorporated traffic signal optimisation on the basis that this would be implemented as necessary by TfL (as part of routine management) to ensure the effective operation of the highway network and respond to changes in traffic conditions.

12.3.21 There would be deliveries of fuel for construction plant at the site and a number of construction products may be classified as hazardous. For the Putney Embankment Foreshore site, it is assumed that there would be one hazardous load per fortnight generated by the site.

12.3.22 With regard to construction workers travelling to the site, it is assumed that no construction workers would drive to the site, as set out in para. 12.5.3.

Limitations

12.3.23 There are no site-specific limitations of the transport assessment undertaken for this site.

12.4 Baseline conditions

12.4.1 The following section sets out the baseline conditions for transport within and around the site. Future baseline conditions (base case) are also described.

Current baseline

12.4.2 As shown in Vol 7 Figure 12.4.1 (see separate volume of figures), the site is located in the southern foreshore of the River Thames, to the west of Putney Bridge, within the LB of Wandsworth. It includes a public drawdock/slipway at the eastern end of Embankment.

12.4.3 There is an existing road access to the site via Lower Richmond Road (B306) and Embankment.

Pedestrian routes

12.4.4 The existing pedestrian network and facilities in the vicinity of the site are shown in Vol 7 Figure 12.4.2 (see separate volume of figures).

12.4.5 The Thames Path routes along Embankment past the site and continues along the section of Lower Richmond Road (B306), to the south of the site towards Putney Bridge.

12.4.6 There are footways in place on both sides of this section of Embankment The footway on the northern side varies between approximately 4.6m and 4.8m in width, whilst the footway on the south is approximately 0.8m wide.

12.4.7 There is an informal pedestrian crossing located on Embankment, to the west of the slipway, which includes dropped kerbs and tactile paving.

12.4.8 Footways are also in place on both sides of Lower Richmond Road (B306). The footways range between 1.4m and 5.4m wide on the northern and southern sides of the road, respectively. Pedestrian crossing facilities are included within the signalised junction of Lower Richmond Road (B306) and Putney High Street (A219). The signal timings operate with an all-red pedestrian phase in each signal cycle which provides pedestrians with a period of safe crossing by stopping all traffic.

Cycle facilities and routes

12.4.9 The existing cycle network and facilities in the vicinity of the site are shown in Vol 7 Figure 12.4.2 (see separate volume of figures).

12.4.10 The main cycle route within the area is National Cycle Network (NCN) Route 4 (on road), which routes across the Lower Richmond Road (B306) and then off-carriageway along Embankment. This route forms part of the Thames Path which passes the site. The cycle path continues westwards towards Barnes along the riverside footway and northeast via Putney Bridge and Fulham High Street. A section of the cycle lane along the Embankment is off carriageway and is marked upon the footway in the vicinity of the construction site access point.

12.4.11 There are no marked cycle lanes along the Lower Richmond Road (B306), although there is a marked advanced cycle stop line at its junction with Putney High Street (A219). There is a marked cycle lane heading north over Putney Bridge, fed from a southbound bus lane along Putney High Street (A219).

12.4.12 Ten cycle stands are provided at the eastern end of Embankment within the northern footway. These are available for public use. There are an additional five cycle stands provided on the eastern side of Thames Place.

12.4.13 There are currently no Cycle Superhighway cycle routes within the vicinity of the site and none are currently planned up to 2015.

12.4.14 There are no cycle hire facilities in the vicinity of the site. However, it is understood that there are plans to extend the scheme into south and west London.

Public transport accessibility level

12.4.15 The Public Transport Accessibility Level (PTAL) of the site has been calculated using TfL's approved PTAL methodology (TfL, 2010)[5] and assumes a walking speed of 4.8km/h and considers rail stations within a 12 minute walk (960m) of the site and bus stops within an eight minute walk (640m).

12.4.16 Using this methodology the site has a PTAL rating of 6a, rated as 'excellent' (with 1a being the lowest accessibility and 6b being the highest accessibility).

12.4.17 Vol 7 Figure 12.4.3 (see separate volume of figures) shows the public transport network around the Putney Embankment Foreshore site.

Bus routes

12.4.18 As shown in Vol 7 Figure 12.4.3 (see separate volume of figures), a total of 12 daytime bus routes and two night-time bus routes operate within

640m of the site. These bus services operate from the following bus stops:

a. Embankment bus stop on Lower Richmond Road, approximately 25m (westbound) and 45m (eastbound) walking distance south of the Putney Embankment Foreshore main site

b. Putney / St Mary's Church bus stop on Putney Bridge Approach, approximately 180m (northbound) and 210m (southbound) walking distance east of the Putney Embankment Foreshore main site.

12.4.19 These routes would also serve other stops further from the site as shown on Vol 7 Figure 12.4.3 (see separate volume of figures).

12.4.20 On average, there are 221 daytime bus services per hour in the AM peak and 184 bus services per hour in the PM peak within a 640m walking distance of the Putney Embankment Foreshore site.

12.4.21 On average there are 31 night-time bus services per hour Monday – Friday (00:00 – 06:00) and 33 bus services per hour on Saturdays (00:00 – 06:00) within a 640m walking distance of the Putney Embankment Foreshore site.

London Underground

12.4.22 As shown on Vol 7 Figure 12.4.3 (see separate volume of figures), Putney Bridge underground station, which serves the District Line, is located approximately 650m walking distance to the northeast of the Putney Embankment Foreshore main site. The station is located north of the River Thames. Trains from this station travel north to Edgware Road via Earls Court or south to Wimbledon.

12.4.23 In both the AM and PM peak hour, the frequency of northbound and southbound trains at Putney Bridge is approximately one every four minutes, providing an average of 15 services in each direction per hour.

12.4.24 East Putney underground station is approximately 1.1km walking distance to the southeast of the Putney Embankment Foreshore main site. This station is the next station south of Putney Bridge underground station. The frequencies of trains at this station are the same as at Putney Bridge station.

National Rail

12.4.25 The closest National Rail station to the Putney Embankment Foreshore main site is Putney station situated approximately 700m walking distance to the southeast. Trains from Putney station travel between London Waterloo and Weybridge.

12.4.26 In the AM peak hour ten northbound and eight southbound trains call at Putney station. In the PM peak hour there are eight trains in both the northbound and southbound direction.

River passenger services

12.4.27 The Putney Embankment Foreshore main site is approximately 70m walking distance to the east of Putney Pier, which is served by the TfL

River Bus. This is shown on Vol 7 Figure 12.4.3 (see separate volume of figures). Putney Pier is accessed via the Embankment.

12.4.28 This service operates from Putney to Blackfriars from Monday to Friday during peak hours. Eastbound services from Putney operate at 07:00 and 08:00 in the AM peak hour. Westbound services from Blackfriars do not serve Putney Pier in the AM peak period.

12.4.29 In the PM peak period there is one eastbound service from Putney to Blackfriars at 18:10 and three westbound services at 18:05, 19:20 and 20:05.The Wandsworth Riverside Quarter Pier is located 1.6km walking distance from the Putney Embankment Foreshore main site. It is the next stop from Putney Pier in the direction of Blackfriars. The services are the same as for Putney Pier.

River navigation

12.4.30 An analysis has been made of the typical volume of river vessel traffic passing the Putney Embankment Foreshore site, based on published river passenger service timetables and estimates of freight traffic based on discussions with operators. It is estimated that the peak hours for river vessel traffic passing the site is between 18:00 and 19:00 hours, Monday to Friday. During these periods around seven vessels are estimated to pass the site. However, this figure is not constant as freight vessel transit patterns, which are included in the traffic, are influenced by the rising and falling tide. Therefore, such a peak will only occur every ten to 12 days when the tide is at its highest[6].

Parking

12.4.31 Vol 7 Figure 12.4.4 (see separate volume of figures) shows the locations of the existing car parks and car club spaces within the vicinity of the site.

Existing on-street car parking

12.4.32 The on-street parking that is provided on both sides of Embankment is subject to Controlled Parking Zones (CPZ) A1 (at the eastern end) and A5 (at the western end). Different permits are required to park in each.

12.4.33 Parking is also permitted on the eastern end of Embankment on a shared use basis, which includes A1 permits and on a pay and display basis. A, maximum stay for pay and display users of four hours operates within restricted time periods.

12.4.34 Additionally there is on-street parking available on the northern side of Lower Richmond Road (B306) to the west of the Embankment / Lower Richmond Road (B306) junction. This is also subject to a CPZ.

12.4.35 There are no dedicated disabled parking bays within the immediate vicinity of the site.

12.4.36 There are no dedicated motorcycle parking bays within the immediate vicinity of the site. The nearest motorcycle parking bays are approximately 200m walking distance southeast of the main site on Weimar Road.

Existing off-street/private car parking

12.4.37 There is a multi-storey car park located approximately 500m walking distance south from Putney Bridge at the Exchange Shopping Centre which is available to members of the public.

Coach parking

12.4.38 There is no coach parking available in the immediate vicinity of the site.

Car clubs

12.4.39 The closest car club parking space to the site is operated by Zipcar and is approximately 50m walking distance to the south of the Putney Embankment Foreshore main site at the entrance of Kenilworth Court, where two car spaces are provided.

12.4.40 The next closest car club parking space is located 250m northwest of the Putney Embankment Foreshore main site on Bemish Road, also operated by Zipcar, where one car space is provided.

Servicing and deliveries

12.4.41 There are no formal on-street loading bays on Embankment. However, customers of the Chas Newens Marine boat hire company often park on the carriageway / slipway adjacent to the workshop when visiting the premises. This is an informal arrangement as no formal customer parking is provided. This is taken account of in the assessment.

12.4.42 There is an on-street loading bay on Glendarvon Street and another 60m away on Ruvigny Gardens.

12.4.43 On-street loading is also permitted on the northern side of Lower Richmond Road (B306), to the east of its junction with Thames Place, outside the hours of 07:00 to 10:00 and 16:00 to 19:00, Monday to Saturday.

Taxis

12.4.44 There are no taxi ranks in the immediate vicinity of the site. However, there are eight taxi bays provided on Putney High Street and two taxi bays on Werter Street, approximately 550m walking distance southeast of the main site.

Highway network and operation

12.4.45 Embankment is a narrow (6.7m) road with a 30mph speed limit and has parking on both sides of the road. This effectively provides a carriageway varying in widths of between 2.7m and 3.4m between the main construction site and Thames Place. There is a one-way westbound section between the junctions of Lower Richmond Road (B306) and Thames Place. Wide footways, a cycle lane and cycle parking are present on the northern side of the road. In its current state of operation, with on-street parking on both sides, Embankment is unsuitable for long and heavy vehicles due to the restricted road width.

12.4.46 Lower Richmond Road (B306) has one lane eastbound and two lanes westbound, with a 30mph speed limit. There are no weight restrictions on this road.

12.4.47 The junction between Lower Richmond Road (B306) and Embankment is a priority junction, with traffic permitted to enter from Lower Richmond Road (B306) into the Embankment. Vehicles may not exit Embankment onto Lower Richmond Road (A306) from this junction.

12.4.48 Thames Place is a two-way single carriageway that links Embankment to Lower Richmond Road (B306).

12.4.49 The junction between Lower Richmond Road (B306), Putney High Street (A219) and Putney Bridge Approach (A219) is a three arm signalised crossroads. Lower Richmond Road (B306) has three lanes on the approach to and one lane on the exit from the junction. Putney High Street (A219) has two approach and two exit lanes and the Putney Bridge Approach (A219) has two approach lanes and one exit lane.

Data from third party sources

Description of data

12.4.50 Data in relation to accidents have been collected from TfL.

Accident analysis

12.4.51 A total of nine serious accidents and 35 slight accidents occurred in the Putney Embankment Foreshore assessment area over the five years of accident data analysed. There were no fatal accidents.

12.4.52 The largest number of road traffic accidents (ten) occurred at the junction of Putney Bridge Approach (A219) with Lower Richmond Road (B306). All of these were classified as slight accidents. This is the only significant cluster of accidents within the area.

12.4.53 The largest number of serious accidents (two) occurred at the junction of Lower Richmond Road (B306) with Embankment. These involved a car and a motorcyclist and a car and a cyclist.

12.4.54 Of the total accidents, five involved HGVs and none included medium or light goods vehicles. A total of 11 accidents involved pedestrians and seventeen involved cyclists.

12.4.55 There is no evidence of accidents occurring due to highway geometry or poor infrastructure.

Description of surveys

12.4.56 Baseline survey data were collected in May, July and August 2011 and in June 2012 to establish the existing transport movements and usage of parking in the area. Vol 7 Figure 12.4.5 (see separate volume of figures) shows the survey locations in the vicinity of the site.

12.4.57 As part of the survey data collection manual and automated traffic surveys were undertaken to establish specific traffic, pedestrian and cycle movements including turning volumes, queue lengths, saturation flows, degree of saturation and traffic signal timings. Parking surveys were undertaken to establish the usage of on-street parking. Surveys were also undertaken in August 2011 to establish the summer usage of the Thames Path.

Results of the surveys

12.4.58 The surveys inform the analysis of the baseline situation in the area surrounding the Putney Embankment Foreshore site.

Pedestrians and cyclists

12.4.59 Pedestrian surveys around the site during the AM, inter-peak and PM peak hours indicate that there is a relatively balanced flow of pedestrians on Embankment during the AM peak hour passing the Putney Embankment Foreshore site with approximately 80 to 90 pedestrians in each direction. However, on Lower Richmond Road (B306) there is a dominant flow eastbound in the morning and westbound in the evening peak hours. This suggests that Embankment is not a key commuter route.

12.4.60 Similarly, the cycle surveys indicate that almost all cyclists prefer to cycle along Embankment (also part of the Thames Path), which is largely a traffic-free route, in preference to cycling in traffic along Lower Richmond Road (B306). During the AM peak hour there were 62 westbound and 52 eastbound trips on Embankment and 37 westbound and 48 eastbound during the PM peak. On Lower Richmond Road (B306) there were no trips recorded during the AM peak with one westbound and six eastbound trips in the PM peak hour.

Traffic flows

12.4.61 The ATC data have been analysed to identify the existing traffic flows along Putney Bridge Road (A3209).

12.4.62 The data show that for Putney Bridge Road (A3209) the AM peak is the busiest hour with a maximum of approximately 200 westbound vehicles every 15 minutes with approximately 140 vehicles travelling eastbound during the same period. The PM peak has a more balanced flow with approximately 170 vehicles travelling eastbound and 160 travelling westbound every 15 minutes.

12.4.63 The traffic flows for the busiest period (weekday AM and PM peak hours) within the area are indicated in Vol 7 Figure 12.4.6 and Vol 7 Figure 12.4.7 (see separate volume of figures).

Parking

12.4.64 Surveys were undertaken to establish the availability of parking stock in the vicinity of the site to understand existing occupancy and capacity. The surveys showed that the greatest number and hence demand is for shared use bays. The use of both the shared use and resident bays is fairly evenly distributed across all time periods, with between 60%-80% occupied.

Local highway modelling

12.4.65 To establish the existing capacity on the local highway network, it was discussed with TfL and the LB of Wandsworth to model the Putney Embankment Foreshore site to assess the junction of Putney High Street (A219) / Lower Richmond Road (B306) / Putney Bridge Road (A219) using LinSig model and the Lower Richmond Road (B306) / Embankment junction using PICADY model. This was undertaken as per the methodology outlined in Vol 2 Section 12.

12.4.66 The weekday AM and PM baseline model flows for Putney Embankment Foreshore were compared against observed queue lengths (from the junction surveys) for the peak periods to validate the PICADY and LinSig models and ensure reasonable representation of existing conditions.

12.4.67 Vol 7 Table 12.4.1 and Vol 7 Table 12.4.2 show the modelling outputs which demonstrate that the network is currently operating within the theoretical capacity in the weekday AM and PM peak hours. The validated model indicates that the PM peak hour is the busiest period and the Putney High Street (A219) ahead/left movement is operating at near capacity in the baseline, with maximum queues of approximately 13 vehicle lengths. The delay to vehicles is most significant during the AM peak hour on the Lower Richmond Road (B306) eastbound turning right into Putney Bridge Road (A219) movement, which currently experiences an average of 74 seconds of delay per vehicle.

Vol 7 Table 12.4.1 Transport – baseline LinSig model outputs

Approach	Movement	Weekday							
		AM peak hour (08:00-09:00)				PM peak hour (17:00-18:00)			
		Flow (PCUs)	DoS	MMQ (PCUs)	Delay (seconds per PCU)	Flow (PCUs)	DoS	MMQ (PCUs)	Delay (seconds per PCU)
Putney Bridge Road (bridge approach) (A219)	Ahead (Bus Lane)	158	12%	2	7	197	16%	2	9
	Ahead	664	71%	13	16	672	77%	15	22
	Right	321	84%	11	63	403	86%	14	59
Lower Richmond Road (B306)	Left	706	68%	12	22	339	27%	2	10
	Right	289	86%	11	74	359	85%	13	64
Putney High Street (A219)	Ahead / left	728	85%	16	41	659	88%	13	54
	Ahead	585	80%	17	42	424	82%	14	54
		PRC		Total delay (PCU hours)		PRC		Total delay (PCU hours)	
Overall junction performance		5.3%		34		2.2%		35	

Notes: DoS represents Degree of Saturation; the ratio of flow to capacity. MMQ represents Mean Maximum Queue for the busiest-case 15 minute modelled period (in vehicle lengths). PRC represents Practical Reserve Capacity; measure of how much additional traffic could pass through a junction whilst maintaining a maximum DoS of 90% on all lanes. Delay represents the mean delay per PCU. PCU value for a car is one PCU. Vans and three-axle vehicles are 1.5 PCUs, vehicles with four or more axles are 2.3 PCUs. Buses and coaches are two PCUs. Motorcycles are 0.4 PCUs and pedal cycles are 0.2 PCUs.

Vol 7 Table 12.4.2 Transport – baseline PICADY model outputs

Approach	Movement	Weekday							
		AM peak hour (08:00-09:00)				PM peak hour (17:00-18:00)			
		Flow (vehs)	RFC	Max Queue (vehs)	Delay (seconds/ veh)	Flow (vehs)	RFC	Max Queue (vehs)	Delay (seconds/ veh)
Embankment	Entry only	0	0	0	0	0	0	0	0
Lower Richmond Road (B306)	Ahead / right	59	16%	0.19	12	44	9%	0.1	8

Notes: RFC represents Ratio of Flow to Capacity. Queue represents number of vehicles in queue. Delay represents the mean delay per vehicle.

Transport receptors and sensitivity

12.4.68 The receptors and their sensitivities in the vicinity of the Putney Embankment Foreshore site are summarised in Vol 7 Table 12.4.3. The transport receptor sensitivity is defined as high, medium or low using the criteria detailed in Vol 2 Section 12.

12.4.69 The transport effects identified in this assessment are directly related to changes to the operation of transport networks which may occur as a result of physical changes to transport networks or of additional vessel or vehicle movements or additional public transport patronage. These changes in operation could lead to effects which would be experienced by people using those transport networks, whether as pedestrians, cyclists, public transport or private vehicle users. The assessment identifies several 'generic' groups of transport users in the list of transport receptors.

12.4.70 Receptors who are occupiers and users of or visitors to existing or committed developments in the vicinity of each of the project sites may experience transport effects on their journeys to and from those developments. In many cases those effects would be similar (or identical) to the effects identified for the 'generic' groups of transport users. However, the assessment specifically includes these receptors to ensure that any particular effects that they would be likely to experience (for instance because they make use of particular routes or transport facilities) have been identified.

Vol 7 Table 12.4.3 Transport – receptors and sensitivity

Receptors (relating to all identified transport effects)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
Pedestrians and cyclists (including sensitive pedestrians[iii]) using the Thames Path and other routes in the vicinity of the site	Construction	High sensitivity to footway closures and diversions, resulting in increases to journey times.
Private vehicle users in the area using the local highways or on-street parking.	Construction Operation	Medium sensitivity to reduction to parking capacity as well as increases in HGV traffic and resulting in journey time delays.

[iii] Sensitive pedestrians include those with mobility impairments, including wheelchair users.

Receptors (relating to all identified transport effects)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
Emergency vehicles travelling on Embankment and the surrounding highway network.	Construction Operation	High sensitivity to journey time delays due to time constraints on journey purposes.
Marine emergency vehicles	Construction	High sensitivity to changes in vessel movements / moorings
Bus users (passengers) travelling on routes along Lower Richmond Road (A306) and on Putney High Street (A219)	Construction	Medium sensitivity to journey time delays as a result of increases to traffic flows.
Passengers using river services	Construction	Medium sensitivity due to proximity of Putney Pier to the site
River vessel operators	Construction	Medium sensitivity to increases in passage of construction barges
Leisure users of the River Thames	Construction	High sensitivity to increases in passage of construction barges and change to river access arrangements
Public transport users using rail services within the area	Construction	Low sensitivity due to distance from the site and low number of construction workers

Receptors (relating to all identified transport effects)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
Houseboats, 10m north of main site Residents of Kenilworth Court, 20m south of main site Residents of houses on Ruvigny Gardens, Thames Place and Embankment, 12m south of temporary slipway site	Construction	High sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays.
Users of Thai Square restaurant, 8m south of main site Users of Odeon Cinema, 82m south of main site Users of Constitutional Club, 12m south of temporary slipway site Users of London Rowing Club, 70m northwest of temporary slipway site Patrons of Dukes Head Public House, 19m south of the temporary slipway site	Construction	Medium sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays for staff and visitors. Medium sensitivity in relation to servicing from Embankment carriageway.
Users of St Marys Church, 5m south of main site	Construction	Medium sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays.

Receptors (relating to all identified transport effects)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
Chas Newens Marine (boat repair and builders commercial business), 7m south of the secondary site	Construction	High sensitivity due to removal of parking bays used for boat storage.

Construction base case

12.4.71 As described in Section 12.3, the construction assessment year for transport effects in relation to this site is Site Year 2 of construction for construction vehicle movements, and Site Year 3 for construction barge movements.

12.4.72 There are no known proposals to change the cycle or pedestrian network by Site Year 2 of construction and it is therefore assumed that the network will operate as indicated in the baseline situation.

12.4.73 In terms of the public transport network it is expected that as a result of the TfL London Underground Upgrade Plan (TfL, 2011)[7], there would be a 24% increase in capacity on the District Line, which serves Putney Bridge station. It is envisaged that London Underground and National Rail patronage will also increase by Site Year 2 of construction.

12.4.74 In order to ensure that the busiest base case scenario is used in the assessment, the capacity for National Rail and Underground in the base case has been assumed to remain the same as capacity in the baseline situation. This ensures a robust assessment as outlined in Vol 2 Section 12.

12.4.75 There are no known proposals to alter river passenger services or river navigation patterns from the current baseline conditions and therefore the construction base case remains similar to the baseline position.

12.4.76 Baseline traffic flows (from the junction surveys) have been used, and forecasting carried out, to understand the capacity on the highway network in the vicinity of the Putney Embankment Foreshore site in Site Year 2 of construction without the Thames Tideway Tunnel project. The construction base case traffic flows (derived from the survey data) at the junction of Putney Bridge Road (A219)/Lower Richmond Road (B306) and Embankment/Lower Richmond Road (B306), providing input to the LinSig and PICADY models, are shown in Vol 7 Figure 12.4.6 and Vol 7 Figure 12.4.7 (see separate volume of figures).

12.4.77 The key findings from the construction base case LinSig and PICADY models for Putney Embankment Foreshore indicate that there would be an increase in queue lengths and delay in the construction base case compared to baseline conditions. The local network is expected to operate at or near to capacity in the construction base case.

12.4.78 The base case in Site Year 2 of construction takes into account the developments described in the site development schedule (see Vol 7 Appendix N). With regard to the identification of additional receptors associated with the other developments, there are two developments within 250m of the site which are relevant to the transport assessment. These are the development of additional café floorspace at Nos. 2 and 4-6 Putney High Street and mixed-use development at 45-53 Putney High Street/329-339 Putney Bridge Road as detailed in Vol 7 Table 12.4.4.

Vol 7 Table 12.4.4 Transport – construction base case additional receptors

Receptors (relating to developments within 1km of the site)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
Staff and patrons of café development, Nos. 2 and 4-6 Putney High Street, adjacent to the secondary site	Construction	Medium sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays for staff and visitors.
Residents of 45-53 Putney High Street & 329-339 Putney Bridge Road, 170m southeast of main site	Construction	High sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays.

Operational base case

12.4.79 The operational assessment year for transport is Year 1 of operation.

12.4.80 As explained in para. 12.3.12 the elements of the transport network considered in the operational assessment are highway layout and operation and parking. For the purposes of the operational base case it is anticipated that the highway layout and parking will be as indicated in the construction base case.

12.4.81 The operational base case, Year 1 of operation, takes into account all the developments described in the site development schedule (see Vol 7 Appendix N). The only developments that are potential receptors within 250m of the Putney Embankment Foreshore site are at Nos. 2 and 4-6 Putney High Street and 45-53 Putney High Street/329-339 Putney Bridge Road which would be complete and operational by Year 1 of operation. However, given the limited effects which are anticipated in the operational phase, these developments do not present any additional relevant transport receptors that require consideration in the operational effects assessment.

12.5 Construction effects assessment

12.5.1 This section summarises the findings of the assessment undertaken for the peak year of construction at the Putney Embankment Foreshore site (Site Year 2 of construction for road traffic and Site Year 3 of construction for river traffic).

12.5.2 The anticipated mode split of worker trips (covering all types of construction worker described in Vol 7 Table 12.2.2) for Putney Embankment Foreshore is detailed in Vol 7 Table 12.5.1 and has been generated based on 2001 Census data for journeys to workplaces within the area in the vicinity of the Putney Embankment Foreshore site[iv]. This shows that the predominant mode of travel for construction workers would be public transport.

12.5.3 At this site there would be no parking provided within the site boundary for workers. As parking on surrounding streets is also restricted, and measures to reduce car use would be incorporated into site-specific Travel Plan requirements, it is highly unlikely that workers would travel by car. The Census mode shares have therefore been adjusted to reflect increased levels of non-car use by workers at this site. This forms the basis of the assessment.

Vol 7 Table 12.5.1 Transport – mode split

Mode	Percentage of trips to site	Equivalent number of worker trips (based on 50 worker trips)	
		AM peak hour	PM peak hour
Bus	23%	11	11
National Rail	29%	14	14
Underground	23%	11	11
Car driver	<1%*	0	0
Car passenger	<1%*	0	0
Cycle	35%	3	3
Walk	16%	8	8
River	1%	<1	<1
Other (taxi/ motorcycle)	3%	2	2
Total	**100%**	**50**	**50**

** Assumed to be zero for the purposes of the assessment.*

[iv] Based on 2001 Census as this type of data had not been released from the 2011 Census at the time of assessment.

Pedestrian routes

12.5.4 The construction phase layout – phase 1-4 and secondary site plans (see separate volume of figures – Section 1) show the layout of pedestrian footways during construction.

12.5.5 The Thames Path runs along the riverside footway of Embankment past both the main and secondary sites. During the construction of the secondary site pedestrians would be diverted from the northern footway of Embankment onto a protected diversion route within the carriageway across the access to the secondary site. This would add approximately 4m to the length of the pedestrian route. Pedestrians would have to cross the secondary site construction access. Traffic marshals would be posted at the site entrance to minimise conflicts between HGVs and pedestrians.

12.5.6 The Embankment / Lower Richmond Road (B306) junction would be widened to facilitate HGV access to the site. This would be achieved via the removal of a traffic island rather than any kerb or footway modifications.

12.5.7 To assess a busiest case scenario it has been anticipated that all worker trips would be completed by foot. As a result the 50 worker trips generated by the site have been added to the construction base case pedestrian flows during the AM and PM peak hours. When these additional worker trips are added to the base case pedestrian flow, no footway capacity issues are expected.

12.5.8 In determining the magnitude of impacts on pedestrian routes the relevant impact criteria are pedestrian delay, pedestrian amenity and accidents and safety (as set out in Vol 2 Section 12).

12.5.9 The diversion of the footway past the secondary site along an adjacent protected route would not noticeably increase journey times and therefore the impact of that diversion on pedestrian delay would be negligible. The impact on pedestrian amenity would be low adverse.

12.5.10 Pedestrians would have to cross the secondary site access as part of the diversion, although pedestrian flows would be low and construction vehicle flows would be less than four two-way HGV movements an hour. This would lead to a low adverse impact on accidents and safety for pedestrians using that part of Embankment.

12.5.11 During work at the main site, pedestrian movements in the area would experience a negligible impact in terms of delay.

12.5.12 With regards to pedestrian amenity in relation to the main site works, the impact would be negligible.

12.5.13 The impact on accidents and safety would be low adverse given that construction vehicle flows would be approximately four two-way HGV movements an hour using the criteria set out in Vol 2 Section 12.

Cycle facilities and routes

12.5.14 There are ten cycle stands in place at the eastern end of Embankment within the footway. These would be relocated approximately 20m to the west along Embankment in order that they do not conflict with the main site access.

12.5.15 The relevant impact criteria for determining the magnitude of impacts on cycle facilities and routes are cycle delay and accidents and safety (as set out in Vol 2 Section 12).

12.5.16 During construction of the secondary site cyclists would be diverted from the off-road cycle lane on the northern side of Embankment (NCN Route 4 / Thames Path) onto the carriageway past the secondary site access before re-joining the off-road cycle lane. This represents a negligible impact in relation to cycle delay.

12.5.17 More generally, cyclists using the highway could experience an additional delay to journey time as a result of the construction works and vehicles at the Putney Embankment Foreshore site. The effect on journey times is identified in the highway operation and network assessments (para. 12.5.56) and would be an increase of a maximum of some five seconds over that in the construction base case. This represents a negligible impact in relation to cycle delay.

12.5.18 With regard to accidents and safety cyclists would be required to travel past the site accesses at both the main and secondary sites. Construction traffic flows would be approximately four two-way HGV movements per hour. Taking these issues into account the impact on accidents and safety for cyclists would be of low adverse magnitude.

Bus routes and patronage

12.5.19 No bus services route immediately past the site on Embankment. However, bus stops P and Q served by routes 22, 265, 485 and N22 are approximately 10m south of the site on Lower Richmond Road (B306).

12.5.20 Additional construction vehicles serving the site may affect some bus journey times along Lower Richmond Road (B306) as well as within the wider area. The effect on journey times is detailed under the highway operation and network assessment in para. 12.5.56 and would be an increase of a maximum of approximately five seconds. This represents a negligible impact.

12.5.21 It is expected that approximately 11 additional two-way worker trips would be made by bus during the AM and PM peak hours, which would result in less than one worker trip per bus (based on a service of 221 buses and 184 buses within a 640m walking distance during the AM and PM peak hours respectively).

12.5.22 Based on the impact criteria outlined in Vol 2 Section 12 the additional worker trips made by bus in peak hours would have a negligible impact on bus patronage.

London Underground and National Rail patronage

12.5.23 No Underground or rail stations are directly adjacent to the site and therefore none would be directly affected by construction works at the site. It is anticipated that approximately 25 construction workers and labourers would use London Underground or National Rail services to access the site, which would result in 14 additional person trips on National Rail services and 11 additional person trips on Underground services in both the AM and PM peak hours.

12.5.24 On London Underground services this equates to less than one person per train during the AM and PM peak hours based on a frequency of 30 trains per hour during the peaks. On National Rail services there would be less than one additional passenger per train based on the AM peak hour service of 16 arrivals and PM peak hour service of 16 departures.

12.5.25 Based on the quantitative assessment of patronage and the impact criteria on rail patronage in Vol 2 Section 12 this would result in a negligible impact on London Underground and National Rail patronage.

River passenger services and patronage

12.5.26 During construction river passenger services would not be directly affected. Services from Putney Pier would continue to operate as scheduled. It is anticipated that 1% of construction workers and labourers would use the river services to access the construction site, which on average would result in less than one construction worker per boat service. In accordance with the impact criteria for river patronage set out in Vol 2 Section 12 this would result in a negligible impact on river passenger service patronage.

River navigation and access

12.5.27 This section addresses the effects on river navigation and access in the vicinity of the Putney Embankment Foreshore site. The wider effects of transporting construction materials by river from a number of sites within the project are dealt with in Vol 3 Section 12.

12.5.28 During construction it is intended that the cofferdam fill (import and export), shaft excavated and ‘other’ material (export) would be transported by barge. For assessment it is taken as 90% of these materials are by river to take into account periods where river transport is unavailable or the material is unsuitable. The peak number of barge movements would occur within Site Year 2 of construction with a daily average of four barge movements (ie, two barges) a day.

12.5.29 Public access to the river would be maintained throughout the construction phase through the provision of the secondary site. The construction works would not impact upon river services or traffic during the construction phases. However, with the relocation of the slipway being less than 200m from the original slipway this would mean a low adverse impact on public access to the river.

12.5.30 Due to the low number of barges accessing the site, and based on the impact criteria outlined in Vol 2 Section 12 it is anticipated that impact on river navigation in the vicinity of the site as a result of the barges accessing Putney Embankment Foreshore would be negligible.

12.5.31 It is noted that a separate *Navigational Issues and Preliminary Risk Assessment* has been undertaken for the construction works and barges to be used at the Putney Embankment Foreshore site. This is reported separately outside of the *Environmental Statement* and *Transport Assessment* and will accompany the application.

Parking

12.5.32 Parking for five essential maintenance vehicles would be provided on site. However, there would be no on-site parking for workers and Travel Plan measures would discourage workers from travelling by car to and from the site. Additionally, parking on the surrounding streets is restricted. Therefore there would be no impact on on-street parking or private parking in the vicinity of the site from construction worker parking during the construction phase.

12.5.33 While there would be no construction worker parking, it would however be necessary to suspend some parking bays during the construction works at the Putney Embankment Foreshore site as shown in the highway layout during construction plans (see separate volume of figures – Section 1).

12.5.34 During the construction of the secondary site it would be necessary to suspend 38m of parking on Embankment to the northwest of the secondary site and 130m of parking to the southeast of the site. This equates to approximately 34 parking spaces. It would also be necessary to suspend 28m of parking at the southern end of Glendavon Street representing a further six spaces. The suspensions would be necessary to create a protected pedestrian diversion route past the secondary site and to allow HGV routing along Glendavon Street and facilitate the turning movements of construction vehicles.

12.5.35 This car parking would not be replaced elsewhere in the vicinity as there is no available kerbside space. Parking surveys show that while there is spare capacity in some parking bays, it is largely found in the bays to be suspended. Therefore the remaining capacity in the area would not be sufficient to accommodate displaced parking demand. On this basis the impact on parking on Embankment during construction of the secondary site has been assessed as high adverse.

12.5.36 There would be periods during construction (eg, during construction and deconstruction of the cofferdam) when construction vehicles would not be able to turn on site and would therefore need to reverse into the site. To enable this, 18m of parking on the northern side of Embankment and 13m of parking on the southern side of Embankment would need to be removed, equating to a loss of five spaces. This would not be provided elsewhere. However, the parking suspended for the construction of the secondary site would be reinstated during construction at the main site, thus much of the baseline spare capacity would be available.

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12.5.37 There would therefore be spare capacity in other parking bays on this stretch of road and in adjacent streets to accommodate this loss of parking provision and consequently the magnitude of the impact on parking on Embankment has been assessed as low adverse during construction at the main site.

12.5.38 The other relevant impact criteria with respect to the assessment of parking is loading changes which would affect any businesses which use loading spaces, as set out in Vol 2 Section 12. There would be a medium adverse impact on loading bay changes as a loading bay would be suspended on Glendarvon Street, however, an alternative loading bay is situated approximately 60m away on Ruvigny Gardens.

Highway network and operation

12.5.39 The highway layout during construction plan (see separate volume of figures – Section 1) show the highway layout during the secondary site and main site construction works. Both sites are on the northern side of Embankment, from which they would be accessed.

12.5.40 The highway layout during construction vehicle swept path analysis (see Putney Embankment Foreshore *Transport Assessment* figures) demonstrates that the construction vehicles would be able to safely enter and leave the main site and the loading/unloading area at the secondary site.

12.5.41 During construction of the secondary site the carriageway width of the westbound lane of Embankment would be reduced by approximately 2m for approximately 80m (adjacent to the boat repair premises and the rear gardens of properties on Ruvigny Gardens) to facilitate the protected diversion route (of the footway and Thames Path) across the site access. This would reduce the overall carriageway to 4.5m, which would not be sufficient for two-way traffic movements.

12.5.42 A signed traffic management system would therefore be implemented on Embankment between Thames Place and the site during construction of the secondary site. This would also reduce the amount of on-street parking that would need to be suspended.

12.5.43 The loading/unloading area at the secondary site would be located in the carriageway. Vehicles accessing the unloading area would access it from the west and then depart in an easterly direction. The loading area would either be fenced with gates or comprise a barrier area to enable safe unloading.

12.5.44 Traffic marshals would be deployed to help ensure HGV access is managed without conflict.

12.5.45 At the main site, access would be via a new access located approximately 10m northeast of the junction between Embankment and Lower Richmond Road (B306).

12.5.46 The junction of Embankment and Lower Richmond Road (B306) would require modification to accommodate construction vehicle movements and the new site access. This would be achieved by the removal of a traffic island with footway widths on both sides being unaffected..

12.5.47 A short length of the existing one-way operation on the Embankment carriageway would be temporarily converted to two way operation during the construction period. This would enable construction vehicles to leave the site directly via the Embankment / Lower Richmond Road (B306) junction and avoid the need for construction vehicles to travel westbound along Embankment.

12.5.48 Construction lorry movements would be limited to the day shift only (08:00 to 18:00 Monday to Friday and 08:00 to 13:00 Saturday). Vol 7 Table 12.5.2 shows the construction lorry movement assumptions for the local peak traffic periods. These are based on the peak months of construction activity at the secondary site and main site. The assessment is based on 10% of the daily number of lorry journeys occurring in the peak hours, which has been agreed with TfL as a reasonable approach. It is recognised that it may be desirable to reduce the number of construction lorry movements in peak hours and the mechanisms for addressing this would form part of the *Traffic Management Plans* which are required as part of the *Code of Construction Practice*.

Vol 7 Table 12.5.2 Transport – peak construction works vehicle movements

Vehicle type	Vehicle movements per time period				
	Total daily	**07:00 to 08:00**	**08:00 to 09:00**	**17:00 to 18:00**	**18:00 to 19:00**
Construction lorry vehicle movements 10%*	42	0	4	4	0
Other construction vehicle movements**	36	4	4	4	4
Worker vehicle movements***	nominal	0	0	0	0
Total	**78**	**4**	**8**	**8**	**4**

** The assessment is based on 10% of the daily construction lorry movements associated with materials taking place in each of the peak hours*
*** Other construction vehicle movements includes cars and light goods vehicles associated with site operations and contractor activity.*
**** Worker vehicle numbers based on less than 1% of workers driving, (see Vol 7 Table 12.5.1) on the basis that there would be no worker parking on site; on-street parking in the area is restricted; and site-specific Travel Plan measures would discourage workers from travelling by driving. In practical terms, this would be close to zero.*

12.5.49 The busiest peak in the AM and PM period for each type of movement (construction lorries, other construction vehicles and worker vehicles) has been combined in the development case and assessed against the peak hour operation of the highway network. In reality, not all peaks for these movements would occur concurrently and the peak for worker trips would be outside of the highway network peak hour, therefore the assessment is considered to be robust.

12.5.50 Assuming that 90% of imported and exported cofferdam fill and 90% of shaft and other excavated material is transported by barge with all other material by road, an average peak flow of 78 vehicle movements a day is expected during the months of greatest activity during Site Year 2 of construction at this site. At other times in the construction period, vehicle flows would be lower than this average peak figure.

12.5.51 The relevant impact criteria for determining the magnitude of impacts on the highway network and operation are accidents and safety, road network delay and hazardous loads (as set out in Vol 2 Section 12).

12.5.52 There would be no more than four two-way construction HGV movements in the vicinity of the Putney Embankment Foreshore site per hour. There would be no HGV movements associated with other Thames Tideway Tunnel project sites passing along Lower Richmond Road (B306). In addition, the site access is not directly onto a strategic road. Therefore, the impact on accidents and safety in relation to the highway network would be negligible.

12.5.53 It is assessed that potentially there would be one vehicle every fortnight transporting hazardous loads to or from this site during construction and therefore the impact on the highway network in relation to hazardous loads would be low adverse.

12.5.54 The local PICADY and LinSig models have been used to apply the construction traffic demands to the construction base case to determine the changes in the highway network operation due to the project (ie, comparison of base and development cases). The development case traffic flows (providing input to the LinSig and PICADY models) are shown in Vol 7 Figure 12.4.6 and Vol 7 Figure 12.4.7 (see separate volume of figures).

12.5.55 A summary of the construction assessment results for the weekday AM and PM peak hours is shown in Vol 7 Table 12.5.3 to Vol 7 Table 12.5.4 Vol 7 Table 12.5.5. The results indicate that there would be a negligible effect on capacity at both modelled junctions.

12.5.56 The LinSig model indicates that the additional road network delay during the AM and PM peak hours created as a result of the additional construction traffic would be a maximum of four seconds per vehicle in the AM peak hour on Putney High Street (A219) and a maximum of five seconds per vehicle during the PM peak hour on Lower Richmond Road (A306) right turn onto Putney High Street (A219).

12.5.57 The PICADY model suggests that it would take approximately 11 seconds and eight seconds for site traffic to gain access onto Lower Richmond Road (B306) in the AM and PM peak respectively.

12.5.58 Overall, this would result in a negligible impact, based on the impact criteria identified in Vol 2 Section 12.

Vol 7 Table 12.5.3 Transport – construction LinSig model outputs (AM peak hour)

Approach	Arm	Flow (PCU)	Weekday								
			AM peak hour (08:00-09:00)								
			DoS			MMQ (PCUs)			Delay (seconds per PCU)		
			Base case	Devt case	Change	Base case	Devt case	Change	Base case	Devt case	Change
Putney Bridge Road (bridge approach) (A219)	Ahead (Bus Lane)	158	12%	12%	0%	2	2	0	8	8	0
	Ahead	702	75%	80%	+5%	14	16	+2	21	23	+2
	Right	337	88%	88%	0%	12	13	+1	71	71	0
Lower Richmond Road (A306)	Left	739	72%	71%	-1%	13	13	0	23	22	-1
	Right	309	90%	87%	-3%	12	12	0	84	75	-9
Putney High Street (A219)	Ahead / left	762	88%	90%	+2%	18	19	+1	45	48	+3
	Ahead	619	84%	87%	+3%	19	20	+1	45	49	+4
			PRC						Total delay (PCU hours)		
Overall junction performance			0.40%	-0.10%	-0.50%				39	41	+2

Notes: 1. DoS represents Degree of Saturation; the ratio of flow to capacity. MMQ represents Mean Maximum Queue for the busiest-case 15 minute modelled period (in vehicle lengths). PRC represents Practical Reserve Capacity; measure of how much additional traffic could pass through a junction whilst maintaining a maximum DoS of 90% on all lanes. Delay represents the mean delay per PCU. PCU value for a car is one PCU. Vans and three-axle vehicles are 1.5 PCUs, vehicles with four or more axles are 2.3 PCUs. Buses and coaches are two PCUs. Motorcycles are 0.4 PCUs and pedal cycles are 0.2 PCUs. Thames Tideway Tunnel project construction vehicles would be a mixture of three- and four-axle vehicles and have therefore been given a PCU value of two.

2. Assessment has assumed that traffic signal optimisation has been undertaken as detailed in para. 12.3.20.

Vol 7 Table 12.5.4 Transport – construction LinSig model outputs (PM peak hour)

Approach	Arm	Flow (PCU)	Weekday								
			PM peak hour (17:00-18:00)								
			DoS			MMQ (PCUs)			Delay (seconds per PCU)		
			Base case	Devt case	Change	Base case	Devt case	Change	Base case	Devt case	Change
Putney Bridge Road (bridge approach) (A219)	Ahead (Bus Lane)	197	17%	17%	0%	3	3	0	12	12	0
	Ahead	716	90%	90%	0%	22	22	0	40	40	0
	Right	424	91%	91%	0%	16	16	0	69	69	0
Lower Richmond Road (B206)	Left	356	29%	29%	0%	2	2	0	10	10	0
	Right	384	89%	91%	+2%	14	15	+1	72	77	+5
Putney High Street (A219)	Ahead / left	694	91%	92%	+1%	16	16	0	60	60	0
	Ahead	449	87%	87%	0%	15	15	0	60	60	0
			PRC						Total delay (PCU hours)		
Overall junction performance			-1.60%	-2.00%	-0.4%				41	45	+4

Notes: 1. DoS represents Degree of Saturation; the ratio of flow to capacity. MMQ represents Mean Maximum Queue for the busiest-case 15 minute modelled period (in vehicle lengths). PRC represents Practical Reserve Capacity; measure of how much additional traffic could pass through a junction whilst maintaining a maximum DoS of 90% on all lanes. Delay represents the mean delay per PCU. PCU value for a car is one PCU. Vans and three-axle vehicles are 1.5 PCUs, vehicles with four or more axles are 2.3 PCUs. Buses and coaches are two PCUs. Motorcycles are 0.4 PCUs and pedal cycles are 0.2 PCUs. Thames Tideway Tunnel project construction vehicles would be a mixture of three- and four-axle vehicles and have therefore been given a PCU value of two.
2. Assessment has assumed that traffic signal optimisation has been undertaken as detailed in para. 12.3.20.

Vol 7 Table 12.5.5 Transport – construction PICADY model outputs (AM peak hour)

Approach	Arm	Flow (vehs)	Weekday								
			AM peak hour (08:00-09:00)								
			RFC			Max Queue (vehs)			Delay (seconds per veh)		
			Base case	Devt case	Change	Base case	Devt case	Change	Base case	Devt case	Change
Embankment	Left	4	0	1%	+1%	0	0.01	+0.01	0	11	+11
Lower Richmond Road (B306)	Ahead / right	67	17%	18%	+1%	0.21	0.23	+0.02	12	12	0

Notes: RFC represents Ratio of Flow to Capacity. Queue represents number of vehicles in queue. Delay represents the mean delay per vehicle.

Vol 7 Table 12.5.6 Transport – construction PICADY model outputs (PM peak hour)

Approach	Arm	Flow (vehs)	Weekday								
			PM peak hour (17:00-18:00)								
			RFC			Max Queue (vehs)			Delay (seconds per veh)		
			Base case	Devt case	Change	Base case	Devt case	Change	Base case	Devt case	Change
Embankment	Left	5	0	1%	+1%	0	0.01	+0.01	0	8	+8
Lower Richmond Road (B306)	Ahead / right	50	10%	10%	0%	0.11	0.12	+0.01	8	8	0

Notes: RFC represents Ratio of Flow to Capacity. Queue represents number of vehicles in queue. Delay represents the mean delay per vehicle.

Significance of effects

12.5.59 The significance of the effects has been determined by considering the transport impacts described above in the context of the sensitivity of the receptors identified in Vol 7 Table 12.4.3 and Vol 7 Table 12.4.4.

12.5.60 Vol 7 Table 12.5.7 sets out the effects on each receptor in the vicinity of the site.

Vol 7 Table 12.5.7 Transport – significance of effects during construction

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
Pedestrians and cyclists (including sensitive pedestrians) using the Thames Path and other routes in the vicinity of the site	**Secondary site construction:** Minor adverse effect on pedestrians. Minor adverse effect on cyclists	**Secondary site construction: Pedestrians**: • High sensitivity • Negligible impact on pedestrian delay • Low adverse impact on pedestrian amenity and accidents and safety • Due to majority of impacts of low adverse magnitude, equates to minor adverse effect. **Cyclists**: • High sensitivity • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Due to impacts being low adverse and negligible magnitude, equates to minor adverse effect.
	Main site construction: Minor adverse effect on pedestrians Minor adverse effect on cyclists	**Main site construction:** **Pedestrians:** • High sensitivity • Negligible impact on pedestrian delay and pedestrian amenity • Low adverse impact on

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
		accidents and safety • Due to low adverse and negligible impacts, equates to minor adverse effect . **Cyclists:** • High sensitivity • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Due to impacts being low adverse and negligible magnitude, equates to minor adverse effect.
Private vehicle users in the area using the local highways or on-street parking.	**Secondary site construction:** Minor adverse effect on highway users Major adverse effect on parking users	**Secondary site construction:** **Highway users:** • Medium sensitivity • Negligible impact on road network delay and accidents and safety • Low adverse impact from hazardous loads. • Due to negligible and low adverse impact magnitudes, and the sensitivity of the receptor, equates to a minor adverse effect. **Parking users:** • Medium sensitivity • High adverse impact on on-street parking • Due to high adverse impact magnitude, equates to major adverse effect.
	Main site construction: Minor adverse effect on highway users Minor adverse effect on parking users	**Main site construction:** **Highway users:** • Medium sensitivity • Negligible impact on road network delay and accidents

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
		and safety • Low adverse impact from hazardous loads. • Due to negligible and low adverse impact magnitudes, and the sensitivity of the receptor, equates to a minor adverse effect. **Parking users:** • Medium sensitivity • Low adverse impact on on-street parking • Due to low adverse impact magnitude, equates to minor adverse effect.
Emergency vehicles travelling on Embankment and the surrounding highway network.	Minor adverse effect	• High sensitivity • Negligible impact on road network delay and accidents and safety • Low adverse impact from hazardous loads. • Due to negligible and low adverse impact magnitudes, equates to a minor adverse effect.
Marine emergency vehicles	Negligible effect	• High sensitivity • Negligible impact from barge movements • Due to negligible impact equates to negligible effect
Bus users (passengers) travelling on routes along Lower Richmond Road (A306) and on Putney High Street (A219)	Negligible effect	• Medium sensitivity • Negligible impact on road network delay and patronage • Due to negligible impacts, equates to negligible effect.

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
Passengers using river services	Negligible effect	• Medium sensitivity • Negligible impact on patronage • Due to negligible impact, equates to negligible effect
River vessel operators	Negligible effect	• Medium sensitivity • Negligible impact from barge movements • Due to negligible impact, equates to negligible effect
Leisure users of the River Thames	Minor adverse effect	• High sensitivity • Negligible impact from barge movements • Low adverse impact on public access to the river • Due to negligible and low adverse impacts, equates to minor adverse effect.
Public transport users using rail services within the area	Negligible effect	• Low sensitivity • Negligible impact on patronage. • Due to negligible impact, equates to negligible effect.
Houseboats Residents of Kenilworth Court Residents of houses on Ruvigny Gardens, Thames Place and Embankment Residents of Glendarvon Street	**Secondary site construction:** Minor adverse effect on pedestrians Minor adverse effect on cyclists Minor adverse effect on highway users Major adverse effect on parking users	**Pedestrians:** **Pedestrians during Secondary site construction:** • High sensitivity • Negligible impact on pedestrian delay • Low adverse impact on pedestrian amenity and accidents and safety • Due to majority of impacts of low adverse magnitude, equates to minor adverse effect.

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
Chas Newen's Marine Boat repair and builders commercial business Users of Thai Square restaurant Users of café development at Nos. 2 and 4-6 Putney High Street Users of Constitutional Club Users of London Rowing Club Patrons of Dukes Head Public House Users of St Marys Church	**Main site construction:** Minor adverse effect on pedestrians Minor adverse effect on cyclists Minor adverse effect on highway users Minor adverse effect on parking users	**Pedestrians during main site construction:** • High sensitivity • Negligible impact on pedestrian delay and pedestrian amenity • Low adverse impact on accidents and safety f • Due to negligible and low adverse magnitude impacts, equates to minor adverse effect for pedestrians. **Cyclists during secondary site and main site construction:** • High sensitivity • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Due to impacts being low adverse and negligible magnitude, equates to minor adverse effect. **Highway users during secondary site and main site construction:** • Medium sensitivity • Negligible impact on road network delay and accidents and safety • Low adverse impact from hazardous loads. • Due to negligible and low adverse impact magnitudes, and the sensitivity of the receptor, equates to a minor adverse effect. **Parking users during secondary site construction:** • Medium sensitivity

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
		• High adverse impact on on-street parking • Due to high adverse impact magnitude, equates to major adverse effect. **Parking users during main site construction:** • Medium sensitivity • Low adverse impact on on-street parking • Due to low adverse impact magnitude, equates to minor adverse effect.
Residents of 45-53 Putney High Street & 329-339 Putney Bridge Road Users of Odeon Cinema	**Secondary site construction:** Minor adverse effect on pedestrians Minor adverse effect on cyclists Minor adverse effect on highway users Minor adverse effect on parking users Main site construction: Minor adverse effect on pedestrians Minor adverse effect on cyclists Minor adverse effect on highway and parking users	**Pedestrians:** **Pedestrians during secondary site construction:** • High sensitivity • Negligible impact on pedestrian delay • Low adverse impact on pedestrian amenity and accidents and safety • Due to majority of impacts of low adverse magnitude, equates to minor adverse effect. **Pedestrians during main site construction:** • High sensitivity • Negligible impact on pedestrian delay and pedestrian amenity • Low adverse impact on accidents and safety • Due to negligible and low adverse magnitude, equates to minor adverse effect for pedestrians

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
		Cyclists during secondary site and main site construction: • High sensitivity • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Due to impacts being low adverse or negligible magnitude, equates to minor adverse effect. **Highway users during secondary site and main site construction:** • Medium sensitivity • Negligible impact on road network delay and accidents and safety • Low adverse impact from hazardous loads. • Due to negligible and low adverse impact magnitudes, and the sensitivity of the receptor, equates to a minor adverse effect. **Parking users during secondary site construction:** • Medium sensitivity • Low adverse impact on on-street parking due to distance from parking suspensions • Due to low adverse impact magnitude, equates to minor adverse effect. **Parking users during main site construction:** • Medium sensitivity • Low adverse impact on on-street parking • Due to low adverse impact

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
		magnitude, equates to minor adverse effect.

Sensitivity test for programme delay

12.5.61 The assessment has been based on an estimated programme for the construction of the Thames Tideway Tunnel project. That programme has been used to derive construction vehicle numbers and to understand the relationships between the project and other developments in the vicinity of project sites, in order to allow appropriate receptors to be identified.

12.5.62 If the overall programme were to be delayed by approximately a year, the implications in relation to the transport effects would be as follows:

a. It is unlikely that the effects on pedestrians and cyclists would change. Over the course of one year, it is unlikely that pedestrian or cycle traffic in the vicinity of the project site would increase by a sufficient amount to change the magnitude of impacts or the significance of effects reported, nor that the arrangements for pedestrian and cycle route diversions would be any different to those currently proposed

b. Effects on public transport are unlikely to change as the rate of public transport patronage growth is relatively low and over the course of one year, any reduction in spare capacity on existing public transport networks would be small. Additionally, there is a general trend towards the enhancement of the public transport network through the provision of additional bus, rail and river services in order to meet future demand and accommodate future patronage growth. The transport assessment typically indicates that the additional public transport patronage arising from Thames Tideway Tunnel project sites would be small and not significant in the context of the capacity available on the wider networks

c. Effects on river navigation and access would not be significantly different as the rate of change in patterns of river usage is comparatively small

d. Effects on the operation of the highway network are derived from the use of the TfL Highway Assignment Models (HAMs), which have a forecast model year of 2021. To provide consistency within the assessment, it has been agreed with TfL that this is an appropriate approach. Since the local highway capacity models for the base case also use traffic flow information from the HAMs, it follows that both the strategic and local capacity assessments are effectively based on a year of 2021. As the peak months of activity at the Putney Embankment Foreshore site fall before 2021 based on the programme that has been assessed, it follows that a delay of up to one year would not alter the outcomes of the highway network modelling and therefore would not alter the effects reported

e. Based on the site development schedule (see Vol 7 Appendix N), there would be no new receptors requiring assessment as a result of a one year delay.

12.6 Operational effects assessment

12.6.1 This section summarises the findings of the assessment undertaken for Year 1 of operation at the Putney Embankment Foreshore site.

12.6.2 The transport demands created by the development in the operational phase would be extremely low and limited to occasional maintenance visits every three to six months, with certain instance where larger cranes and other associated support vehicles may be required for access to the shaft and tunnel every ten years.

12.6.3 The assessment of the operational phase is therefore limited to the physical issues associated with accessing the site from the base case highway network as outlined in Section 12.2. This has been discussed with the LB of Wandsworth and TfL.

12.6.4 The operational assessment has taken into consideration those elements that would be affected, which comprise the short-term impacts upon on-street car parking and on the highway layout and operation when maintenance visits are made to the site.

Parking

12.6.5 No impact on car parking is expected during the routine three to six month maintenance visits.

12.6.6 When large vehicles are required to service the site a maximum of six parking bays would be temporarily suspended to ensure the vehicles have sufficient space to manoeuvre into the site. This temporary suspension would be on an infrequent basis and would occur approximately every ten years.

12.6.7 Based on the impact magnitude criteria outlined in Vol 2 Section 12 the temporary suspension of six parking spaces would result in a **negligible** effect on parking within the local area.

Highway layout and operation

12.6.8 During the operational phase, the site would be accessed via Embankment from the westbound carriageway as shown in the permanent highway layout plans (see separate volume of figures – Section 1).

12.6.9 For routine three or six monthly inspections vehicular access would be required for light commercial vehicles, typically a transit van. On limited occasions there may be a need for flatbed vehicles to access the site.

12.6.10 During ten-yearly inspections space to locate two large mobile cranes within the site area would be required. The cranes would facilitate the lowering and recovery of tunnel inspection equipment and provide duty/standby access for personnel. To assess the effect of these on the highway layout swept path analyses have been undertaken for the largest vehicles expected to access the site: an 11.36m mobile crane, a 10m rigid vehicle and a 10.7m articulated vehicle. The permanent highway layout vehicle swept path analysis plan (see Putney Embankment Foreshore *Transport Assessment* figures) demonstrates that maintenance vehicles would be able to safely enter and leave the site.

12.6.11 As identified above, as a result of the large turning circles of the cranes, a maximum of six parking bays would be suspended to ensure the vehicles have sufficient space to manoeuvre into the site. This would be once every ten years.

12.6.12 When larger vehicles are required to service the site there may also be some temporary, short-term delay to other road users while manoeuvres are made. However, it is anticipated that the arrival of large vehicles would normally be scheduled to take place outside of the peak hours to minimise the effect on the local highway network.

12.6.13 In accordance with the criteria outlined in Vol 2 Section 12, during the routine inspections of the operational site it is anticipated that there would be a negligible impact on road network delay.

12.6.14 Taking into consideration the various sensitivities of the receptors affected during the operational phase (private vehicle users and emergency vehicles) this would result in a **negligible** effect on highway layout and operation.

Sensitivity test for programme delay

12.6.15 If the opening year of the Thames Tideway Tunnel project were to be delayed by approximately one year, the results of the operational assessment would not be materially different to the assessment findings reported above.

12.7 Cumulative effects assessment

Construction effects

12.7.1 As indicated in the site development schedule (see Vol 7 Appendix N) all of the other developments identified within 1km of the Putney Embankment Foreshore site would be complete and operational by Site Year 2 of construction. This means that there are no specific cumulative effects to assess, although it is noted that the TfL HAMs have been developed using GLA employment and population forecasts, which are based on the employment and housing projections set out in the London Plan. As a result, the assessment inherently takes into account a level of future growth and development across London.

12.7.2 Therefore, the effects on transport would remain as described in Section 12.5. This would also be the case if the programme for the Thames Tideway Tunnel project were delayed by approximately one year.

Operational effects

12.7.3 As indicated in the site development schedule (see Vol 7 Appendix N) all other developments within 1km of the site would be complete and operational by Year 1 of operation and therefore there is no need for a cumulative assessment on transport and the effects would remain as described in Section 12.6. This would also be the case if the programme for the Thames Tideway Tunnel project were delayed by approximately one year.

12.8 Mitigation

12.8.1 The project has been designed to limit the effects on transport networks as far as possible and many measures have been embedded directly in the design of the project.

Construction

12.8.2 During construction it is envisaged that the embedded measures set out in Section 12.2 including the measures in the *CoCP* and *Draft Project Framework Travel Plan*, would minimise the effects resulting from construction works at the Putney Embankment Foreshore site.

12.8.3 These are the most appropriate measures for this site and no further mitigation of significant adverse effects is possible.

Operation

12.8.4 No mitigation is required during the operational phase as no significant adverse effects are predicted.

12.9 Residual effects assessment

Construction effects

12.9.1 As no mitigation measures are proposed the residual construction effects remain as described in Section 12.5. All residual effects are presented in Section 12.10.

Operational effects

12.9.2 As no mitigation measures are proposed the residual operational effects remain as described in Section 12.6. All residual effects are presented in Section 12.10.

12.10 Assessment summary

Vol 7 Table 12.10.1 Transport – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Pedestrians and cyclists (including sensitive pedestrians) using the Thames Path and other routes in the vicinity of the site	• Pedestrian diversion routes • Loss of off carriageway cycle path for cyclists • Cycle stand relocation	Minor adverse effect on pedestrians (during secondary site and main site construction) Minor adverse effect on cyclists (during secondary site and main site construction)	None	Minor adverse effect on pedestrians (during secondary site and main site construction) Minor adverse effect on cyclists (during secondary site and main site construction)
Private vehicle users in the area using the local highways or on-street parking.	• Movement of large construction vehicles • Highway layout and operation changes • Suspension of on-street parking.	Minor adverse effect on highway users (during secondary site and main site construction) Major adverse effect on parking users during secondary site construction Minor adverse effect on parking users during main site construction	None	Minor adverse effect on highway users (during secondary site and main site construction) Major adverse effect on parking users during secondary site construction Minor adverse effect on parking users during main site construction
Emergency vehicles travelling on Embankment and surrounding highway network.	• Movement of large construction vehicles • Highway layout and operation changes	Minor adverse effect (during secondary site and main site construction)	None	Minor adverse effect (during secondary site and main site construction)
Marine emergency users	• Movement of construction barges	Negligible effect (during secondary site and main site	None	Negligible effect (during secondary site and main site

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
		construction)		construction)
Bus users (passengers) travelling on routes along Lower Richmond Road (A306) and on Putney High Street (A219)	• Movement of large construction vehicles affecting bus journey times • Some additional patronage of construction workers	Negligible effect (during secondary site and main site construction)	None	Negligible effect (during secondary site and main site construction)
Passengers using river services Public transport users using rail or river services within the area	• Some additional patronage of construction workers	Negligible effect (during secondary site and main site construction)	None	Negligible effect (during secondary site and main site construction)
River vessel operators	• Movement of construction barges	Negligible effect (during secondary site and main site construction)	None	Negligible effect (during secondary site and main site construction)
Leisure users of the River Thames	• Movement of construction barges • Access to river maintained via temporary slipway	Minor adverse effect (during secondary site and main site construction)	None	Minor adverse effect (during secondary site and main site construction)
Houseboats Residents of Kenilworth Court	• Movement of large construction vehicles • Pedestrian diversion routes • Loss of off	Minor adverse effect on pedestrians (during secondary site and main site construction)	None	Minor adverse effect on pedestrians (during secondary site and main site construction) Minor adverse effect on cyclists (secondary site and main site construction)

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residents of houses on Ruvigny Gardens, Thames Place and Embankment Residents of 45-53 Putney High Street & 329-339 Putney Bridge Road Users of café development at Nos. 2 and 4-6 Putney High Street Chas Newen's Marine Boat repair and builders commercial business Users of Constitutional Club Users of London Rowing Club Patrons of Dukes Head Public House Users of St Marys Church	carriageway cycle path for cyclists • Cycle stand relocation • Suspension of on-street parking • Highway layout and operation changes	Minor adverse effect on cyclists (during secondary site and main site construction) Minor adverse effect on highway users (during secondary site and main site construction) Major adverse effect on parking during secondary site construction Minor adverse effect on parking users during main site construction		Minor adverse effect on highway users (during secondary site and main site construction) Major adverse effect on parking during secondary site construction Minor adverse effect on parking users during main site construction

Vol 7 Table 12.10.2 Transport – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Private vehicle users in the area using the local highways or on-street parking.	• Occasional delay to road users when large maintenance vehicles accessing site and loss of on street parking.	Negligible effect	None	Negligible effect
Emergency vehicles travelling on Embankment and Lower Richmond Road (B306).	• Occasional maintenance trips resulting in some temporary, short-term road network delay.	Negligible effect	None	Negligible effect

References

[1] Defra, *National Policy Statement for Waste Water* (2012)

[2] Transport for London, *Travel Planning for new development in London,* Transport for London (2011)

[3] Transport for London, *Assessment Tool for Travel Plan Building Testing and Evaluation (ATTrBuTE)*, 2011. Available at: http://www.attrbute.org.uk/

[4] Greater London Authority, *London Plan*, (July 2011).

[5] Transport for London, *Transport Assessment Best Practice Guidance*, (April 2010).

[6] The estimates are derived from study team calculations that use the arrival and departure times for piers published in TfL River Bus and Tour timetables (http://www.tfl.gov.uk/modalpages/2648.aspx) and information on barge movements obtained from barge operators and commercial users.

[7] Transport for London. *London Underground Upgrade Plan*, (2011) http://www.tfl.gov.uk/assets/downloads/corporate/our-upgrade-plan-london-underground-february-2011.pdf

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 13: Water resources - groundwater

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

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Thames Tideway Tunnel

Environmental Statement

Volume 7: Putney Embankment Foreshore site assessment

Section 13: Water resources – groundwater

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13 Water resources – groundwater

13.1 Introduction

13.1.1 This section presents the findings of the assessment of the likely significant effects of the proposed development on groundwater at the Putney Embankment Foreshore site.

13.1.2 The proposed development has the potential to affect groundwater due to:

a. creation of pathways for pollution

b. obstruction to groundwater flows

c. seepages into and out of the CSO drop shaft during operations.

13.1.3 The groundwater assessment at this site should be read in conjunction with the supporting Volume 7 Appendix K (K.1 – K.9) and the land quality assessment (see Vol 7 Section 8).

13.1.4 The site is underlain by a thick layer of London Clay Formation, which is relatively impermeable. Construction would not extend down below the London Clay layer. The groundwater within the River Terrace Deposits (upper aquifer) would be cut off from the site using a sheet pile wall[i]. There would be no effects on the lower aquifer because of the presence of the London Clay and therefore this aquifer is excluded from this assessment.

13.1.5 An assessment of project-wide environmental effects on groundwater is presented in Volume 3 Project-wide assessment.

13.1.6 The assessment of groundwater presented in this section has considered the requirements of the National Policy Statement for Waste Water (Defra, 2012)[1] Section 4.2. The physical characteristics of the groundwater environment including groundwater resources and quality are presented and the anticipated effects (including cumulative effects) on these resources addressed in the assessment that follows (further detail can be found in Vol 2 Section 13.3).

13.1.7 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 7 Putney Embankment Foreshore Figures).

13.2 Proposed development relevant to groundwater

13.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to groundwater are set out below.

---

[i] Sheet pile wall – a sub-surface structure installed to support excavation and in which amongst other things helps to control inflows of shallow groundwater, typically formed of steel.

Construction

13.2.2 The elements of construction at the Putney Embankment Foreshore site, relevant to the consideration of groundwater, include the following at the main site:

a. A combined sewer overflow (CSO) drop shaft of approximately 6m internal diameter (ID), and approximately 36m deep (based on 69.43mATD[ii] from an assumed ground level of 105.5mATD) (excluding an approximately 2m thick base slab).

b. An interception chamber to the existing CSO.

c. Other hydraulic chambers to manage the flow of discharges between the interception chamber and the drop shaft.

d. A connection culvert from the interception chamber to the drop shaft.

e. Putney Bridge connection tunnel from the base of the drop shaft to the main tunnel.

13.2.3 In addition a temporary slipway would be constructed at the secondary site, using prefabricated steel, to provide alternative public access to the river whilst the existing slipway is unavailable.

13.2.4 The proposed methods of construction for these elements are described in Section 3 Proposed development of this volume and approximate duration of construction and depths are also included in Vol 7 Table 13.2.1 below.

Vol 7 Table 13.2.1 Groundwater – methods of construction

Design elements	Method of construction	Construction periods (years)*	Construction depth**
CSO drop shaft	Sheet piling through superficial deposits–Sprayed Concrete Lining (SCL) through London Clay Formation	<1	Deep
Interception chamber and connection culvert	The initial set up piles forming the cofferdam (see below) followed by steel bar re-inforcement and formwork panels	<1	Shallow
Putney Bridge connection	SCL techniques	< 1	Deep

[ii] In general, the measurements of depth are expressed as metres Above Tunnel Datum (mATD). The standard zero point for mATD scale is -100maOD (metres above Ordnance Datum is based on Newlyn datum point for mean sea level). The use of the mATD scale avoids the need for use of negative values, and is widely used for large scale sub-surface projects.

Design elements	Method of construction	Construction periods (years)*	Construction depth**
tunnel (to main tunnel)			
Temporary slipway	Prefabricated steel upon augered steel piles	3 months for construction and 3 months for removal.	Shallow
Cofferdam	Sheet piles driven into bed of river	3 months	Shallow

** The site would be used for construction purposes for up to 3 years*
***In terms of construction depth – shallow (means <10m) and deep (>10m).*

Code of Construction Practice

13.2.5 All works would be undertaken in accordance with the *Code of Construction Practice (CoCP).* The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B). Relevant measures included within the *CoCP* Section 8 to ensure adverse effects on groundwater are minimised are as follows:

a. Measures include providing bunded stores for fuel/oils held on site and the settlement of water from excavations to prevent silty water from entering watercourses, surface water drains and onto roads as per Environment Agency (EA) guidelines (EA, 2011)[2]. The contractor would have plans and equipment in place to deal with emergency situations as well as ensuring that staff are appropriately trained.

b. A precautionary approach, involving targeted risk-based audits and checks by monitoring water quality, would be applied to licensed abstractions and unlicensed abstractions thought to be at risk.

c. Monitoring arrangements for any permits required on change of licensing regulations would be developed in liaison with the EA (see also the groundwater monitoring strategy in Vol 3 Appendix K.1).

d. At the end of construction where temporary support does not form part of the operational structure it would be removed, piped through or cut down to avoid the build up of groundwater on the upstream side of underground structures

13.2.6 There are no site specific groundwater measures contained within the *CoCP* Section 8.

Other measures during construction

13.2.7 The depth of the CSO drop shaft means that it would extend down through the River Terrace Deposits and into the London Clay Formation (units B and A3ii). The base slab would extend down into the London Clay Formation, unit A3ii.

13.2.8 For the purposes of this assessment it is not anticipated that dewatering of the River Terrace Deposits (upper aquifer) would be required. During the initial set up, piles in the form of a cofferdam would be built around the river bounded side of the site. In order to construct the interception chambers and culverts, these excavations would have steel bar re-inforcement and formwork panels. This combination of sheet pile walls would seal out any inflows from the River Terrace Deposits at the site. Any water which seeps into the sheet pile walled areas would be pumped out and discharged directly to the river, following any necessary treatment and subject to EA approval. The duration of pumping for the interception chamber and connection culvert would be determined by ground conditions but is likely to be less than 12 months.

13.2.9 For the purposes of this assessment it is not anticipated that dewatering would be required for the construction of the Putney Bridge connection tunnel, as it would be constructed in the relatively impermeable London Clay Formation.

13.2.10 For the purposes of this assessment it is not anticipated that any ground treatment or grouting[iii] would be required at the site.

Operation

13.2.11 A groundwater monitoring strategy forms an environmental design measure for the project (see Vol 3 Appendix K.1). This covers groundwater levels and groundwater quality and outlines the future monitoring and actions in the event of trigger levels being exceeded.

13.3 Assessment methodology

Engagement

13.3.1 Volume 2 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. There have been no site-specific comments relevant to the Putney Embankment Foreshore site for the assessment of groundwater.

Baseline

13.3.2 The baseline methodology follows the methodology described in Vol 2. There are no site-specific variations for identifying the baseline conditions for this site.

13.3.3 The baseline describes receptors within a 1km radius of the site.

13.3.4 There are unlikely to be any effects on groundwater beyond a kilometre at the Putney Embankment Foreshore site given the hydrogeological setting and the method of construction.

[iii] Grouting – a thin, coarse mortar injected into various narrow cavities or voids, such as rock fissures, to fill them and consolidate the adjoining objects into a solid mass and to eliminate water.

Construction

13.3.5 The assessment methodology for the construction phase follows that described in Vol 2. There are no-site specific variations for undertaking the construction assessment of this site.

13.3.6 The assessment year applied to the construction assessment is Site Year 1 of construction, when sheet piling could obstruct groundwater flows and small-scale pumping from within the sheet pile wall would take place.

13.3.7 A number of proposed developments which are likely to be complete and operational before commencement of construction have formed part of the construction base case. The developments considered as part of the base case and those included in the cumulative effects assessment are detailed in Vol 7 Table 13.3.1. The developments relevant to groundwater are those which would contain basements.

13.3.8 The baseline is not anticipated to change substantially between 2011 and Site Year 1 of construction (2016) and so baseline data from 2011 have formed the basis (base case) for the construction assessment.

Vol 7 Table 13.3.1 Groundwater – construction base case and cumulative assessment developments (2016)

Development	Component or receptor relevant to groundwater	Construction base case	Cumulative effect assessment
113 Upper Richmond Road	Basement*	✓	✗
131-133 Upper Richmond Road	Basement*	✓	✗
45-53 Putney High Street & 329-339 Putney Bridge Road	Basement*	✗	✓
77-83 Upper Richmond Road and Carlton Court, 26 Carlton Drive	Basement*	✓	✗
84-88 Upper Richmond Road	Basement*	✓	✗
Carlton House, 27a Carlton Drive	Basement*	✗	✓
Former Putney Hospital	Basement*	✓	✗
No. 2 Putney High Street	Basement*	✓	✗
No. 4 - 6 Putney High Street	None	✓	✗

** Relevant to the upper aquifer*
Symbols ✓ applies ✗ does not apply

13.3.9 Section 13.5 details the likely significant effects arising from the construction at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on groundwater resources within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

Operation

13.3.10 The assessment methodology for the operation phase follows that described in Vol 2. There are no site-specific variations for undertaking the operational assessment of this site.

13.3.11 The assessment year applied to the operational assessment is Year 1 of operation. The baseline is not anticipated to vary significantly by the start of the operational phase in 2023, and therefore baseline data from 2011 have formed the basis for the operational assessment. In addition, information on proposed development schemes likely to have been completed before commencement of the operation of the Thames Tideway Tunnel project site have formed part of the operational base case.

13.3.12 The developments considered as part of the operational base case are included in Vol 7 Table 13.3.2. No developments have been identified which would be considered as part of the cumulative effects assessment. The developments relevant to groundwater are those which would contain basements.

Vol 7 Table 13.3.2 Groundwater – operational base case and cumulative assessment developments (2023)

Development	Component or receptor relevant to groundwater	Operational base case	Cumulative effect assessment
113 Upper Richmond Road	Basement*	✓	✗
131-133 Upper Richmond Road	Basement*	✓	✗
45-53 Putney High Street & 329-339 Putney Bridge Road	Basement*	✓	✗
77-83 Upper Richmond Road and Carlton Court, 26 Carlton Drive	Basement*	✓	✗
84-88 Upper Richmond Road	Basement*	✓	✗
Carlton House, 27a Carlton Drive	Basement*	✓	✗

Development	Component or receptor relevant to groundwater	Operational base case	Cumulative effect assessment
Former Putney Hospital	Basement*	✓	✗
No. 2 Putney High Street	Basement*	✓	✗
No. 4 - 6 Putney High Street	None	✓	✗

** Relevant to the upper aquifer*
Symbols ✓ applies ✗ does not apply

13.3.13 Section 13.6 details the likely significant effects arising from the operation at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on groundwater resources within the assessment area for this site during the operational phase and so no other Thames Tideway Tunnel project sites are considered in this assessment.

Assumptions and limitations

Assumptions

13.3.14 The construction assumptions relevant to this site are presented in Section 13.2.

13.3.15 The assessment of obstruction effects in Sections 13.5 and 13.6 is based on an estimated hydraulic gradient[iv] of 0.004 in the upper aquifer across the site.

13.3.16 This assessment has assumed that the shaft would have a design criterion to limit the rate of seepage of 1l/m^2/d (see Vol 2 Appendix K.3).

13.3.17 In the absence of active baseline groundwater monitoring boreholes, the hydrogeological conditions and groundwater quality encountered at the nearest off site boreholes have been assumed to be representative of site conditions at Putney Embankment Foreshore.

13.3.18 The measurements of the depth of shafts are quoted to two decimal places, however these measurements may be altered slightly in the future and are therefore indicative only.

13.3.19 For the purposes of this assessment, deep refers to greater than 10m below ground level (bgl) and shallow refers to less than 10m bgl.

Limitations

13.3.20 No site-specific pumping tests have yet been undertaken as part of the ground investigation. In the absence of site-specific hydrogeological data,

[iv] Hydraulic gradient – the slope of the water table which drives groundwater movement.

published sources of hydrogeological information have been used in this assessment (see Vol 7 Appendix K.2).

13.3.21 No groundwater level or groundwater quality data was available locally for the upper aquifer. The nearest groundwater levels have been obtained from another Thames Tideway Tunnel project site (Barn Elms), 1km to the northwest.

13.3.22 Groundwater level data available to this assessment from the Barn Elms site is also limited, with monitoring data available from only one borehole (or monitoring horizon) within the upper aquifer. This has meant that hydraulic gradients have been estimated across the site. In addition, the range of hydrological conditions experienced during the monitoring period (2010-2012) did not include a prolonged wet winter period when exceptionally high groundwater levels might occur.

13.3.23 Despite the limitations identified above, the assessment, which uses the best available information, is considered robust.

13.4 Baseline conditions

13.4.1 The following section sets out the baseline conditions for groundwater within and around the site. Future baseline conditions (base case) are also described.

13.4.2 This section of the assessment is supported by Vol 7 Appendix K.1 – K.9.

Current baseline

Hydrogeology

13.4.3 The CSO drop shaft to the main tunnel would pass through Made Ground, River Terrace Deposits and London Clay Formation, units B and A3ii. The depths and thicknesses of geological layers have been determined by reference to two ground investigation boreholes located within 50m of the Putney Embankment Foreshore site: SR1112 and SR2083. The superficial and solid geology in the vicinity of the site, as published by the British Geological Survey (BGS, 2009)[3], is shown in Vol 7 Figure 13.4.1 and Vol 7 Figure 13.4.2 respectively (see separate volume of figures). The depths and thicknesses of geological layers encountered are summarised in Vol 7 Table 13.4.1.

Vol 7 Table 13.4.1 Groundwater – estimated ground conditions and hydrogeology

Formation	Top elevation* (mATD)	Depth below river bed (m)	Thickness (m)	Hydrogeology
River Terrace Deposits	100.0	0.0	0.4	Upper Aquifer
London Clay B A3ii	 99.6 77.5	 0.4 22.5	 22.1 12.2	Aquiclude

Formation	Top elevation* (mATD)	Depth below river bed (m)	Thickness (m)	Hydrogeology
A3i	65.3	34.7	1.9	
A2	63.4	36.6	10.6	

** Based on an assumed ground level of 105.54mATD and top elevation of over-water boreholes is approximately 4m below assumed ground level.*

13.4.4 The River Terrace Deposits form the upper aquifer and are classified by the EA as a secondary A aquifer[v]. The London Clay Formation is considered to be an aquiclude[vi], in which any groundwater present is likely to consist of localised seepages and/or minor flows, with the exception of unit A3ii which is regarded as the most porous section of this formation.

Groundwater level monitoring

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

13.4.6 For the *Environmental Statement*, there are no active baseline groundwater level monitoring boreholes within the Putney Embankment Foreshore site. Information on groundwater levels for this assessment was therefore collected from an off site monitoring point (SA1115) located at the Barn Elms site, approximately 480m to the northwest (see Vol 7 Figure 13.4.3 in separate volume of figures). This borehole has a response zone[vii] (EA, 2006)[4] in the River Terrace Deposits and is monitoring groundwater levels in the upper aquifer. The average, minimum and maximum recorded water levels at this borehole is shown in Vol 7 Table 13.4.2.

Vol 7 Table 13.4.2 Groundwater – water level summary

Borehole ID	Formation	Average over the period of record (mATD)	Minimum (mATD)	Maximum (mATD)
SA1115	River Terrace Deposits	100.84	100.52	101.38

13.4.7 The recorded water levels at SA1115 range from 100.52 to 101.38mATD. These water levels generally remain below the top of the River Terrace Deposits at 101.69mATD. This suggests that this formation is generally not fully saturated and is unconfined.

[v] Secondary aquifer – either permeable strata capable of supporting local supplies or low permeability strata with localised features such as fissures (was previously referred as a minor aquifer).

[vi] Aquiclude – a geological formation through which virtually no water moves.

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

13.4.8 There are no EA observation boreholes sufficiently close to provide representative water levels for the upper aquifer at the site.

13.4.9 A plot of the groundwater levels within the River Terrace Deposits in the vicinity of the site is shown in Vol 7 Figure13.4.3 (see separate volume of figures). Given that there is one monitoring borehole within the upper aquifer, any determination of the direction of groundwater flow can only be approximate and is based on toporgaphy. It is anticipated that groundwater flow would be to the northeast, towards the River Thames, in these shallow deposits.

13.4.10 Further detail on groundwater level monitoring is provided in Vol 7 Appendix K.3.

Licensed abstractions

13.4.11 The nearest licensed groundwater abstraction from the River Terrace Deposits or upper aquifer is located at 0.7km to the east (licence no. 28/39/39/0177). This source is used for sports ground and facilities supply purposes. A capture zone[viii] was estimated for this source using licence information, the boundaries of which are 0.6km from the site (see Vol 7 Appendix K.5). In addition, this abstraction source is located on the opposite bank of the River Thames, where the groundwater flow direction is likely to be localised and toward the river. Therefore this source is not anticipated to be impacted by construction or operation at the Putney Embankment Foreshore site.

13.4.12 There are no known licensed groundwater abstraction sources from the lower aquifer or known unlicensed groundwater abstraction sources located within 1km of the Putney Embankment Foreshore site. In addition, the licensed groundwater abstractions from the Chalk are unlikely to be impacted as no construction would take place within the lower aquifer.

Groundwater source protection zone

13.4.13 The EA defines Source Protection Zones (SPZ) around all major public water supply abstraction sources and large licensed private abstractions in order to safeguard groundwater resources from potentially polluting activities. The Putney Embankment Foreshore site does not lie within a SPZ. The nearest SPZ for a Chalk source is over 4.6km to the northeast.

Environmental designations

13.4.14 There are no designations relevant to groundwater within 1km of the site.

Groundwater quality and land quality

13.4.15 Historical land use mapping, reviewed as part of the land quality assessment, has indicated one potentially contaminative land use or potential contaminant source: the wharves at the eastern end of the Putney Embankment Foreshore site (see Vol 7 Section 8).

[viii] Capture zone – the area from which groundwater would be drawn.

13.4.16 For the *Environmental Statement*, there are no active baseline groundwater quality monitoring boreholes within the Putney Embankment Foreshore site. Information on groundwater quality for this assessment has been collected from an off site monitoring point (SA1115A) as described in para. 13.4.16. The data has been compared with the UK drinking water standards (The Water Supply Regulations, 2000)[5] or relevant Environmental Quality Standards – EQS) (Defra, 2010)[6].

13.4.17 The data shows only one exceedance of the relevant standards within the River Terrace Deposits for nitrate at SR1115A.

13.4.18 The land quality data from the ground investigation borehole used in the groundwater quality assessment show few exceedances of the human health screening values (EA, 2009)[7] (soil guideline values designed to be protective of human health) with respect to heavy metals within the River Terrace Deposits. Further detail is provided in the land quality assessment (see Vol 7 Appendix F).

Groundwater flood risk

13.4.19 The closest recorded groundwater flooding incident is approximately 800m to the southeast of the site, based on information from the London Borough (LB) of Wandsworth *Surface Water Management Plan* (SWMP) (Capita Symonds and Scott Wilson, 2011)[8].

Groundwater receptors

13.4.20 Groundwater receptors which could be affected during construction or operation are summarised in Vol 7 Table 13.4.3 below. It can be seen that the only receptor of relevance to the Putney Embankment Foreshore site and which has therefore been assessed, is the upper aquifer.

Vol 7 Table 13.4.3 Groundwater – receptors

Receptor	Construction	Operation	Comment
Groundwater body – upper aquifer	✓	✓	Would be penetrated by CSO drop shaft, interception chamber and culvert
Licensed abstractions - upper aquifer	✗	✗	Nearest licensed abstraction at 0.7km from site, no impacts anticipated as no dewatering of upper aquifer
Licensed abstractions - lower aquifer	✗	✗	No impacts anticipated as no construction within lower aquifer
Unlicensed abstractions	✗	✗	None known
Planned developments	✗	✗	No planned abstractions or Ground Source Heat Pumps (GSHPs)

* *Symbols ✓ applies ✗ does not apply*

Receptor sensitivity

13.4.21 The upper aquifer (River Terrace Deposits) is classified by the EA as a secondary A aquifer and is allocated a medium value in terms of quality and quantity in this assessment.

Construction base case

13.4.22 The construction base case in Site Year 1 would be as per the current baseline. It also includes developments that are likely to be complete and partially or fully operational during construction at the Putney Embankment Foreshore site and which have the potential to lead to a change to groundwater in the upper aquifer.

13.4.23 The basements associated with other developments identified in Vol 7 Table 13.3.1 could cause some disruption to groundwater flow in the upper aquifer. However, any impacts are expected to be highly localised. Any substantive changes from baseline conditions prior to construction would be detected by monitoring of groundwater levels in the upper aquifer.

13.4.24 The lower aquifer would not be impacted by the developments identified in Vol 7 Table 13.3.1. Therefore, there would be no change from the current observed groundwater baseline (levels, movements and quality).

Operational base case

13.4.25 The operational base case is as per the construction base case, with one further scheme included which contains a basement (at Carlton House) as detailed in Vol 7 Table 13.3.2. This scheme would be located approximately 0.8km to the southeast and therefore it would be unlikely to cause any disruption to groundwater flow in the vicinity of the Putney Embankment Foreshore site.

13.5 Construction effects assessment

Construction impacts

Groundwater quality

13.5.1 The baseline groundwater quality data available for the upper aquifer in the vicinity of the Putney Embankment Foreshore site shows one exceedance of the relevant standards for nitrate. No dewatering of the upper aquifer would be required at the Putney Embankment Foreshore site and instead sheet piling would be constructed around the CSO drop shaft excavation. Therefore there would be no potential for mobilisation of contamination at this site. The magnitude of the impact on the upper aquifer is assessed to be negligible.

Physical obstruction

13.5.2 The combination of the cofferdam (sheet pile wall) and the steel-bar re-inforcement and formwork panels around the sub-surface structures (interception chambers and connection culvert) may disrupt local groundwater flows and alter groundwater levels within the upper aquifer.

13.5.3 The method for assessing the impact of all below ground activities upon the groundwater levels in the upper aquifer is described in Vol 2 Appendix K.2. It has been estimated that groundwater levels would rise during the construction phase at Putney Embankment Foreshore by around 0.2m, based on an estimated hydraulic gradient of 0.004.

13.5.4 Groundwater levels in the upper aquifer are likely to be around 2 to 3m below the existing ground surface at the Putney Embankment Foreshore site as suggested by groundwater seepage[ix] encountered at 3.2mbgl in one of the GI boreholes, SA1112 (20m from the site) and by the average recorded groundwater level of 2mbgl at the nearby Barn Elms site (recorded at SA1115A located 480m to the northwest of the Putney Embankment Foreshore site). The groundwater flow direction in the upper aquifer is anticipated to be towards the River Thames and therefore to be from the southwest to the northeast. Given the small predicted rise in groundwater levels (0.2m) on the southwest side of the site, the change in groundwater levels as a result of the physical obstruction would result in a negligible impact on the upper aquifer.

Construction effects

13.5.5 By combining the impacts above with the receptor value (as shown in para. 13.4.21), the significance of the effects has been derived using the generic significance matrix (Vol 2 Section 2). The results are described in the following sections.

Groundwater quality

13.5.6 The negligible impact on the groundwater quality of a medium value receptor, the upper aquifer, would lead to a **negligible** effect.

Physical obstruction

13.5.7 The physical impact of all below ground activities upon local groundwater levels is considered negligible. A negligible impact on a medium value receptor, the upper aquifer with regard to quantity, would result in an overall **negligible** effect.

13.6 Operational effects assessment

Operation impacts

Physical obstruction

13.6.1 The presence of the CSO drop shaft and interception chamber and other hydraulic chambers and connection culvert in the upper aquifer may disrupt groundwater flows and alter groundwater levels.

[ix] Groundwater seepage – recorded flow during borehole which may indicate the approximate groundwater level.

13.6.2 The method for assessing the impact upon the groundwater levels in the upper aquifer is described in Vol 2 Appendix K.2. It has been estimated that the groundwater levels would rise during the operational phase at the Putney Embankment Foreshore site by less than 0.1m, based on an estimated hydraulic gradient of 0.004

13.6.3 Groundwater levels in the upper aquifer are likely to be around 2 to 3m below the existing ground level. Given the small predicted rise in water levels (less than 0.1m) on the southwest side of the structure, the magnitude of impact has been assessed as negligible.

Seepage into CSO drop shaft

13.6.4 An estimate of the theoretical seepage volumes into the CSO drop shaft at Putney Embankment Foreshore is included in Vol 2 Appendix K.3. The estimated loss of water resources from the upper aquifer into the shaft would be $3m^3$/annum (Vol 2 Appendix K.3, Vol 2 Table K.4). The magnitude of impact is assessed as negligible for the upper aquifer.

Seepage from CSO drop shaft

13.6.5 An estimate of the theoretical seepage volumes from the CSO drop shaft at the Putney Embankment Foreshore site is included in Vol 2 Appendix K.3. The shaft would be full for only approximately 3% of the year or 11 days per year (see Vol 3 Section 13). The estimated volume of seepage from the drop shaft into the upper aquifer is $0.1m^3$/annum (Vol 2 Appendix K.3, Vol 2 Table K.5). The higher heads outside the CSO drop shaft would mean that any risk of seepage from the CSO drop shaft into the upper aquifer would be further reduced. The magnitude of impact has been assessed as negligible for the upper aquifer.

Operational effects

13.6.6 Combining the receptor value with the impacts (above), the significance of the effects has been derived using the generic significance matrix (Vol 2 Section 2). The results are described in the following sections.

Physical obstructions

13.6.7 Altering the groundwater levels on the southwest side of the CSO drop shaft would have a negligible impact on a medium value receptor (the upper aquifer) and would lead to a **negligible** effect.

Seepage from CSO drop shaft

13.6.8 Seepage from the main tunnel shaft has been determined as a negligible impact on groundwater quality for the upper aquifer. A negligible impact on a medium value receptor, the upper aquifer, would lead to a **negligible** effect.

Seepage into CSO drop shaft

13.6.9 Seepage into the main tunnel shaft has been determined as a negligible impact, which on a medium value receptor (the upper aquifer) would lead to a **negligible** effect.

13.7 Cumulative effects assessment

Construction effects

13.7.1 Two developments identified in Vol 7 Table 13.3.1 could potentially give rise to cumulative effects on groundwater in the upper aquifer through the inclusion of basements. It is considered that although there may be local impacts on groundwater levels in the upper aquifer due to the location of the developments, these impacts are not expected to be significant. Any substantive changes would be detected by monitoring of groundwater levels in the upper aquifer.

Operational effects

13.7.2 No assessment of cumulative effects during operation has been undertaken, as no major development schemes within 1km of the site have been identified which would be under construction in Year 1 of operation of the Thames Tideway Tunnel project at the Putney Embankment Foreshore site.

13.8 Mitigation

13.8.1 There are few impacts from the construction phase and those which have been identified would have negligible effects and no mitigation is required.

13.8.2 For the operational phase, no significant effects are identified in the operational assessment and therefore no mitigation is required.

13.9 Residual effects assessment

Construction effects

13.9.1 As no mitigation measures are required, the residual construction effects remain as described in Section 13.5. All residual effects are presented in Section 13.10.

Operational effects

13.9.2 As no mitigation measures are required, the residual operational effects remain as described in Section 13.6. All residual effects are presented in Section 13.10.

13.10 Assessment summary

Vol 7 Table 13.10.1 Groundwater – construction assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Upper aquifer	Deterioration in groundwater quality caused by creation of a pathway	Negligible	None	Negligible
Upper aquifer	Change in groundwater storage and flood risk as a result of physical obstruction	Negligible	None	Negligible

Vol 7 Table 13.10.2 Groundwater – operational assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Upper aquifer	Change in groundwater levels as a result of physical obstruction	Negligible	None	Negligible
Upper aquifer	Seepage into drop shaft affecting groundwater resources	Negligible	None	Negligible
Upper aquifer	Deterioration in water quality in the upper aquifer from seepage out of shaft	Negligible	None	Negligible

References

[1] Defra. *National Policy Statement for Waste Water* (2012).

[2] Environment Agency. *Introducing pollution prevention: PPG 1 – EA Consultation* (2011).

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

[4] Environment Agency. *Guidance on the design and installation of groundwater quality monitoring points Science Report SC020093* (2006). Available at: http://publications.environment-agency.gov.uk/PDF/SCHO0106BKCT-E-E.pdf.

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

[6] Defra. *River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Direction* 2010. Available at: http://www.defra.gov.uk/environment/quality/water/legislation/water-framework-directive/.

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

[8] Capita Symonds and Scott Wilson. *London Borough of Wandsworth Surface Water Management Plan* (September 2011).

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 14: Water resources - surface water

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 7: Putney Embankment Foreshore site assessment

Section 14: Water resources – surface water

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14 Water resources – surface water

14.1 Introduction

14.1.1 This section presents the findings of the assessment of the likely significant effects of the proposed development on surface water at the Putney Embankment Foreshore site. The assessment of surface water presented in this section has considered the requirements of the *National Policy Statement for Waste Water*, 2012 (NPS)[1]. The physical characteristics of the surface water environment including surface water resources and quality are presented and the anticipated effects (including cumulative effects) on these resources addressed in the assessment that follows. Further details on how the NPS requirements relevant to surface water resources have been met can be found in Vol 2 Section 14.3.

14.1.2 The proposed development has the potential to affect surface water resources (ie, surface waterbodies including the reaches of the River Thames [tidal Thames]) due to:

a. construction activities

b. operation of the main tunnel.

14.1.3 The assessment of construction and operational effects on surface water includes the following:

a. identification of existing water resources baseline conditions

b. determining base case conditions against which the proposed development has been assessed

c. assessment of significant effects from the proposed development during construction and operation

d. identification of mitigation measures and residual effects during construction and operation.

14.1.4 The assessment of surface water effects partially overlaps with that for groundwater, land quality, aquatic ecology and flood risk. Effects on groundwater resources are assessed separately in Section 13 of this volume. Land quality is assessed in Section 8. Effects on aquatic ecology are assessed in Section 5 of this volume. A *Flood Risk Assessment* (*FRA*), which assesses the effects of the proposed development on surface water run-off and considers the use of Sustainable Drainage Systems (SuDS), has been carried out separately and is included in Section 15 of this volume.

14.1.5 This assessment covers the effects of the proposed development at the Putney Embankment Foreshore site and in particular in relation to the interception of the Putney Bridge combined sewer overflow (CSO). It is however important to recognise that whilst the reductions in spills from the Putney Bridge CSO would be important to water quality in the immediate area of the CSO outfall, the overall water quality benefits in any part of the tidal Thames would accrue as a result of the project as a whole, rather than a single part of it. The catchment-wide effects on the tidal Thames, particularly the water quality improvements anticipated from the proposed Thames Tideway Tunnel project are assessed separately and presented in Volume 3 Project-wide assessment.

14.1.6 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 7 Putney Embankment Foreshore figures).

14.2 Proposed development relevant to surface water resources

14.2.1 The proposed development is described in Section 3 of this volume. The elements of the proposed development relevant to surface water are set out below.

Construction

14.2.2 The Putney Embankment Foreshore site would be partially located within the River Thames channel, which means that the majority of the proposed working area would be within the river bed. It is proposed that the existing public slipway within the main site would be temporarily closed and a replacement structure provided upstream (at the secondary site). The temporary slipway would be constructed from floating platforms within the river. A temporary cofferdam would be constructed in the foreshore to enable construction of the permanent infrastructure (as shown on the Construction plans, see separate volume of figures – Section 1).

14.2.3 Barges would be used to import the majority of the cofferdam fill, although it is assumed that other imported materials would be brought in by road. Barges would also be used to export the majority of the cofferdam fill and excavations from the CSO drop shaft and other structures. In order to facilitate the use of barges, a campshed would be constructed adjacent to the temporary cofferdam, and there is also the option for a campshed to be constructed at the secondary site (which would be decided by the contractor, and which has been assessed here). One of the riverboats on the adjacent Putney Pier would be temporarily relocated during construction works to a position further upstream on the same pier.

14.2.4 The drop shaft would be almost entirely within London Clay, with the exception of an initial thin layer of River Terrace Deposits, and it is assumed that dewatering and/ or ground treatment would not be required at this location. The impacts on surface water resources from the disposal of dewatering effluent have therefore not been considered in this assessment.

14.2.5 The construction of in-river structures, and in particular the temporary cofferdam, would affect the river regime with the potential that localised increases in flow velocity cause scour of the river bed and foreshore, or deposition of sediments. The scour could occur around the face of the cofferdam or at the adjacent bridge supports (abutment scour) or across the channel width (contraction scour). Any potential scour development during construction would be monitored and if relevant trigger levels are reached, appropriate protection measures would be provided. Further details are provided in the *Scour and Accretion Monitoring and Mitigation Plan for Temporary Works in the Foreshore* (Vol 3 Appendix L.4).

Code of construction practice

14.2.6 There is a direct pathway for pollutants to be discharged to the tidal Thames due to the location of part of the construction area within the river channel. The *Code of construction practice (CoCP)*[i] Part A (Section 8) includes a number of measures to minimise the potential for impacts to surface waters, including impacts such as discharge of pollutants via surface water drains, and these are summarised below.

14.2.7 Appropriate drainage, sediment and pollution control measures are included in the *CoCP* Part A (Section 8). These are in accordance with the relevant Pollution Prevention Guidelines (PPGs) issued by the Environment Agency (EA) and other Construction Industry Research and Information Association (CIRIA) documents.

14.2.8 All site drainage would be drained and discharged to mains foul or combined sewers. Where this is not practicable, the site would be drained such that accumulating surface water would be directed to holding or settling tanks, separators and other measures prior to discharge to the surface water drains. Foul drainage from the site welfare facilities would be connected to the mains foul or combined sewer.

14.2.9 Suitable spill kits would be provided and positioned in vulnerable areas, staff would be trained in their use and a record would be kept of all pollution incidents or near-misses, to ensure appropriate action is taken and lessons are learned from any incidents. Regular ‘toolbox talks’ would be held to raise staff awareness of pollution prevention and share lessons learned from any recorded incidents. There would be written procedures in place for dealing with spillages and pollution (the *Pollution Incident Control Plan* or *PICP*).

14.2.10 There are no site specific measures incorporated in the *CoCP* Part B (Section 8) relevant to the surface water assessment.

Operation

14.2.11 The operation of the main tunnel would enable the interception of combined sewage generated during storms which would otherwise discharge to the tidal Thames at Putney Embankment Foreshore from the Putney Bridge CSO. There would therefore be a reduction in the frequency, duration and volume of spills from this CSO.

14.2.12 The construction of the new permanent structure in the river would affect the river regime with the potential that localised increases in flow velocity cause scour of the river bed and foreshore, or deposition of sediments. Scour protection for the new permanent works would be provided and this would be located within the zone shown on the parameter plan for the

[i] The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B)

site. The approach to scour on third party structures, contraction scour and accretion during the operational phase would be a reactive approach with mitigation measures only provided if required. Further details of the approach are provided in the *Engineering Design Statement*.

14.3 Assessment methodology

14.3.1 The methodology used for the assessment of effects on surface water and their significance differs from the standard Website Transport Analysis Guidance (WebTAG) (DFT, 2003)[2] environmental impact assessment (EIA) methodology for water resources, in that the requirements of the Water Framework Directive (WFD) have also been taken into account. In the absence of an EIA specific assessment methodology for WFD compliance, an assessment methodology has been derived specifically for the Thames Tideway Tunnel project to assess the significance of effects. The methodology also takes into consideration the requirements of the Urban Waste Water Treatment Directive (UWWTD)[3] and is outlined in Volume 2 Environmental assessment methodology. A WFD assessment for the project as a whole is presented in Vol 3 Project-wide.

Engagement

14.3.2 Vol 2 documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Vol 2 Section 13 summarises the engagement that has been undertaken for the surface water assessment and the consultation responses relevant to surface water.

14.3.3 There are no site-specific engagement comments relevant to the surface water assessment at the Putney Embankment Foreshore site.

Baseline

14.3.4 The baseline methodology follows the methodology described in Vol 2. There are no site-specific variations for identifying baseline conditions for this site.

Construction

14.3.5 The assessment methodology for the construction phase follows that described in Vol 2. There are no site-specific variations for undertaking the construction assessment of this site.

14.3.6 The assessment year for construction effects is Site Year 1 when construction would commence. No modelled water quality data are available for this year. The water quality conditions for the base case have therefore been derived from available modelled simulation data which uses population projections for 2021. This assumption is considered reasonable as substantial changes in water quality are considered unlikely between Year 1 and 2021.

14.3.7 The Lee Tunnel and the sewage works upgrades at Mogden, Beckton, Crossness, Long Reach and Riverside sewage treatment works (STWs) would be operational by the time construction of the Thames Tideway Tunnel project commences, as described in Vol 2. Significant improvements in the water quality in the tidal Thames are anticipated as a result of these projects. Both the construction base case and the operational base case would be the water quality in the tidal Thames with the Lee Tunnel and sewage works upgrades in place.

14.3.8 The construction base case has also considered the developments that are scheduled to be complete and in operation by Site Year 1 (presented in Vol 7 Appendix N). The developments in Vol 7 Appendix N would not result in additional surface water receptors (ie, waterbodies) and are considered unlikely to result in changes in water quality as the majority of these developments are remote from the tidal Thames. The café development at No. 2 Putney High Street and the development at No. 4 - 6 Putney High Street are adjacent to the site and are small in scale and would have no effect on water quality. The base case would therefore not change from that outlined above.

14.3.9 The developments listed in Vol 7 Appendix N that would be under construction during Site Year 1 of construction have been considered in the cumulative effects assessment (Section 14.7).

14.3.10 The assessment area for the assessment of effects of construction activities at the Putney Embankment Foreshore site would be limited to one section of the river, namely the Thames Upper and Middle waterbodies as listed in Vol 7 Table 14.4.1 below.

14.3.11 Section 14.5 details the likely significant effects arising from the construction at the Putney Embankment Foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on surface water within the assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

Operation

14.3.12 The assessment methodology for the operation phase follows that described in Vol 2. There are no site-specific variations for undertaking the operational assessment of this site.

14.3.13 The assessment year for operational effects is Year 1 of operation. As with the construction assessment, the operational assessment also relies on modelled water quality data which uses population projections for 2021. In addition, the influence of climate change on the proposed development has been assessed in 2080.

14.3.14 As noted above, the operational base case would be the water quality in the tidal Thames with the Lee Tunnel and sewage works upgrades in place. The operational base case has also considered the developments that are scheduled to be complete and in operation by Site Year 1 of operation (presented in Vol 7 Appendix N). The developments in Vol 7 Appendix N would not result in additional surface water receptors and are considered unlikely to result in changes in water quality as the majority of these developments are remote from the tidal Thames. The café development at No. 2 Putney High Street and the development at No. 4 - 6 Putney High Street are adjacent to the site and are small in scale and would have no effect on water quality. The base case would therefore not change from that outlined above.

14.3.15 No developments have been identified that would be under construction during Site Year 1 of operation, therefore a cumulative effects assessment has not been undertaken.

14.3.16 The operational assessment uses the same assessment area identified above for the construction assessment.

14.3.17 Section 14.6 details the likely significant effects arising from the operation at the Putney Embankment Foreshore site.

Assumptions and limitations

14.3.18 The assumptions and limitations associated with this assessment are presented in Vol 2. Based on the geology at the site, it is assumed that dewatering would not be required. There are no other assumptions and limitations specific to the assessment of this site.

14.4 Baseline conditions

14.4.1 The following section sets out the baseline conditions for surface water within and around the site. Future baseline conditions (base case) are also described.

Current baseline

Water quality

14.4.2 All surface water receptors and their WFD status given in the River Basin Management Plan (RBMP) (EA, 2009)[4], which are either adjacent to the site, or downstream of the site, and therefore have the potential to be affected by the proposed development, are listed in Vol 7 Table 14.4.1 below.

14.4.3 The overall classification of status or potential under the WFD is a detailed process, which includes an assessment of water quality, physico-chemical and hydromorphological elements. Reference should be made to the United Kingdom Technical Advisory Group (UKTAG)[5] guidance, as given in the RBMP (EA, 2009)[6].

Vol 7 Table 14.4.1 Surface water – receptors

Waterbody Name/ID	Hydro-morphological Status	Current ecological quality	Current chemical quality	2015 Predicted ecological quality	2015 Predicted chemical quality	2027 Target status
Thames Upper GB530603911403	Heavily Modified	Moderate Potential	Good	Moderate Potential	Good	Good
Thames Middle GB530603911402	Heavily Modified	Moderate Potential	Fail	Moderate Potential	Fail	Good

14.4.4 The River Thames and its Tidal Tributaries are designated as a Site of Importance for Nature Conservation (Grade III of Metropolitan importance). The Thames Upper (which stretches from Teddington to Battersea Bridge) and the Thames Middle (which stretches from Battersea Bridge to Mucking Flats) waterbodies are considered to be high value waterbodies; although their current, and predicted status in 2015 (target date from RBMP [EA, 2009][7]), is moderate potential, a status objective of good by 2027 has been set. In addition, the tidal Thames is a valuable water resource, habitat, and source of amenity, recreation and transport throughout London. At Putney Embankment Foreshore it is particularly important for recreational and competitive rowing (see Section 10 of this volume).

14.4.5 Sediment levels within the tidal Thames are estimated to currently reach a peak of 4,000kg/s in the lower tidal Thames estuary, or more than 40,000t of sediment a day during spring tides (HR Wallingford, 2006)[8].

14.4.6 In addition to the Putney Bridge CSO which discharges to the tidal Thames, there is one other consented discharge within 1km of the Putney Embankment Foreshore site: the West Putney Storm Relief CSO, which is approximately 850m upstream. There are no licensed abstractions within 1km of the site.

14.4.7 The Putney Embankment Foreshore site is less than 1km downstream of the EA's Automatic Quality Monitoring Station (AQMS) at Putney Pier, as shown on Vol 7 Figure 14.4.1 (see separate volume of figures). 2011 summary data from this monitoring point, which gives 90 percentile values for ammonium (concentration that is exceeded 10% of the time) and 10% percentile values for dissolved oxygen (DO) (concentration exceeded 90% of the time), are presented below in Vol 7 Table 14.4.2.

Vol 7 Table 14.4.2 Surface water – Putney Pier AQMS 2011

Month	DO (mg/l) (10%)	Ammonium (mg/l) (90%)
January	11.00	0.94
February	9.76	0.89
March	8.66	0.67
April	6.17	1.10
May	5.31	1.76
June	3.03	1.80
July	2.62	1.60
August	3.08	1.40
September	3.67	3.00
October	4.70	2.96
November	6.16	3.50

Month	DO (mg/l) (10%)	Ammonium (mg/l) (90%)
December	10.16	3.36

14.4.8 The data presented above demonstrate that the DO levels in the tidal Thames decrease in the summer months, as there is an inverse relationship between temperature and oxygen saturation ie, warmer water holds less DO than colder water. The discharge from the Putney Bridge CSO has the effect of depleting DO in the tidal Thames as a result of the biological breakdown of organic matter in the discharges. This causes both a localised effect at the Putney Embankment Foreshore site and a more widespread effect along the tidal Thames of rapidly dropping DO levels. Vol 3 details half-tide plots displaying the changes in DO levels along the tidal Thames

14.4.9 No contamination sources were identified within the site boundary or within a 250m search radius[ii] of the site. Samples of sediment taken from the foreshore at the site showed elevated levels of arsenic, mercury, lead and copper in comparison with approved sediment guidelines[iii] [9]. An assessment of potential on-site contamination is provided within Section 8 of this volume.

Current CSO operation

14.4.10 The current operation of the Putney Bridge CSO has been characterised using the catchment model of the sewer system (See Vol 3 for further details of catchment modelling), and the annual average duration, frequency and volume of spill has been defined as follows:

a. the CSO spills an average of 33 times in the Typical Year[iv]

b. the CSO spills for an average duration of 107 hours in the Typical Year

c. the spill volume from the CSO is approximately 68,000m^3 in the Typical Year, representing 0.17% of the total volume discharged to the tidal Thames in the Typical Year from all CSOs.

14.4.11 Using the same model, the annual polluting loading of biochemical oxygen demand (BOD), ammonia and total Kjeldahl nitrogen (TKN) (the sum of organic nitrogen, ammonia [NH_3], and ammonium [NH_4^+]) of spills from the Putney Bridge CSO has been defined as follows:

a. the CSO discharges 2,900kg of BOD in the Typical Year

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ii 250m buffer has been included within the assessment area in order to take account of any off-site sources / receptors, as discussed in the Volume 2 Section 7 Land Quality Methodology.

iii In order to assess potential risk to surface water resources, reference was made to PLA approved sediment quality guidelines, namely the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. The guidelines provide contaminant concentration limits in the form of Threshold Effect Level (TEL) and Probable Effect Level (PEL).

iv Typical Year: single year which is most representative of an observed Typical Year of rainfall with the dataset. The 1979-1980 'water year' defined as the 12 month period ending on the 30th September 1980

b. the CSO discharges 60kg of ammonia in the Typical Year

c. the CSO discharges 370kg of TKN in the Typical Year.

14.4.12 Each discharge increases the risk of exposure to pathogens for river users who come into contact with water. An assessment of health impacts upon recreational users of the River Thames was conducted and reported by the Health Protection Agency in 2007 (Lane, C, Surman-Lee, S, Sellwood, J and Lee, JV, 2007)[10] . The study concluded that risk of infection can remain for two to four days following a spill as the water containing the sewage moves back and forward with the tide[v]. The same study also noted that analysis of the illness events reported against discharges on the tidal Thames shows that 77% of cases related to rowing activities undertaken within three days of a CSO spill.

14.4.13 Assuming the average 33 spills per annum from the Putney Bridge CSO occur on separate days, there could be up to a maximum of 132 days per year where recreational users are at risk of exposure to pathogens in the vicinity of the outfall as a result of the Putney Bridge CSO spills alone (Lane, C, Surman-Lee, S, Sellwood, J and Lee, JV, 2007)[11].

14.4.14 The operation of the Putney Bridge CSO results in the discharge of sewage litter along with the discharge of effluent. It has been estimated by the *Thames Tideway Tunnel Strategic Study (TTSS)* that overflows from all the CSOs along the tidal Thames introduce approximately 10,000t of sewage derived solid material to the tidal Thames annually. Catchment modelling of the current CSO operation has defined the average volume of discharge from the Putney Bridge CSO, and assuming litter tonnages are proportional to discharge volumes, this would indicate that approximately 17t of sewage derived litter is discharged from the Putney Bridge CSO in the Typical Year. An assessment of amenity effects of the sewage litter is given in Vol 3 Section 10.

Construction base case

14.4.15 As explained in Section 14.3, both the construction base case and the operational base case would be the water quality in the tidal Thames with the Lee Tunnel and sewage works upgrades in place (further details are provided below under operational base case).

14.4.16 The base case in Site Year 1 of construction taking into account the schemes described in Section 14.3 would not change since no new sensitive receptors would be introduced.

Operational base case

14.4.17 As noted above, the operational base case would be the same as the construction base case and would include water quality improvements achieved by the Lee Tunnel and sewage works upgrades.

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[v] The EA has provided advice on CSO excursion areas[v], which states that CSOs below Tower Bridge will only impact the Thames Middle waterbody and those upriver of Tower Bridge will impact both the Thames Upper and Thames Middle waterbodies.

14.4.18 The base case in Year 1 of operation taking into account the schemes described in Section 14.3 would not change since no new sensitive receptors would be introduced.

14.4.19 Catchment modelling results of the base case have demonstrated that by Year 1 of operation (assessed using 2021 modelled assumptions) the frequency, duration and volume of spills from the Putney Bridge CSO will have increased (as a result of increased population) beyond the current baseline as follows:

a. the CSO would spill on average of 33 times per year (the same as the current baseline)

b. the CSO would spill for an average duration of 110 hours per year (3 hours more than the current baseline)

c. the spill volume from the CSO would be approximately 71,000m^3 in the Typical Year (3,000m^3 more than the current baseline).

14.4.20 The same catchment modelling has demonstrated that by the operational assessment year the annual polluting loading of BOD, ammonia and TKN would have increased (as a result of increased population) beyond the current baseline as follows:

a. the CSO would discharge 3,500kg of BOD in the Typical Year (600kg more than the current baseline)

b. the CSO would discharge 80kg of ammonia in the Typical Year (20kg more than the current baseline)

c. the CSO would discharge 450kg of TKN in the Typical Year (80kg more than the current baseline).

14.4.21 Following on from the interpretation of the current baseline as per para. 14.4.13, the number of risk days for river users being exposed to pathogens during the operational base case year (taking into account 2021 modelled assumptions) would be a maximum of 132 days (the same as the current baseline) in the Typical Year as a result of spills from the Putney Bridge CSO alone.

14.4.22 The tonnage of sewage derived litter discharged from the Putney Bridge CSO can be expected to increase from approximately 17t to 18t in the Typical Year.

14.5 Construction effects assessment

14.5.1 This section presents the construction impacts that could occur at the site and identifies where no further assessment of effects is required (eg, where the impact pathway has been removed). The second part of the section identifies effects that may occur and the likely significance of these effects.

Construction impacts

Temporary landtake and morphological changes

14.5.2 In order to accommodate the temporary works at the Putney Embankment Foreshore site, construction of a temporary cofferdam within the river channel would be required as described in Section 3.3 of this volume. In addition, a temporary slipway would be constructed upstream of the main site, to allow boat access to the river during construction works. The channel would be more constricted than at present and together with the profile of the new structures, this would be likely to lead to changes in flows (velocities, directions) and lead to changes in scour and deposition of sediments.

Release of sediments from piling and scour

14.5.3 The act of piling may disturb minor amounts of bed sediment in the immediate vicinity of the Putney Embankment Foreshore site. The total volume of sediment released to the tidal Thames by the proposed pilling activity at all construction sites has been estimated to be 890t[vi]. The proportion of this estimate that would originate from the Putney Embankment Foreshore site is approximately 127t.

14.5.4 It is also possible that the temporary cofferdam would affect the river regime with the potential that localised increases in flow velocity could cause scour of the river bed and foreshore and could result in the mobilisation of suspended solids (see Section 14.2). Any potential scour development during construction would be monitored and protection measures provided if set trigger levels are reached (see Vol 3 Appendix L.4).

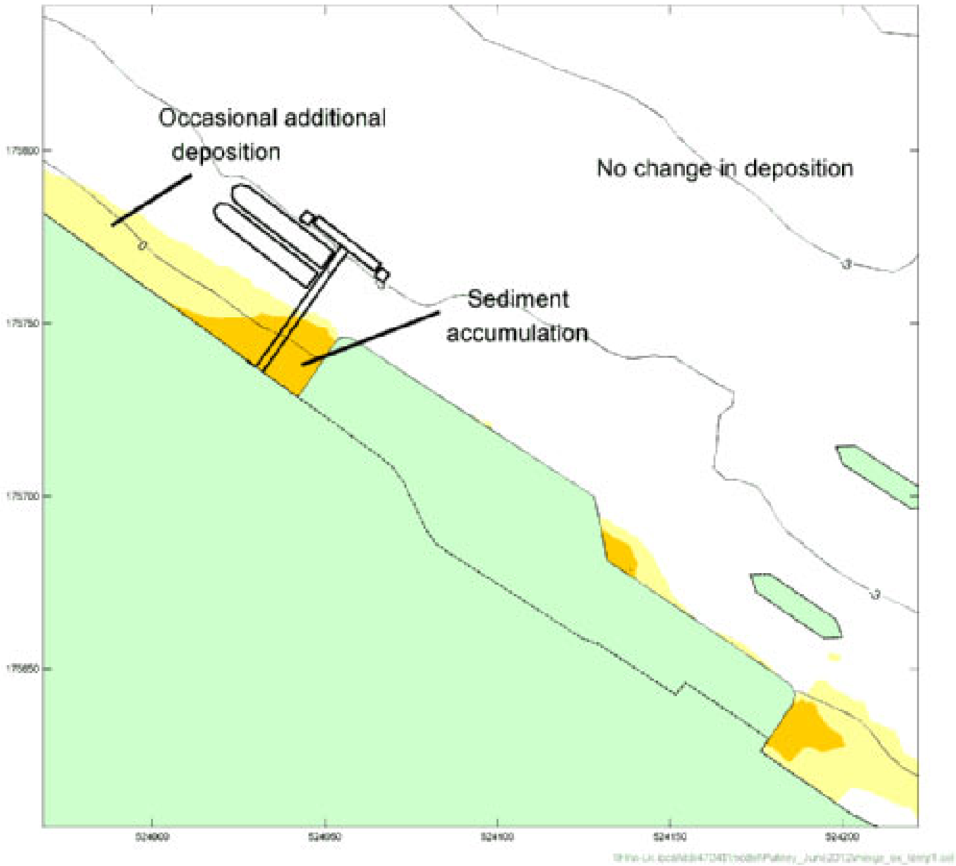
14.5.5 The Thames is a high sediment environment and levels already present within the tidal Thames are estimated to reach a peak of 4,000kg/s in the lower Thames estuary or more than 40,000t of sediment passing the site four times a day during spring tides (HR Wallingford, 2006)[12]. In this context, the volumes produced by the construction works from piling and potential scour would not be detectable against natural fluctuations in sediments and would not have an impact on surface water resources (HR Wallingford, 2006)[13] and are therefore not considered further within the assessment.

Deposition

14.5.6 The temporary cofferdam would be likely to lead to changes in flows (velocities, directions) and cause changes in deposition of sediments around the Putney Embankment Foreshore site. These sediments could be those generated by the project itself but would also include sediments occurring naturally in the water column. Modelling carried out (see Vol 3 Appendix L.3) has predicted the extent of this deposition, as shown below in Vol 7 Plate 14.5.1.

[vi] An assessment of the potential sediment losses anticipated from construction activities within the foreshore is provided in the *Habitats Regulation Assessment: No Significant Effects Report.*

Vol 7 Plate 14.5.1 Surface water – prediction deposition around temporary works at Putney Embankment Foreshore site



14.5.7 Most deposition is likely to be localised and occur in newly created areas of slack water (as shown above in Vol 7 Plate 14.5.1) and may be remobilised by spring tides (for deposition during neap tides) or by large fluvial flows (for deposition during seasonal low fluvial flows). The overall impact on channel morphology would be negligible.

14.5.8 Impacts on channel morphology from deposition can have an effect on ecological receptors, by changing habitat availability. This effect is assessed in Section 5 of this volume.

Pumping and pollution during cofferdam construction

14.5.9 The main pathways for surface water quality impacts during construction at the Putney Embankment Foreshore site are as a result of the requirement for a temporary cofferdam to be constructed in the river channel to create a construction working area, and a permanent cofferdam to create a permanent foreshore structure to house the permanent structures.

14.5.10 The cofferdam would be constructed by driving sheet piles into the river bed, which would be sealed and the water pumped out into the river channel. As the works would be in the channel, there would be a direct pathway for pollutants to be discharged to the river during the construction of the cofferdam which could impact on water quality in this location of the tidal Thames. The adoption of appropriate drainage and pollution control measures as included in the *CoCP* Part A (Section 8) (see para. 14.2.6) would remove the impact pathway.

14.5.11 Before being released to the river, the water to be pumped from behind the cofferdam would be subject to settlement using a lagoon/pond, silt trap or other suitable method (see *CoCP* Part A Section 8) to ensure excessive levels of potentially contaminated suspended solids are not discharged to the tidal Thames. It is considered that via the proposed management of pumping out water from the cofferdam area, the pollution pathway would be removed and therefore no impact is anticipated from this source and this is not considered further in the assessment.

Foreshore and contamination within the river channel

14.5.12 A cover of Made Ground and foreshore sediments (of variable thickness and quality) is likely to be present across the site which represents a potential source of contamination, although overall the mobility of metal and PAH contaminants has been recorded as low. Given the current environment (ie, significant water flow), it is expected that the majority of mobile contaminants have already been leached from the sediment, although the disturbance of sediments caused by the proposed construction works could cause additional sediment contamination to be leached.

14.5.13 Any additional sediment input to the river as a result of construction processes would be minimal in comparison to the already high background levels (see para.14.5.5) and any mobilised contaminants would be expected to be rapidly diluted and their potential impact on water quality attenuated. Sediments mobilised by the construction works (including piling for the cofferdam walls and campshed construction) are therefore likely to pose only a low risk of causing deterioration in water quality. Such sediments are continually transported along the tidal Thames as a natural action of erosion and deposition, as well as by other dredging operations and river users,

14.5.14 Therefore, there is considered to be no impact from this source and this is not considered further within this assessment.

Surface water drainage

14.5.15 Once constructed, the cofferdam area and the CSO drop shaft excavation work within it would be protected from flooding to ensure the construction activity is not affected by high water levels. This would require the cofferdam walls to be raised to at least the existing flood defence level. Surface water from rainfall on the CSO drop shaft construction area may need to be pumped periodically to ensure the working activities are not affected by ponding of rainwater, if drainage of surface water by gravity is not possible.

14.5.16 The construction of the working area and drainage of surface water from it could therefore create a direct pathway to the river for contaminated runoff, high suspended solids and other pollution from the site. However, appropriate site drainage would be used to control pollutants in the general site runoff, preventing the discharge of pollutants via combined or surface water drains as part of the surface water discharge from the construction site (see *CoCP* Part A Section 8). This would enable the pollution pathway to be removed and therefore there is considered to be no impact from this source. Surface water drainage is therefore not considered further within this assessment.

Debris accumulation

14.5.17 The temporary cofferdam at the Putney Embankment Foreshore site may interact with Putney Bridge to cause an area of slack 'dead' water between them. Floating debris, oils and other pollutants could build up in the area if the flow of the river is unable to clear the accumulation due to the shelter provided by the Putney Embankment Foreshore site working area.

Construction effects

14.5.18 The potential surface water impacts identified above as likely as a result of construction at Putney Embankment Foreshore have been assessed for their likely effects on WFD objective compliance, compliance with other legislation and effects on other users of the surface waters. The surface water receptors are identified in Vol 7 Table 14.4.1.

14.5.19 The WFD objectives as taken from Article 4 of the WFD are as follows:

a. WFD1 – Prevent deterioration of the status of all bodies of surface water

b. WFD2 – Protect, enhance and restore all bodies of surface water, with the aim of achieving good surface water status by 2015

c. WFD3 – Protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status by 2015

d. WFD4 – Reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances

14.5.20 The significance of effects has been assessed based on the magnitude of the impacts as described in Vol 2 Section 14.5.

Temporary land take and morphological changes

14.5.21 The presence of the temporary cofferdam in the channel would impact on the morphology of the tidal Thames in this location, altering it from its current state.

14.5.22 At the end of the construction period, the riverbed would naturally regenerate following the removal of the temporary structures. This would occur due to the natural circulation of sediments within the estuary and the accumulation of silt and estuarine mud that is likely to occur. The temporary change to the riverbed is also unlikely to alter the 'in place' mitigation measures identified in the RBMP as necessary to achieve good ecological potential. Therefore, because mitigation measures required to meet the WFD objective of Good Ecological Potential could still be implemented irrespective of the proposed development at this site, works at this site would not prevent any of the WFD objectives being met in the future. However, there would be a measurable change in foreshore morphology during construction and hence the effect is considered to be **minor adverse**.

14.5.23 Impacts on channel morphology can have an effect on ecological receptors, by changing habitat availability. This effect is assessed in Section 5 of this volume.

Debris accumulation

14.5.24 The change in flow regime of the tidal Thames due to construction of the cofferdam could result in an area of slack 'dead' water between the construction area and the nearby Putney Bridge, where floating debris, oils and other pollutants could build up and reduce the amenity value of the river for recreational users.

14.5.25 A change in appearance and aesthetic quality of the tidal Thames in the near vicinity of the site is likely, but it would not prevent or limit recreational use of the tidal Thames in this location. There are no abstractions or discharges that could be affected by this change in debris accumulation, which would also not affect compliance with the WFD or other legislation as it is not assessed under this legislation. Therefore, the effect is considered to be **minor adverse**.

14.6 Operational effects assessment

14.6.1 This section presents the operational impacts that could occur at the site. The second part of the section identifies any effects that may occur and the likely significance of these effects.

Operational impacts

Reduction in Putney Bridge CSO spills

14.6.2 Catchment modelling of the operational development case (with the operational Thames Tideway Tunnel project) predicts that by Year 1 of operation, the frequency, duration and volume of spills from the Putney Bridge CSO would substantially decrease (as a result of the capture of combined sewer overflows flow into the main tunnel) as follows:

a. the CSO would spill on average only once in the Typical Year (32 times less than the operational base case)

b. the CSO would spill for an average duration of three hours in the Typical Year (107 hours less than the operational base case)

c. the spill volume from the CSO would be approximately 1,600m^3 in the Typical Year (69,400m^3 less than the operational base case).

14.6.3 The frequency, duration and volume of spills at Putney Bridge CSO would therefore be reduced by approximately 98% as a result of the operation of the Thames Tideway Tunnel project.

14.6.4 Given the reductions in spills, the number of days in which river users would be exposed to pathogens in Year 1 of operation, as a result of spills from the Putney Bridge CSO, would be a maximum of four days in the Typical Year (a reduction of up to 128 days of risk of exposure).

14.6.5 Similarly, the tonnage of sewage derived litter from the CSO can be expected to reduce by approximately 98% from approximately 18t to less than half a tonne in the Typical Year.

14.6.6 The reduction in polluting load that would be discharged from the CSO with the project in place would be as follows:

a. the CSO would discharge 170kg of BOD in the Typical Year (3,330kg less than the operational base case)

b. the CSO would discharge 6kg of ammonia in the Typical Year (74kg less than the operational base case)

c. the CSO would discharge 30kg of TKN in the Typical Year (420kg less than the operational base case).

14.6.7 Catchment modelling of the 2080 development case (to account for the effects of climate change and predicted increases to population) predicts that by 2080 with the operational Thames Tideway Tunnel project, the frequency, duration and volume of the Putney Bridge CSO would be the following:

a. the CSO would spill on average once per Typical Year (the same as the Year 1 of operation development case)

b. the CSO would spill for an average duration of 6 hours (3 hours more than the Year 1 of operation development case)

c. the spill volume from the CSO would be approximately 4,400m^3 per Typical Year (2,800m^3 more than the Year 1 of operation development case).

14.6.1 In summary, the model predicts that in the 2080 development case the Putney Bridge CSO at Putney Embankment Foreshore would maintain its spill frequency, but increase in total spill duration and volume. These changes in spill frequency, duration and volume would be due to the impact of climate change, which is expected to lead to fewer, but more intense rainfall events during winter, and drier summers.

14.6.2 Climate change is also predicted to increase average water temperatures, which combined with changes to rainfall patterns could affect water quality in the tidal Thames. As these water quality changes would be realised across the tidal Thames they have been assessed in Vol 3 project-wide and climate change is not considered further within this site assessment.

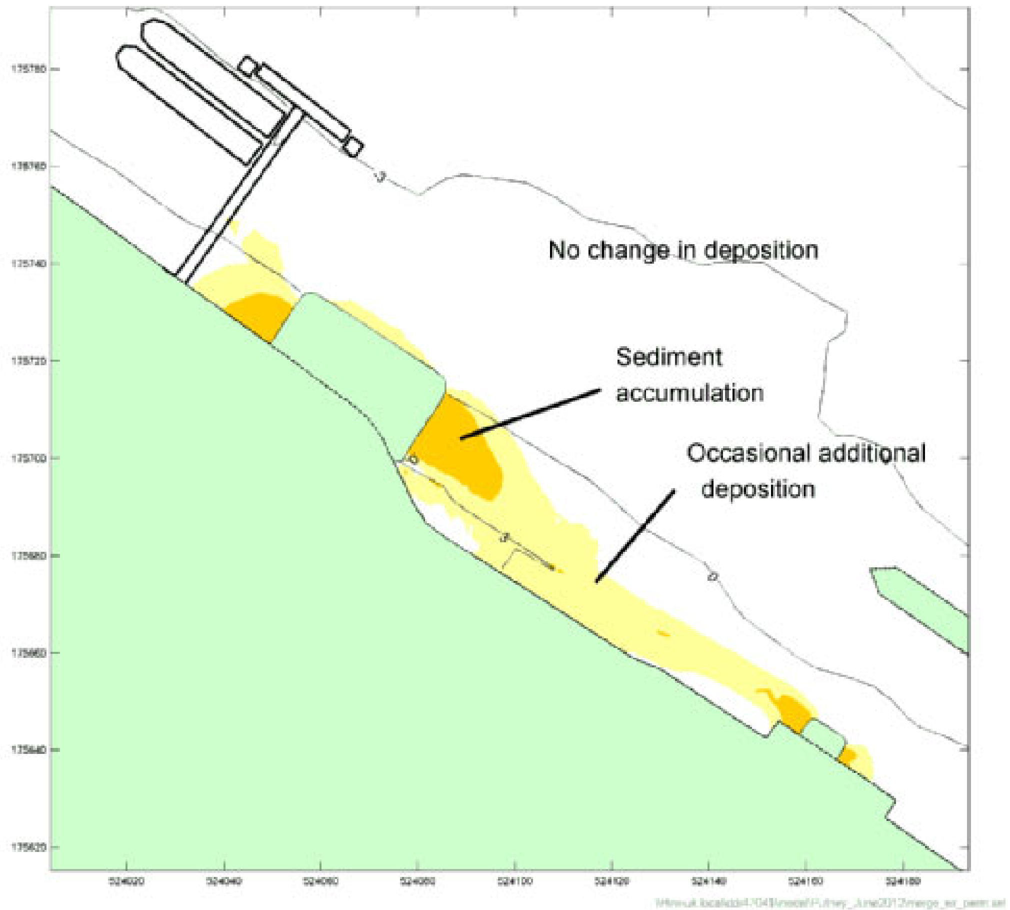
Permanent landtake and morphological changes

14.6.3 In order to accommodate the permanent works at the Putney Embankment Foreshore site, construction of a permanent structure within the river channel would be required, as described in Section 3.2 of this volume. The permanent structure could affect the river regime with the potential that localised increases in flow velocity cause scour of the river bed and foreshore and could result in the mobilisation of suspended solids. The approach to scour protection for the permanent works is described in the *Engineering Design Statement* and scour is not considered further with the assessment.

Deposition

14.6.4 The permanent works would be likely to lead to changes in flows (velocities and directions) and cause changes in deposition of sediments around the Putney Embankment Foreshore site. These sediments could be those generated by the project itself but would also include sediments occurring naturally in the water column. Modelling carried out (Vol 3 Appendix L.3) has predicted the extent of this deposition, as shown below in Vol 7 Plate 14.6.1.

Vol 7 Plate 14.6.1 Surface water – prediction deposition around permanent works at Putney Embankment Foreshore site



14.6.5 Most deposition is likely to be localised (as shown above in Vol 7 Plate 14.6.1) but may be remobilised by spring tides (for deposition during neap tides) or by large fluvial flows (for deposition during seasonal low fluvial flows). The impact on channel morphology would be negligible.

14.6.6 Impacts on channel morphology, such as deposition, can have an effect on ecological receptors, by changing habitat availability. This effect is assessed in Section 5 of this volume.

Operational effects

Reduction in Putney Bridge CSO spills

14.6.7 The reduction in CSO spills from the Putney Bridge CSO would represent an important contribution towards:

a. meeting the requirements of the Urban Waste Water Treatment Directive[14] (UWWTD) in relation to the Putney Bridge CSO

b. meeting the required TTSS DO standards

c. moving the tidal Thames towards its target status under the WFD, both locally and throughout the tidal Thames.

14.6.8 Therefore, the reduction would result in a **major beneficial** effect, most notably in the context of the UWWTD. It should be noted that, as explained in Section 14.1, the water quality in the vicinity of Putney Embankment Foreshore site also depends on the project-wide improvements, as documented in Vol 3.

14.6.9 The associated reduction in exposure to pathogens would greatly improve the conditions for recreational users of the tidal Thames around Putney Bridge, allowing the tidal Thames in this location to be used more frequently with a reduced risk of exposure. This is considered to be a **moderate beneficial** effect.

14.6.10 The reduction in sewage derived litter discharge would also improve the aesthetic quality of the tidal Thames locally, improving conditions for recreational users. This is considered to be a **moderate beneficial** effect. As explained in Section 14.4, an assessment of the amenity effects of the sewage litter is given in Vol 3 Section 10.

Permanent landtake and morphological changes

14.6.11 The permanent structures proposed in the tidal Thames have been designed and engineered to minimise the impediment of flow and although some changes to flows are likely, the changes are unlikely to lead to further substantive deterioration of the morphological condition of the channel which is already modified by flood defences and channel dredging. In addition, the changes in flow are unlikely to result in an area of slack ‘dead’ water around the permanent structures. The WFD objectives are not considered to be affected by this change, and hence the effect is considered to be **minor adverse**.

14.6.12 Impacts on channel morphology can also have an effect on ecological receptors, by changing habitat availability. This effect is assessed in Section 5 of this volume.

14.7 Cumulative effects assessment

14.7.1 Considerable improvements in the water quality of the tidal Thames will occur as a result of the works associated with the Lee Tunnel and sewage works upgrades. These already form part of the base case and so are not considered as part of the assessment of cumulative effects.

14.7.2 No significant cumulative effects have been identified for the construction phase at this site. This is because the schemes identified in 7 Appendix N that would be under construction during Site Year 1 of construction considered unlikely to result in changes in water quality as these developments are remote from the tidal Thames and are therefore unlikely to have significant effects on the channel morphology.

14.7.3 As explained in Section 14.3, no developments have been identified that would be under construction during Year 1 of operation, therefore a cumulative effects assessment has not been undertaken. No significant cumulative effects have therefore been identified for the operational phase at this site. The effects on surface water would therefore remain as described in Section 14.5 and Section 14.6 above.

14.8 Mitigation

14.8.1 No significant adverse effects have been identified and therefore no mitigation is required.

14.9 Residual effects assessment

Construction effects

14.9.1 As no mitigation measures are proposed, the residual construction effects remain as described in Section 14.5. All residual effects are presented in Section 14.10.

Operational effects

14.9.2 As no mitigation measures are proposed, the residual operational effects remain as described in Section 14.6. All residual effects are presented in Section 14.10.

14.10 Assessment summary

Vol 7 Table 14.10.1 Surface water resources – construction assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Thames Upper and Middle	Temporary changes to channel morphology (cofferdam)	Minor adverse	None	Negligible
Thames Upper and Middle	Changes in aesthetic quality due to debris accumulation in slack water between structures	Minor adverse	None	Negligible

Vol 7 Table 14.10.2 Surface water resources – operational assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Thames Upper and Middle	Compliance with UWWTD and WFD. Improved water quality in the vicinity of the Putney Bridge CSO by reduced pollutant loading and no reduction of dissolved oxygen levels due to reduced spill frequency, duration and volume from the Putney Bridge CSO	Major beneficial	None	Major beneficial
Thames Upper and Middle	Risk of exposure days to pathogens would be reduced to a maximum of 4 days in the Typical Year (a reduction of up to 132 days of risk of exposure)	Moderate beneficial	None	Moderate beneficial
Thames Upper and Middle	Sewage derived litter discharge at Putney Bridge CSO would be reduced by approximately 98% improving the aesthetic quality of the river locally	Moderate beneficial	None	Moderate beneficial

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.07**

Volume 7: Putney Embankment Foreshore site assessment

Section 15: Water resources - flood risk

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

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Box **21** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

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Thames Tideway Tunnel

Environmental Statement

Volume 7: Putney Embankment Foreshore site assessment

Section 15: Water resources – flood risk

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15 Water resources – flood risk

15.1 Introduction

Background

15.1.1 This section forms a Flood Risk Assessment (FRA) for the Putney Embankment Foreshore site. This FRA has been developed in line with the requirements of the National Policy Statement (NPS) for Waste Water (Defra, 2012)[1] Section 4.4 and includes a qualitative appraisal of the flood risk posed to the site, the potential impact of the development on flood risk on and off the site and an appraisal of the scope of possible measures to reduce the flood risk to acceptable levels. Further details on how the NPS requirements relevant to flood risk have been met can be found in Volume 2 Environmental assessment methodology Section 15.3.

15.1.2 The proposed development is described in Section 3 of this volume. Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 7 Putney Embankment Foreshore Figures).

15.1.3 A summary of the regulations and policy that have informed the assessment are presented in this section. Section 15.2 provides a summary of the proposed development in relation to flood risk. Section 15.3 provides an assessment of the flood risk to the site and elsewhere as a result of the development, during both the construction and operational phases. Section 15.4 provides details of the design measures that have been adopted within the proposals to ensure the flood risk to the site is not increased and ensure that flood risk does not increase elsewhere.

15.1.4 The assessment of flood risk should be considered in conjunction with the assessment of other water resources ie, groundwater and surface water. The assessment of effects on groundwater and surface water is presented in Section 13 and Section 14 of this volume respectively.

15.1.5 A project-wide FRA has been undertaken and is presented in Volume 3 Project-wide effects assessment

Regulatory context

15.1.6 The NPS seeks to ensure that where the development of new waste water infrastructure is necessary in areas at risk of flooding, flood risk from all sources of flooding is taken into account at all stages in the planning process in order for the development to be safe without increasing flood risk elsewhere.

15.1.7 A review of local flood risk policy relevant to the proposed development is provided in Vol 7 Appendix M.1.

NPS Sequential and Exception Tests

15.1.8 The NPS aims to direct development towards low risk areas through the use of a sequential approach which avoids inappropriate development in areas at risk of flooding. Using this approach, preference should be given to locating projects in Flood Zone 1 although if there is no "reasonably available site" in Flood Zone 1 then projects should be located in Flood Zone 2. However if there is no "reasonably available site" in Flood Zones 1 or 2, then nationally significant waste water infrastructure projects can be located in Flood Zone 3 subject to the Exception Test.

15.1.9 The Exception Test is detailed in Section 4.4.15 of the NPS. The test requires overall sustainability benefits (part a) to outweigh flood risk, whilst ensuring the development is safe and does not increase flood risk elsewhere (part c) and is preferably located on previously developed land (part b).

15.1.10 The overall project is considered to pass the Sequential Test, as detailed in Vol 3 Section 15. The project-wide Exception Test is also detailed in Vol 3 Section 15.

15.1.11 The proposed development at Putney Embankment Foreshore would form an integral part of the Thames Tideway Tunnel project and so would help achieve the project wide sustainability benefits outlined in the *Sustainability Statement*. Given the project-wide sustainability benefits, the proposed development is considered to satisfy part a) of the Exception Test.

15.1.12 The proposed development would not be entirely located on previously – developed land. However, as detailed in Vol 3 Section 15 no reasonably alternative sites on developable previously- developed land were identified during the site selection process and as such the proposed development at Putney Embankment Foreshore would satisfy part b) of the Exception Test.

15.1.13 This FRA shows that the proposed development would be appropriate for the area, as flood risk to the development would be managed through appropriate design measures such as raising the site out of the functional floodplain and constructing new flood defences to protect the site to the 1 in 1000 year standard. As such, the development can be considered safe and the development would not lead to a significant increase in flood risk on the surrounding areas. Therefore, part c) of the Exception Test has also been met.

15.2 Elements of the proposed development relevant to flood risk

15.2.1 The proposed development site is made up of two areas along the River Thames foreshore: the Putney Embankment Foreshore combined sewer overflow (CSO) site (main site) and the Putney Embankment Temporary Slipway site (secondary site).

15.2.2 The proposed development at this site is described in Section 3 of this volume. The elements of the proposed development relevant to flood risk are set out below.

Construction

15.2.3 The construction elements of the proposed development relevant to flood risk would include:

a. Construction of a temporary cofferdam including connection to the existing river wall and construction of a campshed.

b. The cofferdam would be constructed to the statutory flood defence level and would incorporate the existing public drawdock / slipway.

c. An interception chamber would be constructed below the bridge arch to intercept the Putney Bridge combined sewer overflow (CSO). A connection culvert would divert flows to the CSO drop shaft located west of the interception chamber. A Putney Bridge connection tunnel would link the drop shaft to the main tunnel. The CSO outfall would be relocated to discharge from a new location in the permanent foreshore structure.

d. A temporary slipway would be constructed further upstream, prior to commencement of the works at the Putney Embankment Site. This temporary slipway would be removed once works at Putney Embankment have been completed and the existing slipway would be made available for public use again.

Code of Construction Practice

15.2.4 Appropriate guidance regarding flood defence construction and emergency planning are included in the *Code of Construction Practice* (*CoCP)*. The *CoCP* is provided in Vol 1 Appendix A. It contains general requirements (Part A), and site specific requirements for this site (Part B). The relevant measures are summarised below.

15.2.5 The *CoCP* (Section 8) states the contractor would ensure that procedures are in place for awareness of flood warning and preparation for a potential flood event. This would include the identification of an evacuation route and potential refuge areas.

15.2.6 The *CoCP* (Section 8) states that the contractor would be responsible for providing and maintaining continuous flood defence provision, for both permanent and temporary works, to the statutory flood defence level as detailed within the FRA. This is a requirement of the Thames River Protection of Floods Amendment Act 1879[2].

Operation

15.2.7 As part of the permanent works the following elements relevant to flood risk are proposed:

a. The permanent foreshore area would be raised to the statutory flood defence level. This would be designed to allow future raising in accordance with the *Thames Estuary 2100 Plan* (TE2100) (EA, 2012)[3] requirements. This would form a raised area above the surrounding area that would be protected from flooding to the statutory level. It should be noted that access to the new foreshore structure would be provided to the statutory flood defence level.

b. An interception chamber would be constructed below the southern shore arch of Putney Bridge

c. An electrical and control kiosk would be constructed on Waterman's Green and would utilise a brown roof.

d. Following construction of the proposed development, outfalls from the Putney Bridge CSO would be intercepted. The Putney Bridge CSO would be relocated to discharge from the permanent foreshore structure, spilling only when either the main tunnel reaches capacity or is unavailable due to maintenance.

e. As the site is adjacent to the River Thames, surface water associated with the impermeable surfaces on the site would be discharged into the tidal reaches of the River Thames (tidal Thames) without attenuation. It is anticipated that flows would be passed through an oil interceptor prior discharge.

15.3 Assessment of flood risk

Introduction

15.3.1 The NPS requires that all potential sources of flooding that could affect the proposed development are considered.

15.3.2 This assessment is based on an FRA screening exercise that identified relevant potential flood sources and pathways. The tidal and fluvial assessments were based on the flood zones which do not take account of the presence of existing defences.

15.3.3 The assessment of flood risk from the proposed development takes into account the proposed design measures detailed in Section 15.4.

15.3.4 It should be noted that due to the nature of a flood risk assessment, the risk based approach outlined in the National Planning Policy Framework (NPPF) (Communities and Local Government, 2012)[4] was considered to be preferable to the general environmental impact assessment (EIA) methodology described in Vol 2 Section 3. This approach is based on the probability of an event occurring as a result of the proposed development rather than a direct change in conditions. This is detailed further in the methodology (see Vol 2 Section 15).

Tidal flood risk to the proposed development

Level of flood risk based on the flood zones

15.3.5 The Putney Embankment Foreshore site is situated within the tidal foreshore of the River Thames, adjacent to the southern river bank, underneath and to the west of Putney Bridge. The Environment Agency (EA) Flood Map identifies the adjacent riverfront area as lying within Flood Zones 2 & 3. The location of the site in relation to the flood zones is shown in Vol 7 Figure 15.3.1 (see separate volume of figures). As the majority of the site (with the exception of areas of the pavement along the Embankment) is located within the foreshore, it is part of the active floodplain of the tidal Thames and subject to daily tidal inundation. This area is therefore considered as functional floodplain and is classified as Flood Zone 3b (land where water has to flow or be stored in times of flood). Due to the undefended nature of the floodplain at this location and the frequency at which tidal inundation occurs, the current risk of flooding to this foreshore part of the site (without the design measures) is considered to be very high (see Vol 2 Section 15).

Existing tidal defences

15.3.6 A raised flood defence wall runs along the south side of the Embankment carriageway and is landward of the portion of the site, which is located in the foreshore. The river wall that runs north of Embankment does not represent the flood protection wall and is often inundated during spring tides. The foreshore part of the site is therefore not protected from tidal flooding by flood defences other than the Thames Tidal Barrier located further downstream.

15.3.7 The EA has stated that the statutory flood defence level relevant to the Putney Embankment Foreshore site is 5.54mAOD. The National Flood and Coastal Defence Database (NFCDD) (EA, 2011)[5] identified the crest level of the flood defences adjacent to the site are 5.54-7.16mAOD.

15.3.8 Condition surveys of the flood defences carried out by the EA in April 2011 (EA, 2012)[6] confirm that the condition of these defences is overall good (Grade 2).

Tidal flood level modelling

15.3.9 The most extreme flood risk scenario that could affect the site would be a combination of a high tide with a storm surge in the Thames Estuary. This scenario, assuming the Thames Barrier is operational is the EA's 'design flood' event, a hypothetical flood representing a specific likelihood of occurrence, in this case the 1 in 200 year (0.5% Annual Exceedance Probability [AEP][i]) flood event.

15.3.10 The EA *Thames Tidal Defences Joint Probability Extreme Water Level Study* (2008)[7] provides modelled tidal flood levels for the 1 in 200 year (0.5% AEP) flood event for specific locations (model node locations) within the River Thames.

15.3.11 Vol 7 Table 15.3.1 presents the modelled tidal levels from this study for model node 2.23 (see Vol 7 Figure 15.3.1 in separate volume of figures) which is the most relevant (ie. closest) to the site. It should be noted that the water levels are expected to decrease in the future due to an amended future Thames Barrier closure rule (see Vol 2 Section 15); therefore the 2005 scenario (ie, the present day scenario provided by the EA) produces the highest water level.

15.3.12 Vol 7 Table 15.3.1 also identifies that the existing defence levels at the site are above the 0.5% AEP tidal flood level. However, the defences are set back behind the foreshore part of the site (along the back of Waterman's Green and Embankment) and do not protect it from flooding.

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[i] A flood with a 0.5% AEP has a one in 200 year probability of occurring

Vol 7 Table 15.3.1 Flood risk – water levels

Return period	Flood level (mAOD)	Statutory flood defence level (mAOD)
0.5% AEP (2005)	5.10	5.54
0.5% AEP (2107)	5.06	

Tidal risk from the proposed development

New tidal defences

15.3.13 The presence of new permanent structures within the foreshore has the potential to influence the flood risk to the site itself and to the surrounding environment. The temporary works would involve the construction of a temporary cofferdam at the main site and temporary flood defences around the main site to the statutory flood defence level.

15.3.14 The permanent development would raise the foreshore site to the statutory flood defence level (5.54mAOD). As a result, the majority of the site which is currently located in Flood Zone 3b would be protected by defences and would be located in Flood Zone 3a and defended from tidal flooding. The risk of tidal flooding would therefore be considered to be high, due to the location of the site in Flood Zone 3a (see Vol 2 Section 15). The site would also be subject to residual risk in the event of a breach in the local defence wall or overtopping. However, this residual risk is not considered to compromise the long term operational function of the main tunnel (see Vol 3 Section 15).

15.3.15 In the event of a spring tide, both the temporary and permanent works would be partially surrounded by flood waters. A dry access route would be maintained off the Lower Richmond Road and Embankment carriageways. An existing ‘high spot’ within the carriageway currently provides a continuation in the flood protection level between the wall located at the south of the Embankment carriageway and the wall located at the rear of Waterman’s Green. The alignment of the new permanent access route would utilise this ‘high spot’.

15.3.16 Potential risks are described further in paras. 15.3.17 to 15.3.32 and measures included within the design are outlined in Section 15.4.

Flood defence integrity

15.3.17 The tunnel excavation process using tunnel boring machines (TBMs) and other construction methods, has the potential to create differential settlement (that is a gradual downward movement of foundations due to compression of soil which can lead to damage if settlement is uneven), which could affect the level of some of the existing flood defences. The main tunnel runs adjacent to the site within the channel of the River Thames. The Putney Bridge connection tunnel runs from the site to the main tunnel. These works therefore have the potential to affect the defences at the site.

15.3.18 The proposed design has been informed by consideration of settlement and the alignment and methods to be used have been selected to minimise it as far as possible.

15.3.19 A potential settlement of up to 20mm is estimated to occur across the river walls at the site (based on information provided by Thames Water). The flood defence levels following settlement are estimated to range from 5.54mAOD to 6.14mAOD. As such, the sections of river wall at the site would remain at, or above, the statutory flood defence level.

15.3.20 An initial assessment of the effect of construction activities on the structural integrity of flood defences at this site was undertaken by Thames Water. This considered effects from ground movement as well as a range of other construction-related impacts where applicable. At the main site, the assessment indicated that the structural integrity of the flood defences may be potentially affected by additional surcharge loading, increased water differential, excavation in front of the wall, 'Burland'[ii] damage modification of the existing wall and construction of support piles.

15.3.21 The proposed schedule of works (Schedule 1 of *The Draft Thames Water Utilities Limited (Thames Tideway Tunnel) Development Consent Order*) includes a provision for "works for the benefit of the protection of land or structures affected by the authorised project" which would provide the powers to mitigate for any impact that might affect the flood defences at the site.

Flood defence line

15.3.22 Both temporary and permanent works to flood defences have the potential to impact on the level of tidal flood risk to the surrounding area. The alignment of the existing flood defence wall is along the southern side of the Embankment carriageway and the rear of Waterman's Green. A localised high spot in the Embankment carriageway provides a continuation in the flood defence line. The formation of neither the temporary cofferdam nor the permanent foreshore structure would breach the alignment of the existing flood defence line. The existing flood defences would be retained.

15.3.23 The existing public drawdock / slipway would be within the temporary cofferdam and would be unavailable for use during the construction period and therefore a temporary slipway would be constructed further upstream to the west of the site, to provide alternative river access. The construction of the temporary slipway would not impact the local flood defences, as access to the slipway would be constructed to tie in with the existing river wall. The temporary slipway would be removed following the completion of the works when the existing public drawdock / slipway would be reinstated.

Scour management

15.3.24 The *TE2100 Plan* includes an assessment of the River Thames foreshore at this location, where there are long lengths of naturally eroding reaches

[ii] Tensile strains in gravity wall due to longitudinal differential settlement

of the River Thames. Results from this study show that works within the foreshore at this site may have an influence on downstream river structures if the pattern of sediment movement is greatly changed. In addition, should any permanent or temporary works within the river cause the channel width to be considerably altered, the flow velocity of the river at this point may vary, thereby altering contraction scour across the channel bed.

15.3.25 A scour summary report outlines the modelling studies that have been undertaken to determine the magnitude of scour associated with both the temporary and permanent works at ten foreshore sites on the tidal Thames (Vol.3, Appendix L.3) including the Putney Embankment Foreshore site.

15.3.26 Scour is predicted at the Putney Embankment Foreshore site to be greatest during construction with maximum estimated scour depths around temporary works of up to 2.5m. The contraction scour has been estimated during construction to be less than 0.1m across the river bed and less than 0.1m at the adjacent river walls.

15.3.27 During the operational phase, local scour depths of up to 2.5m are predicted around the permanent works. Contraction scour has been estimated at <0.1m. As a proactive approach, permanent scour protection is proposed at the base of the new flood defence wall.

15.3.28 Both the temporary and permanent works therefore have the potential to influence scour and /or deposition rates within the river and affect river structures including flood defences.

Loss of volume from the Thames Tideway

15.3.29 The presence of temporary and permanent structures within the foreshore has the potential to reduce the availability of flood storage within the tidal Thames. The impact of the removal of flood storage on flood levels may propagate throughout the hydrological unit of the Thames reach and has been modelled on a project-wide basis.

15.3.30 The Putney Embankment Foreshore site is located within the reach of Richmond to Chelsea in the tidal and fluvial modelling study. The modelling identifies that for this reach, the potential maximum decrease in peak water level is 0.038m during the temporary works scenario reducing to 0.018m during the permanent scenario. The modelling also identifies a potential maximum increase of 0.017m in peak water level during the temporary works scenario reducing to 0.01m during the permanent scenario. As identified in para. 15.2.7a, a section of the flood defences at this site falls below the statutory level, and the surrounding flood defences are above the statutory flood defence level. When the flood defence levels are compared to the 1 in 200 year tidal level for the year 2107 these would provide between 0.48-2.1m in freeboard.

15.3.31 The predicted changes in water level and freeboard are not considered to reduce flood protection at this site below design standard requirements and are therefore not deemed significant.

15.3.32 The results of the above modelling exercise show that the proposed project –wide works (both temporary and permanent works) are not considered to have a detrimental impact on the flood storage or tidal levels within the tidal Thames. This is discussed further in Vol 3 Section 15.

Fluvial flood risk to the proposed development

Level of risk based on the flood zones

15.3.33 At this location within the tidal Thames, both fluvial and tidal inputs are component parts of the resulting water level. The results of flooding from the tidal influence of the tidal Thames are judged to be of greater importance than those from fluvial influences. As the Putney Embankment Foreshore site is largely located within Flood Zone 3b, and as the extent of the tidal and fluvial floodplain cannot be distinguished from each other at this location, the risk of flooding from this flood source is considered to be very high. Further detail is included in Vol 2 Section 15.

Fluvial flood risk from the proposed development

15.3.34 As explained in Vol 2 Section 15, it is considered that a fluvial flood event on the tidal Thames with a return period of 1% AEP would result in lower water levels on the tidal Thames than those experienced during an extreme tidal flood event with the same return period.

15.3.35 The site is located in the functional floodplain of the River Thames. Fluvial influences were also considered when developing the hydraulic modelling summarised in para. 15.3.29. Overall, the results of the modelling exercise show that the proposed project-wide works are not considered to have a detrimental impact on the flood storage or tidal levels within the River Thames. This is discussed further in Vol 3 Section 15.

Surface water flood risk to the proposed development

15.3.36 Flooding of land from surface water runoff is usually caused by heavy rainfall that is unable to infiltrate into the ground or drain quickly enough into the local drainage network. Flooding can also occur at locations where the drainage network system is at full capacity and floodwater is not able to enter the system. This form of flooding often occurs in lower lying areas where the drainage system is unable to cope with the volume of water.

15.3.37 As part of the Drain London Project[iii], a Surface Water Management Plan (*SWMP*) was prepared for the London Borough (LB) of Wandsworth (GLA, 2011)[8]. This shows that the land adjacent to the Putney Embankment Foreshore site is not located within a Critical Drainage Area (CDA)[iv], which suggests that the site is relatively less susceptible to surface water flooding than other local areas in the borough. Modelling results for a 1 in 100 year (1% AEP) rainfall event plus climate change allowance show

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[iii] A London wide strategic surface water management study undertaken by the Greater London Authority (GLA) and London Councils.

[iv] Area susceptible to surface water flooding

potential surface water flooding of 0.1m - 0.25m deep in areas adjacent to the foreshore site.

15.3.38 To the south of the site lies the hard standing associated with the Lower Richmond Road and Embankment. Ground levels decrease towards the tidal Thames. The Lower Richmond Road is at an elevation of approximately 6mAOD. The levels in Embankment and adjacent pedestrian walkway are lower and at approximately 4.5mAOD. The elevation of Embankment increases to the east, where it joins the Lower Richmond Road at approximately 6mAOD. Surface water from the south would therefore flow towards the site and the River Thames.

15.3.39 As the adjacent area to the site is identified as having a potential flood depth of up to 0.25m, the flood risk from this source is considered to be low (see Vol 2 Section 15).

Surface water flood risk from the proposed development

15.3.40 A full assessment of the likely significant effects on surface water from the construction and operation of the Putney Embankment Foreshore site is provided in Section 14 of this volume.

15.3.41 The NPS requires that surface water runoff from new developments is effectively managed so that the risk of surface water flooding to the surrounding area is not increased. In accordance with NPS, runoff rates following the proposed development should not be greater than the existing (pre-development) rates. The *London Plan 2011* (GLA, 2011) [9] and the Mayor's *Water Strategy* (Mayor of London, 2011)[10] sets out a preferred standard of attenuation to the greenfield runoff rate and an essential standard of 50% attenuation of the peak surface water runoff rate at peak times.

15.3.42 The foreshore area of the site naturally drains directly to the tidal Thames without inundating surrounding land. In agreement with the EA (as set out in their phase two consultation response), surface water runoff from the proposed site would also be discharged unattenuated to the tidal Thames. Due to the tidal nature of the receiving watercourse, surface water runoff rates to the tidal Thames would not increase surface water flood risk to the site or surrounding area and would therefore not require attenuation prior to discharge. Furthermore, a brown roof is proposed on the electrical and kiosk, which would help manage surface water run-off as well as provide wider sustainability benefits.

15.3.43 In the event of a storm coinciding with a high tide event, surface water drainage from the site would be restricted and would need to be stored on site. If necessary, on-site storage would therefore be provided to manage the risk of site flooding in the event of tide-locking of the surface water outfall.

15.3.44 Following the implementation of the above drainage measures the risk of flooding from the development to the surrounding area is considered to be low.

Groundwater flood risk to the proposed development

15.3.45 Groundwater flooding occurs where groundwater levels rise above ground surface levels. There are no groundwater monitoring boreholes at the site. Groundwater levels in the upper aquifer (river terrace deposits) at the Barn Elms site (1km to the north-west) are approximately 3m below ground level (bgl). On this basis, it is assumed that groundwater levels would be 3m bgl at the Putney Embankment Foreshore site. As there is no layer overlying the river terrace deposits, the upper aquifer is therefore unconfined and there is the potential for groundwater to reach the surface level of the site.

15.3.46 There are no records in the LB of Wandsworth Strategic Flood Risk Assessment (SFRA) (Scott Wilson, 2009)[11] of groundwater flooding within the vicinity of the site.

15.3.47 The proposed site would be raised up to the adjacent land levels, thereby providing greater separation between the ground water level and the finished ground level.

15.3.48 As there are no groundwater levels available for this site, the flood risk classification is based on the alternative criteria set out in Vol 2 Section 15. Given that there is a potential pathway, the river terrace deposits are permeable and there are no flood records, the flood risk from groundwater is considered to be medium.

Groundwater flood risk from the proposed development

15.3.49 An assessment of the likely effects on groundwater at the Putney Embankment Foreshore site is provided in Section 13 of this volume.

15.3.50 The CSO drop shaft would pass through river terrace deposits and London Clay. The shaft would not extend down into the lower aquifer. No dewatering of the upper aquifer is anticipated to be required. Sheet pilling would be constructed around the Putney Embankment Foreshore site to seal out water held within the upper aquifer.

15.3.51 The presence of the CSO drop shaft creating a physical barrier to groundwater movement has been assessed as leading to a predicted rise in water levels (approximately 0.2m). This is considered to be a negligible impact on the water levels of the upper aquifer, and therefore there would be no increase in the risk from groundwater flooding to the site as a result of the development.

Sewers flood risk to development

15.3.52 The combined southern Low Level Sewer No. 1 (which is 1372mm by 914mm) runs in a south easterly direction in the Lower Richmond Road, before turning south at the junction to Putney High Street. An overflow weir from the Low Level Sewer No. 1 is located at the junction of the Lower Richmond Road and Putney High Street. Overflow from the Low Level Sewer No. 1 flows towards the tidal Thames from Putney High Street, through the Putney Bridge Storm Outlet. The CSO outfalls, via twin outfalls, to the tidal Thames below Putney Bridge.

15.3.53 A series of smaller combined sewers from the surrounding buildings drain to the Low Level Sewer No. 1.

15.3.54 If the capacity of the Low Level Sewer No. 1, or the smaller combined sewers were exceeded, the combined sewerage would surcharge though outlets, such as manholes and gullies, located along the length of the sewer.

15.3.55 Thames Water flooding records (Thames Water, 2012)[12] show that there have been 5 records of sewer flooding within 200m of the site since 1990.

15.3.56 As there is a high number of sewer flooding records within the vicinity of the site and there is a pathway for flood waters towards the site, the flood risk from this source is considered to be high.

Sewers flood risk from the proposed development

15.3.57 It is proposed that the Putney Bridge Storm Outlet would be intercepted underneath Putney Bridge. Flows would be diverted to the CSO drop shaft via a connection culvert. The CSO drop shaft would be linked to the main tunnel via a connection tunnel. The outfall from the Putney Bridge Storm Outlet would be relocated to discharge from the permanent foreshore structure. The flood risk during construction would be managed using design measures described in Section 15.4.

15.3.58 The CSO interception and connections have been designed so that there is no increased flooding risk in the existing system for the 1 in 15 year design storm when compared to the base case scenario[v]. Further detail is provided in Vol 3 Section 15.

15.3.59 Following construction, there would only be a restriction on flows entering the main tunnel should it become full or be unavailable due to maintenance. In such a scenario, flows would overflow from the connection culvert to the relocated Putney Bridge Storm Outlet outfall.

15.3.60 Following the construction of the proposed development the risk of flooding from this source would be unchanged and therefore would remain high.

Artificial sources flood risk to and from the proposed development

15.3.61 There are no nearby artificial flood sources eg, canals or reservoirs, which could lead to flooding of the site.

15.3.62 The flood risk from this source both to and from the proposed development is therefore not applicable at this site and is not assessed further.

[v] The base case scenario comprises the sewage treatment works (STW) improvements and Lee Tunnel in the 2020s.

15.4 Design measures

15.4.1 Measures have been incorporated into the design of the proposed development to ensure that the risk of flooding to and from the site and surrounding areas is not increased during the construction and operational phases. These measures are described below although many have already been referred to in the preceding section.

Tidal and fluvial

Construction

Flood defences

15.4.2 As discussed in para. 15.3.17 the proposed tunnel alignment runs parallel to the river wall flood defence and has the potential to affect the integrity of the defences. During construction the level of the flood defences at the site would be monitored, and where required repairs would be made in agreement with the asset owner and the EA to ensure crest heights of the flood defences at the site are maintained to the existing levels. With this strategy in place, no effects of settlement are anticipated.

15.4.3 Design options to ensure the structural integrity of the flood defences at this site would be dependent on the contractor's construction methodology. Potential options for the impact to the river wall from surcharge loading and increased water differential may include temporarily supporting the wall within the temporary cofferdam while it is unfilled, and restricting loading in Waterman’s Green. Suitable construction methods would be used to ensure no adverse impact from excavation in front of the walls. It is envisaged that ‘Burland’ damage due to ground movement would be mitigated using pre and post construction survey, monitoring and if necessary reactive repair. The detailed design of modifications to the existing wall would ensure that the structural stability of the wall is maintained. The detailed design and construction of the circular support piles would ensure no permanent adverse effect on the structural stability of the wall.

15.4.4 As discussed in para. 15.3.22 a cofferdam and temporary flood defences would be constructed around the site to the statutory flood defence level. This would ensure a suitable level of flood protection and flood risk is maintained during construction. Further information is included in the *CoCP* (Section 8).

15.4.5 The construction of a temporary slipway to the west of the main site would not impact the local flood defences as the slipway would be constructed in line with the existing river wall.

15.4.6 Appropriate Protection Provisions would be agreed with the EA for any works within 16m of the flood defences on the landward side, and within the River Thames prior to any works on or within 16m of the flood defences being commenced.

Scour management

15.4.7 During construction the formation of scour would be monitored and mitigation proposed if the scour exceeds agreed trigger values.

15.4.8 Mitigation options could include riprap or rock fill, articulated concrete blocks, gabion mattresses and grout filled mattresses. The detailed approach to the implementation of these mitigation measures would be informed by the monitoring results as well as site specific design requirements. Further details are provided in *Scour Monitoring and Mitigation Strategy* (Vol 3 Appendix L.4).

Emergency plan

15.4.9 Appropriate emergency planning procedures would be adopted by the contractor during the construction phase to mitigate the potential consequences in the event of a flood. Further information is included within the *CoCP* (Section 8).

15.4.10 A dry access and egress route to and from the construction site would be maintained by utilising the existing 'high spot' that exists within the Embankment carriageway. By utilising this 'high spot' for the alignment of the access route, access would be maintained to the site during all tidal states.

Operation

Flood defences

15.4.11 The permanent operational area would be raised to the statutory flood defence level as outlined in para. 15.2.3. The flood defence line of the existing defences would not be altered as part of the permanent works.

15.4.12 The new permanent foreshore structure has been designed to ensure that future flood defence raising can be achieved to meet the TE2100 requirements.

15.4.13 The residual flood risk to the site would therefore be the same as it currently is behind the existing defences. As detailed in para. 15.5.6 and Vol 3 Section 15, the residual risk to the site is considered to be acceptable and no further mitigation is required.

Loss of volume from the tideway

15.4.14 As discussed in para. 15.3.29, the impact of removal of tideway flood storage on flood levels has been considered on a project-wide basis and is discussed further in Vol 3 Section 15. The floodplain volume loss from river structures has been minimised whilst maintaining fundamental engineering requirements and therefore no further measures are proposed.

Scour management

15.4.15 The shape of the protrusion for the permanent foreshore structure has been designed to minimise the influence on the flow regime of the tidal Thames.

15.4.16 As a proactive approach permanent scour protection would be provided at the toe of the new flood defence river wall. It is assumed for the assessment that permanent scour protection would consist of loose large stone placed just below foreshore level. The size and type of the stone is yet to be defined. It is assumed therefore that a 1m depth of stone would be placed up to 0.5m below the existing foreshore level within the zone indicated on the Site parameter plan (see separate volume of figures – Section 1). It is assumed that these works would be undertaken towards the end of the construction period. This permanent protection would be within the area of the temporary cofferdam.

Emergency plan

15.4.17 During the operational phase the site would not be permanently staffed with the exception of visits from maintenance personnel. An emergency plan would only be required for staff undertaking maintenance visits.

Surface water

Construction

15.4.18 In accordance with the *CoCP* (Section 8) all site drainage runoff during construction would be drained and discharged to mains foul or combined sewers and where this is not practicable, the site would be drained such that accumulating surface water would be directed to holding or settling tanks, separators and other measures prior to discharge to the combined or surface water drains. Foul drainage from the site welfare facilities would be connected to the mains foul or combined sewer. This approach would ensure that the risk of surface water flooding is managed during construction but would not reduce the overall level of flood risk from the site from surface water.

Operation

Scour management – surface water discharge

15.4.19 As outlined in para. 15.3.42 it is intended to discharge surface water from the operational site directly into the tidal Thames. This outfall would be of appropriate size for the potential discharge volumes. Scour protection is included within the operational layout. This would provide sufficient scour protection for the surface water outfall.

Surface water management

15.4.20 As described in para. 15.3.42, surface water runoff from the site would be discharged directly to the tidal Thames. Due to the tidal nature of the receiving watercourse, surface water runoff rates to the tidal Thames would not increase surface water flood risk to the site or surrounding area and would therefore not require attenuation prior to discharge.

Groundwater

Construction and operation

15.4.21 Groundwater monitoring is proposed during construction and operation. Further related mitigation measures regarding maintaining groundwater levels are described in Section 13 of this volume.

Sewers

Construction

15.4.22 There are no proposed diversions of the existing sewer network for the site other than for the primary purpose of the proposed development. The operation of the Putney Bridge Storm Outlet would be maintained to the same capacity using flumes and flap valves and extended through the cofferdam during the construction period.

Operation

15.4.23 Following construction, the Putney Bridge Storm Outlet would be intercepted underneath Putney Bridge and flows would be diverted to the CSO drop shaft via a connection culvert. Should the tunnel become full or unavailable due to maintenance, sewage flows would be diverted to the tidal Thames via the relocated Putney Bridge Storm Outlet outfall, ensuring no increase in flood risk compared to the existing scenario.

15.5 Assessment summary

Flood risk

15.5.1 The majority of the Putney Embankment Foreshore site is located in Flood Zone 3b associated with the River Thames. As part of the proposed development, flood defences would be constructed, providing protection to the site from tidal flooding during both construction and operation.

15.5.2 In line with the NPS, this FRA shows that the proposed development would be appropriate for the area, as flood risk to the development would remain unchanged as it would be managed through appropriate design measures and the development would not lead to a significant increase in flood risk on the surrounding area. Therefore no significant flood risk effects are considered likely.

15.5.3 Vol 7 Table 15.5.1 provides a summary of the findings of the FRA undertaken for this site.

Residual risk to the development

15.5.4 The residual risk to the site is the risk that remains after all design measures have been incorporated.

15.5.5 Following the construction of the permanent foreshore structure, the site would be raised to the statutory flood defence level. The site would be at residual risk of tidal flooding in the event of a breach in the new flood defence wall or overtopping of the defence wall as a result of a failure of the Thames Barrier.

15.5.6 It is considered that the consequence of a breach or failure of flood defences would not compromise the long term operational function of the Thames Tideway Tunnel project and therefore no additional measures over and above those outlined above are proposed. Further detail is provided in Vol 3 Section 15.

Residual risk from the development

15.5.7 Following the incorporation of the design measures outlined in Vol 7 Table 15.5.1, the level of residual risk from the development to adjacent areas would remain unchanged. The project-wide residual risks are discussed in Vol 3 Section 15.

Vol 7 Table 15.5.1 Flood risk –FRA summary

Source	Pathway	Current flood risk to the proposed development	Design measures (construction and operation)	Flood risk from the proposed development (post design measures)	Flood risk to the proposed development post design measures
Tidal	Tidal Thames	Very high	New flood defences built around the main site so site defended from tidal flooding to statutory level (changing the Flood Zone from 3b to 3a). Monitoring of scour and mitigation if trigger value exceeded. Scour protection measures for permanent works. Monitoring of flood defence levels and repair as required to maintain existing crest level.	No increase in tidal flood risk as a result of proposed development.	High due to change from Flood Zone 3b to 3a (but risk is residual only)
Fluvial	Tidal Thames	Very high	New flood defences built around the main site so site defended from fluvial flooding to statutory level (changing the Flood Zone from 3b to 3a). Monitoring of scour and mitigation if trigger value exceeded. Scour protection measures for permanent works. Monitoring of flood defence levels and repair as required to maintain existing crest level.	No increase in fluvial flood risk as a result of proposed development.	High due to change from Flood Zone 3b to 3a (but risk is residual only)
Surface	Surrounding	Low	Discharge surface water to tidal Thames.	No increase in	Low

Source	Pathway	Current flood risk to the proposed development	Design measures (construction and operation)	Flood risk from the proposed development (post design measures)	Flood risk to the proposed development post design measures
water	area		On site attenuation in the event of tide locking.	surface water flood risk as a result of proposed development.	
Groundwater	Underlying geology and groundwater levels un restricted pathway	Medium	Monitoring proposed during construction and operation. Sheet piling around the site to prevent groundwater inflows from the upper aquifer.	No increase in groundwater flood risk as a result of proposed development.	Medium
Sewers	Local drainage system	High	CSO maintained with flumes and flap valves during construction. All flows currently discharged through the Putney bridge Storm Outlet would be diverted to the main tunnel.	No increase in sewers flood risk as a result of proposed development.	High
Artificial sources	None	Not applicable	Not applicable	Not applicable	Not applicable

** Definitions of these classifications are included in Vol 2 Section 15*
() indicate the flood risk is residual ie in the event of a failure or overtopping of flood defences

References

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

[2] Great Britain. *Thames River Protection of Floods Amendment Act 1879* London, The Stationery Office.

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DCO-DT-000-ZZZZZ-060207