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

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

List of contents

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

List of contents

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Sections 1 to 3: Introduction, site context and proposed development

List of contents

Page number

List of plates

Page number

List of tables

Page number

This page is intentionally blank

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 1: Introduction

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

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 Chelsea Embankment Foreshore site.

1.1.2 The proposal at this site is to intercept the existing combined sewer overflow (CSO) at Ranelagh, and to connect to the northern Low Level Sewer No. 1. The Ranelagh CSO currently discharges approximately 26 times in a typical year. The total volume discharged is approximately 283,000m^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 13 Chelsea Embankment Foreshore figures and Vol 13 Chelsea Embankment Foreshore appendices). In addition, there is a separate glossary and abbreviations document which explains technical terms used within this assessment.

This page is intentionally blank

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 2: Site context

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

2 Site context

2.1.1 The proposed development site is located in the Royal Borough (RB) of Kensington and Chelsea on the northern bank of the River Thames. It would comprise an area of the River Thames foreshore, a section of pavement and roadway of the Chelsea Embankment (A3212), and a small part of Ranelagh Gardens. The Ranelagh CSO discharges into the River Thames along this section of the Chelsea Embankment.

2.1.2 The site extent is defined by the limits of land to be acquired or used (LLAU) and covers an area of approximately 2.5 hectares (ha). The site context and location is shown in Vol 13 Figure 2.1.1 (see separate volume of figures).

2.1.3 The site is bounded to the north by the Chelsea Embankment, the Royal Hospital Chelsea and its South Grounds and Ranelagh Gardens. The River Thames bounds the site to the east, south and west. Residential properties (mid-rise flats) and the Lister Hospital are located to the northeast. Further to the east is Chelsea Bridge (A3216) and Chelsea Bridge Gardens. The plate below provides an aerial view of the site and Vol 13 Plate 2.1.2 shows a view of the site looking upstream from Chelsea Bridge.

Vol 13 Plate 2.1.1 Chelsea Embankment Foreshore– aerial photograph[i]

[i] Note that the photograph was taken when the Royal Hospital Chelsea was hosting an event and as such the photograph is not representative of the usual baseline conditions at this site.

2.1.4 The general pattern of land uses within and around the site is shown in Vol 13 Figure 2.1.2 (see separate volume of figures).

2.1.5 There is no existing vehicle access to the foreshore (see Vol 13 Plate 2.1.2). Grosvenor College Stairs just to the west of the site provide pedestrian access to the foreshore. The site is located on Chelsea Embankment providing access to the inland sections of the site. The closest stations are Sloane Square Underground Station and Battersea Park Station, which are situated approximately one kilometre (km) north and south of the site respectively. The Thames Path National Trail runs along the southern pavement of Chelsea Embankment within the boundaries of the site.

Vol 13 Plate 2.1.2 View upstream, from Chelsea Bridge

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

a. recreational:

   i River Thames – within cofferdam area

   ii Thames Path National Trail – runs along the southern pavement of Chelsea Embankment within the boundaries of the site

   iii Royal Hospital Chelsea South Gardens and Ranelagh Gardens – adjacent to north of the hoarding

b. Residential

   i 23 Embankment Gardens – 95m west of hoarding;

   ii Chelsea Court (supported housing) – 130m west of hoarding

c. Other

i Royal Hospital Chelsea– 300m north of the hoarding;

ii Lister Hospital – 95m northeast of hoarding

2.1.7 Environmental designations for the site and immediate surrounds are shown in Vol 13 Figure 2.1.3 (see separate volume of figures).

2.1.8 The site is located in the RB of Kensington and Chelsea air quality management area (AQMA) which has a borough-wide designation declared for nitrogen dioxide (NO_2) and particulate matter (PM_{10}).

2.1.9 There are a number of ecological designations close to the site. The site is predominantly located within the River Thames which is classified as the River Thames and Tidal Tributaries Site of Importance for Nature Conservation (SINC) (Metropolitan level). Additionally, within 250m of the site is the Ranelagh Gardens SINC (Borough level) and, on the south bank of the river, the Battersea Park SINC (Metropolitan level) as well as the Battersea Park Nature Areas Local Nature Reserve.

2.1.10 Chelsea Embankment is Grade II listed to the west of the site, but is not listed within the site. Other nearby Grade II listed structures include Chelsea Bridge (100m to the east); a Bazalgette designed sewer vent in the pavement on Chelsea Embankment; entrance gates (Bull Ring Gates) on Royal Hospital Road to the north of the site and the War Memorial Obelisk in the grounds of the Royal Chelsea Hospital (70m to east). The Grade II registered historic park and gardens (Royal Hospital Chelsea South Grounds and Ranelagh Gardens) are also located immediately to the north of the site. The main Royal Hospital building is Grade I listed and is approximately 300m north of the site.

2.1.11 The majority of the site is located in the River Thames Conservation Area, whilst the inland sections of the site (the pavement, carriageway and a small section of Ranelagh Gardens) are located within the Royal Hospital Conservation Area. The site is not in an Archaeological Priority Area (APA).

2.1.12 There are no tree preservation orders (TPOs) in effect within the site. However, the trees within the site are indirectly protected by virtue of their position within the Royal Hospital Conservation Area.

2.1.13 There is considered to be a low potential for contamination at the site. Local geology comprises of superficial deposits; made ground; London clay, and Lambeth group.

2.1.14 The site is located within the Thames Tideway foreshore and is therefore considered to be a functional floodplain (Flood Zone 3b), ie, where water must flow or be stored in times of flooding.

This page is intentionally blank

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 3: Proposed development

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

3 Proposed development

3.1 Overview

3.1.1 The proposed development at Chelsea Embankment Foreshore would intercept the existing combined sewer overflow at Ranelagh and make a connection to the northern Low Level Sewer No. 1 to control flows from other CSOs along the embankment[ii]. A CSO drop shaft would be constructed as well as an overflow weir chamber to connect to the northern Low Level Sewer No. 1 under Chelsea Embankment and an interception chamber to intercept the Ranelagh CSO. Two connection culverts would also be constructed to link the flows to the shaft. A short connection tunnel would link the shaft to the main tunnel.

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 the 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 ('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 13 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.

[ii] By diverting the flow from the Low Level Sewer No. 1 at Chelsea Embankment Foreshore, Victoria Embankment Foreshore and Blackfriars Bridge Foreshore sites, the flows from ten other CSOs along the north bank of the river would be controlled. This avoids the need for additional sites at or near the ten CSOs from Church Street in Chelsea to Essex Street in the City of Westminster.

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

Vol 13 Table 3.2.1 Chelsea 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 13 Chelsea Embankment Foreshore figures – Section 1
Demolition and site clearance plans	For approval	Vol 13 Chelsea Embankment Foreshore figures – Section 1
Access plan	For approval	Vol 13 Chelsea Embankment Foreshore figures – Section 1
Proposed landscape plans	Illustrative only – but scale of above ground structures is indicative	Vol 13 Chelsea 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 (Chelsea Embankment Foreshore)	For approval	*Design Principles* report Section 4.10 (see Vol 1 Appendix B)
Code of Construction Practice Part A: General requirements	For approval	*CoCP Part A* (see Vol 1 Appendix A)

Document /Plan Title	Status	Location
Code of Construction Practice Part B: Site specific requirements Chelsea Embankment Foreshore	For approval	*CoCP Part B Chelsea Embankment Foreshore* (see Vol 1 Appendix A)

Description of the proposed works

3.2.1 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).

3.2.2 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.

3.2.3 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

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

a. **Work No. 12a**: Chelsea Embankment Foreshore CSO drop shaft – A shaft with an internal diameter of 12 metres and a depth (to invert level) of 45 metres.

b. **Work No. 12b**: Ranelagh connection tunnel - A tunnel between Chelsea Embankment Foreshore CSO drop shaft (Work No. 12a) and the main tunnel (west central) (Work No. 1b).

Associated development

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

a. **Work No. 12c**: Chelsea Embankment Foreshore associated development - Works to intercept and divert flow from the Ranelagh CSO and connect the northern Low Level Sewer No.1 to the Chelsea Embankment Foreshore CSO drop shaft (Work No. 12a) and into the Ranelagh connection tunnel (Work No. 12b) including the following above and below ground works:

- i 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. 12a and 12c (iv), (v), (vi) and (vii) and scour protection works, relocation of existing CSO, and new CSO outfall apron
- ii removal of existing CSO apron in foreshore
- iii dredging and construction of a cofferdam including the placement of fill material, connection to the existing river wall and construction of a campshed
- iv construction of an interception chamber, overflow weir 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 structures for air management plant and equipment including filters and ventilation columns and associated below ground ducts and chambers
- vi construction of electrical and control equipment kiosks
- vii construction of pits, chambers, ducts and pipes for cables, hydraulic pipelines, utility connections, utility diversions and drainage
- viii provision of construction access from Chelsea Embankment and subsequent reinstatement to original highway layout
- ix provision of permanent access from Chelsea Embankment
- x provision of temporary signalised pedestrian crossing and its subsequent removal
- xi permanent relocation of existing pedestrian traffic island
- xii realignment of existing kerb line of the Bull Ring
- xiii removal and subsequent reinstatement of existing wall to frontage of Ranelagh Gardens, with new gate to provide access to diverted utilities.

3.2.6 The maximum heights of above ground structures, which are for approval, and shown on the site works parameter plan are as follows:

a. Ventilation column(s) serving the shaft = 8m (with minimum 4.0m)

b. Ventilation column(s) serving the interception chamber and overflow weir chambers = 6.0m

c. Electrical and control kiosks = 1.5m

3.2.7 In addition, further works are required at this site that constitute associated development within the meaning of section 115(2) of the Act. 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

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

Ancillary works

3.2.9 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 is sought and are included within Schedule 1 to the *Draft DCO*.

3.2.10 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

c. 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

d. installation of pumps in chambers and buildings

e. works to trees and landscaping works not comprising development

f. works associated with monitoring of buildings and structures

g. provision of construction traffic signage

h. the relocation of boats/vessels

3.2.11 The works defined by bullet b and h (in the list above) are not considered likely to be applicable to the works proposed at this site.

Design principles

3.2.12 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 structure).

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

3.2.14 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.

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

Site features and landscaping

3.2.16 The above ground structures are shown at indicative scale on the landscape plan and the scales of these structures (in addition to the defined heights) have been considered within the assessments as appropriate. The possible locations of these above ground structures, as well as the CSO drop shaft, are defined by the zones on the site works parameter plan.

3.2.17 All other features on the landscape plan are illustrative only and have not been assessed. The landscaping proposals for approval for this site are provided in the site-specific design principles for this site (see *Design Principles* report Section 4.10).

Code of Construction Practice

3.2.18 All works would be undertaken in accordance with the *Code of Construction Practice (CoCP)* (Vol 1 Appendix A). 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* 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.

3.2.19 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 at Chelsea 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.

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 only 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 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 EA (including Flood Defence Consents, Abstraction Licenses and Discharge Consents) and the 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 2017 (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 Chelsea Embankment Foreshore is anticipated to take approximately four years and would involve the following main works (with some overlaps):

a. Site Year 1 – Site setup (approximately ten months)

b. Site Years 1 to 2 - Shaft construction (approximately eight months)

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

d. Site Years 2 to 4 – Construction of other structures (approximately 16 months)

e. Site Year 4 – Completion of works and site restoration (approximately eight months).

3.3.7 This site would operate to the standard and continuous working hours for various phases and activities as set out in the *CoCP* Part A and B (Section 4). Standard working hours would be applied to all of the above phases of construction work apart from elements described below.

3.3.8 It has been assumed that continuous hours would be required for the construction and secondary lining of the Ranelagh connection tunnel for a period of approximately four months. However, 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 13 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 principle construction phases and relevant activities.

Vol 13 Table 3.3.1 Chelsea Embankment Foreshore – construction phase plans

Document/Plan title	Activities	Status	Location
Construction phases – phase 1	Site setup Installation of cofferdam	Illustrative	Vol 13 Chelsea Embankment figures – Section 1
Construction phases – phase 2	Shaft construction Tunnelling	Illustrative	Vol 13 Chelsea Embankment figures – Section 1
Construction phases – phase 3	Construction of other structures	Illustrative	Vol 13 Chelsea Embankment figures – Section 1
Construction phases – phase 4	Removal of cofferdam Site demobilisation	Illustrative	Vol 13 Chelsea Embankment figures – Section 1

3.3.11 The following physical construction works are described below:

a. site setup

b. shaft construction

c. tunnel construction

d. tunnel and shaft secondary lining

e. construction of other structures

f. completion of works and site restoration

g. excavated materials and waste

h. access and movement.

Site setup

3.3.12 Implementation of a traffic management scheme would be required for the diversion of existing services in the vicinity of the low level sewer interception chamber on Chelsea Embankment. Traffic management would also need to be established to facilitate the set up of the main foreshore construction site. The Thames Path and National Cycle Route 4 would also need to be diverted.

3.3.13 Prior to any works commencing the site boundary would be established and secured. The boundary would consist of approximately 2.4m high close boarded hoarding panels, attached to timber posts concreted in the ground. The hoarding wouldl incorporate suitable art work and viewing windows. The site would be set up to provide office and welfare facilities. Water and power would be mains connected if available. If not available power would be supplied by a silent running generator. Water would be stored in a tank and pumped on demand and resupplied as required.

3.3.14 The extent of demolition and site clearance works are shown on the demolition and site clearance drawings.

3.3.15 Access gates would provide access off of westbound Chelsea Embankment. The gates would be manned by a security contractor.

3.3.16 Tree works would be required during site setup.

3.3.17 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 phase.

3.3.18 As the site is within the River Thames foreshore a cofferdam would be constructed. The piles used to form the temporary cofferdam would be driven 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 maintain the level of defence during construction.

3.3.19 A concrete campshed would be constructed along the southern face of the temporary cofferdam for barges to sit safely on the river bed. The area of the campshed has been assumed to be approximately 400m^2. It is assumed that no dredging would be required at this site, although it is likely that there would be some disturbance to the riverbed during construction of the cofferdam and campshed.

3.3.20 For the purpose of this assessment it is assumed that the piles would be driven using vibration piling techniques although the intention would be to seek to maximise the use of pressed piling techniques where reasonably practicable.

3.3.21 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 includes silt, peat and other materials. Removal of this 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. All soft material within permanent cofferdams would be removed to ensure sound foundations for permanent construction.

3.3.22 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. A drain sump would be maintained within the filled cofferdam to enable any water entering the cofferdam to be pumped back to river. The CSO shaft construction (see below) would commence once the cofferdam is in place as described above.

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

3.3.24 Internal site roads, plant and material storage areas, offices, welfare and workshops would be established on the cofferdam.

Shaft construction

3.3.25 Major plant required for the main shaft construction would include cranes, excavators, and dumpers.

3.3.26 The shaft would be constructed with a primary lining of precast concrete segmental shaft linings. The upper portion would be constructed as a jacked caisson through the water bearing gravels and the lower portion of the shaft would likely be mined using underpinning techniques in tandem with dewatering.

3.3.27 Approximately five dewatering wells would be drilled outside the periphery of the shaft. Pumps would be placed in the drill casings and groundwater extracted. Approval would be sought from the Environment Agency (EA) so that extracted groundwater can be discharged directly into the River Thames. Extracted water would be sampled on a regular basis to check water quality.

3.3.28 Excavated material would be stored adjacent to the shaft in an excavated materials handling area prior to disposal offsite. A crawler crane would service the shaft.

Tunnel construction

3.3.29 To connect the CSO drop shaft to the main tunnel, an approximately 70m long (4.0m internal diameter) connection tunnel would be constructed. A section of this connection tunnel would include a 4.8m internal diameter de-aeration chamber. The connection tunnel would be constructed using sprayed concrete lining (SCL) techniques. The tunnel would be progressively excavated and the SCL tunnel lining would built up in even layers until the required profile is achieved. The concrete would be batched on the surface and pumped to the tunnel.

3.3.30 Due to the anticipated ground conditions to be encountered the tunnelling would be undertaken with advance dewatering, probing and ground treatment as required.

Secondary lining of tunnel and shaft

3.3.31 Secondary lining is an additional layer of concrete placed against the inside of a tunnel's primary concrete segmental lining for watertightness and to improve the overall structural durability. For the purposes of assessment, it has been assumed that both the short connection tunnel and the shaft would have a reinforced concrete secondary lining.

3.3.32 The secondary lining of the connection tunnel would be constructed by installing steel reinforcement, erecting a cylindrical shutter within a short length of tunnel and pumping concrete into the gap between the shutter and the primary lining. Once the concrete has hardened sufficiently, the shutters would be removed and erected in the next section of tunnel.

3.3.33 It is assumed that the lining of the CSO shaft would be made of reinforced concrete placed inside the shaft's primary support. The steel reinforcement would be assembled in sections and a shutter would be used to cast the concrete against. The shutter would be assembled at the bottom of the shaft and sections of reinforcement installed and lining cast progressively up the shaft.

3.3.34 Any reinforced concrete structures internal to the main tunnel shaft and the roof slab would be constructed in a similar manner progressively from the shaft bottom. In some cases precast concrete members may be used.

Construction of other structures

3.3.35 An overflow weir chamber, connection culvert and valve chamber would connect to the existing Low Level Sewer No.1 on the north side of Chelsea Embankment to the CSO drop shaft. An interception chamber, connection culvert and valve chamber would intercept the Ranelagh CSO and connect it to the CSO drop shaft.

3.3.36 To construct the overflow weir chamber on the Low Level Sewer No.1, the services above the sewer would be diverted where possible or supported and protected where necessary. It is anticipated that traffic management would be required for both the utility diversions and the overflow weir chamber construction.

3.3.37 The Low Level Sewer No.1 would be lined before the overflow weir chamber is constructed. The overflow weir chamber would be constructed using secant or sheet piles and excavated exposing the low level sewer. The base slab and internal walls would then be constructed. Flow would be temporarily diverted from the Low Level Sewer No.1 to allow the existing sewer to be broken out on completion of the weir chamber.

3.3.38 Sheet pile walls would be used to provide support within which the underground chambers would be constructed. Walls would be constructed to a depth to minimise ground water ingress into the excavation, but small pumps would be utilised to manage any ground water that does seep through.

3.3.39 The walls, bases and roofs of the chambers and shallow foundations for above ground structures would be formed by in-situ concrete techniques. Concrete would be pumped or skipped to the chamber. The piled walls would be extended to the CSO drop shaft to allow the connection culvert to be constructed in a similar manner to the chambers.

3.3.40 It is assumed that piles would be used to support the underground chambers, and would be bored reinforced concrete piles. The diameter, depth and spacing would depend on the structure design and ground conditions.

3.3.41 The connection culvert from the overflow weir chamber to the shaft would be constructed as an SCL tunnel, driven from the main shaft site to the overflow weir chamber. The tunnel would be fully within the London Clay formation and hence neither ground treatment nor dewatering would be required.

3.3.42 The existing Ranelagh outfall to the tidal Thames would be intercepted within the new foreshore structure and flow through a flap valve chamber before entering the drop shaft. These chambers would be constructed using secant or sheet piles for temporary support. A new outfall would be constructed on the front of the new river wall to cater for the event that the main tunnel cannot accept any more flow. Flap valves would be fitted to prevent tidal flow entering the system.

3.3.43 Air management structures comprising an underground air treatment chamber and associated ducts and ventilation columns and the electrical and control kiosks would also be built and commissioned.

Completion of works and site restoration

3.3.44 On completion of the main construction (outlined above) the new river wall would be finished prior to removal of the temporary cofferdam to ensure flood protection.

3.3.45 Once the cofferdam fill is removed, the geotextile layer would be removed and the area of the foreshore where permanent scour protection is required would be excavated by approximately 1.5m by an excavator.

3.3.46 It is assumed for the assessment that permanent scour protection and new outfall apron would consist of loose large stone placed just below foreshore level. The size and type of the stone is 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 works parameter plan (see separate volume of figures – Section 1). This permanent protection would be within the area of the temporary cofferdam.

3.3.47 Once the permanent scour protection is in place, the bed would be reinstated to match the existing river bed conditions as required and the sheet piling forming the temporary cofferdam would then be removed by pulling. Material excavated would be disposed of in accordance with the project's Waste Management procedure.

3.3.48 Once the main elements of construction are completed, the final landscaping works would be undertaken including final treatments and surfaces, planting and installation of street furniture. Final treatments to the river wall would be completed prior to removal of the temporary cofferdam.

3.3.49 Testing and commissioning would also be undertaken once construction is complete. For the purposes of this assessment, completion of the commissioning stage represents the end of construction and the commencement of the operational phase.

Excavated materials and waste

3.3.50 The construction activities described above and in particular the construction of the shaft would generate a large volume of excavated material which would require removal. This is estimated at 99,000 tonnes, the main elements of which would comprise approximately 64,000 tonnes of imported fill (which would require later removal), 16,500 tonnes of made ground, 18,000 tonnes of London Clay, and 500 tonnes of Lambeth group.

3.3.51 In addition, it is estimated that approximately 2,500 tonnes of construction waste would be generated including 2,000 tonnes of imported fill and 350 tonnes of concrete.

3.3.52 Excavated materials and construction wastes would be exported from the site in accordance with the *Transport Strategy* (see Access and movement below).

Access and movement

3.3.53 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 a ‘barge’.

3.3.54 The transport strategy requires that the importation of granular fill for the formation of the temporary working area, and the subsequent removal fill would be by barge. It is also anticipated that the removal of shaft and ‘other’ excavated material would be by barge. The assessment assumes 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.

3.3.55 The highest barge movements (peak barge movements) would occur during cofferdam construction. Peak daily barge numbers, averaged over a one month period, would be three barges per day, equivalent to six barge movements. It is estimated that total barge numbers for this site would be 209, equivalent to 418 barge movements over the construction period. Barge numbers are based upon an assessed barge size of 800T.

3.3.56 Barges would sit on campsheds during periods of low tide and it is assumed that they would be moved by tugs at this site. It is estimated that tugs would be present at this site for approximately 20 minutes when delivering/collecting barges.

3.3.57 The highest lorry movements (peak vehicle movements) at the site would occur during sewer connection works/fit out. The peak daily vehicle numbers at this time, averaged over a one month period, would be 42 HGV lorries, equivalent to 84 movements per day. It is estimated that total vehicle numbers for this site would be in the order of 5,600 HGV lorries, equivalent to 11,200 movements over the construction period.

3.3.58 The site would be serviced via a new access off the A3212 – Chelsea Embankment which forms part of the Transport for London Route Network (TLRN). The extent of the construction site would encompass part of the eastbound lane of Chelsea Embankment roadway when the utility diversions are being carried out and the overflow weir chamber is being constructed. As the lanes along this road are quite wide, two-way traffic flow would be maintained during the partial lane closure.

3.3.59 The pedestrian footpath and Thames Path running along the river embankment would be diverted to the northern footpath of Chelsea Embankment utilising existing crossing facilities at the western end of the diversion and a temporary signalised crossing at the eastern end of the diversion. Appropriate diversion signage would be deployed.

3.3.60 A *Traffic management plan* would be developed for the site, produced, coordinated and implemented by the contractor. This is requirement of the *CoCP*.

3.3.61 A *Draft Project Framework Travel Plan* has also 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 developed the project would divert the majority of current CSO discharges via the CSO shaft and connection tunnel to the main tunnel, and then via the Lee Tunnel for treatment at Beckton Sewage Treatment Works. The number of CSO discharges would be reduced from 26 spill events per typical year to approximately twice in a typical year at an average rate of 19,000m^3 per year.

3.4.5 It would, additionally, provide control to the northern Low Level Sewer No.1. By diverting the flow from the Low Level Sewer No. 1 at Chelsea Embankment Foreshore, Victoria Embankment Foreshore and Blackfriars Bridge Foreshore, the flows from ten other CSOs along the north bank of the river would be controlled. This avoids the need for additional sites at or near the ten CSOs from Church Street in Chelsea to Essex Street in the City of London.

Operational structures

3.4.6 For the purposes of the application for development consent (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 the proposed schedule of works description in 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).

3.4.7 The heights of the main ventilation columns and the dimensions of other above and below ground structures 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 and other structures where this is considered helpful to the reader.

3.4.8 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.

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

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

Shaft

3.4.11 The location, diameter and depth of the shaft are described in Section 3.2. Ground level access covers on the shaft would be used for access/egress by maintenance vehicles and personnel during planned inspections of the connection tunnel and CSO drop shaft. Those access covers to the shaft which are only used for the ten yearly inspections (see below) would generally be buried under surface landscape treatments and not be visible.

Chambers and culverts

3.4.12 The overflow weir chamber and interception/valve chambers would be below ground. There would be covers on top of the chambers to allow access and inspection. Two connection culverts are required one each to connect the overflow weir chamber and interception chamber to the CSO drop shaft. These would be below ground level and accessible from each end.

Tunnel

3.4.13 The CSO drop shaft would be connected to the main tunnel under the river by a connection tunnel, which would be approximately 70m long. There would be a horizontal de-aeration chamber in the tunnel with a 4.8m internal diameter.

River wall

3.4.14 A new river wall at current flood defence levels would be provided around the public space on top of the foreshore structure. The inter-tidal terraces between the embankment and the foreshore structure would sit below the defence level and would occasionally be flooded

Air management structures

3.4.15 The heights and locations of above ground air management structures, which comprise the ventilation columns, are defined in Section 3.2. In addition to these structures, an underground air treatment chamber would contain an air management filter and would be connected to the ventilation columns. The air treatment chamber would have ground level covers to allow access and inspection.

Electrical and control kiosk

3.4.16 The height and location of the above ground electrical and control kiosk defined in Section 3.2. The electrical and control kiosk would contain gas monitors, electrical and control panels and metering equipment.

Permanent restoration and landscaping

3.4.17 The proposed illustrative landscape plans and design principles in Section 3.2 should be referred to for information on landscaping principles.

3.4.18 The area around the CSO drop shaft would be finished with hardstanding to allow crane access to the covers on top of the shaft. This hardstanding would usually be publicly accessible but Thames Water would retain a right of access over it and would install temporary security fencing when the area is used for access to the below ground structures.

3.4.19 Operational access to the foreshore site would be from Chelsea Embankment and may require a traffic management depending on the plant requirements for the specific task.

3.4.20 The existing pedestrian crossing (refuge) to the east of the ‘Bull Ring’ gates would be reinstated a short distance to the east as part of the overall landscaping scheme.

Typical maintenance regime

3.4.21 A light commercial vehicle 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. Additionally once every ten years, more significant maintenance work would be carried out. This would be carried out in normal working hours. Vehicular requirements for these visits would include two mobile cranes and associated support vehicles and equipment.

3.4.22 Operational personnel access to the Low Level No.1 Sewer overflow weir chamber would be from the north-side footpath adjacent to the chamber and may require traffic management to facilitate this. Access for larger items of equipment or materials would be through a larger access opening at the edge of the eastbound carriageway, which would require traffic management.

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, 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 schedules included in the assessment. A schedule is provided in Vol 13 Appendix N of the resulting development projects for the Chelsea Embankment Foreshore site, a description of what is proposed and assumptions on phasing. Longer term development projects may be included under both base case, where construction precedes 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 Chelsea Embankment Foreshore are listed below. A map showing their location is included in Vol 13 Figure 3.5.1:

a. South Grounds, Royal Hospital, Royal Hospital Road

b. Bullring Gate, South Grounds, Royal Hospital, Royal Hospital Road

c. Chelsea Barracks, Chelsea Bridge Road

d. Royal Hospital, Royal Hospital Road

e. Battersea Power Station

f. Riverlight (Tideway Industrial Estate)

g. Northern Line Extension

3.6 On-site alternatives

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

3.6.2 Vol 13 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 13 Table 3.6.1 Chelsea Embankment Foreshore – on-site alternatives

Item	Alternatives considered	Reason not progressed
Location of the foreshore structure	A location slightly further downstream, in closer proximity to Chelsea Bridge	• This location was originally chosen due to the presence of a safeguarding area for the Crossrail project. However this safeguarding area was moved and the restriction lifted. • Moved further upstream to align with Monument Walk and the Bull Ring to strengthen the setting of the structure.
Location of foreshore structure	Locating all works within Ranelagh Gardens	• At this site, construction would occur within the Lambeth Group which is considered a higher risk environment to construct within. This option would require a longer connection tunnel to the main tunnel and avoiding this option therefore reduces the health and safety risks of constructing the connection tunnel within the Lambeth Group. • Stakeholder concerns over impact of construction on the Grade II registered Ranelagh Gardens
Number of foreshore structures	Two separate foreshore structures, one for the shaft and one for the interception chamber	• Stakeholder concerns over impact of the structures on the historical character of the area and impact on habitat and aquatic ecology.

This page is intentionally blank

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 4: Air quality and odour

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 4: Air quality and odour

List of contents

Page number

List of tables

Page number

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 Chelsea Embankment Foreshore 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. temporary closure of lanes during construction, which can lead to an increase in vehicle emissions through worsened congestion or through vehicles being routed onto other roads (air quality)

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

d. emissions from construction plant (air quality)

e. construction-generated dust (air quality)

f. 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 Chelsea 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 Volume 2 Environmental assessment methodology 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 13 Chelsea Embankment Foreshore Figures). Appendices supporting this site assessment are contained in Vol 13 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 annual lorry movements in any one year at the Chelsea Embankment Foreshore site would occur during the sewer connection works/fitout (Site Year 3 of construction). The average daily number of vehicle movements during the peak month would be approximately 84 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 in any one year is Site Year 3 of construction when there would be four barges a day averaged over a one month period. The emissions associated with the tugs are presented in Vol 13 Appendix B.3.

Construction plant

4.2.8 Construction plant is likely to affect local air quality in two ways: from direct exhaust emissions; and from construction dust 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 Chelsea Embankment Foreshore site in the peak construction year and associated emissions data are presented in Vol 13 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:

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

a. site preparation and establishment

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 Chelsea Embankment Foreshore site there would be approximately 10m^3 of demolition material generated while the amount of material moved during the earthworks would be approximately 21,000 tonnes. The volume of building material used during construction would be approximately 5,700m^3.

Code of Construction Practice

4.2.13 Appropriate dust and emission control measures are included in the *Code of Construction Practice (CoCP)*[ii] (Section 7) in accordance with the London Councils *Best Practice Guidance* (GLA and London Councils, 2006)[1]. Measures incorporated into the *CoCP* (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 Chelsea Embankment Foreshore site.

4.2.14 The effective implementation of the *CoCP* (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 air through two carbon filters 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 each passive filter would be 0.5m^3/s. The maximum air release rate through each filter during a typical year is expected to be about 0.16m^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 columns for about 20 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 any 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] *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 Vol 2 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 13 Table 4.3.1).

Vol 13 Table 4.3.1 Air quality and odour – stakeholder engagement

Organisation	Comment	Response
RB of Kensington and Chelsea, Position Paper, February 2011	RB of Kensington and Chelsea to be provided further information on how sites and their risk will be classified. What risk has been assigned to Chelsea Embankment site?	Risks are classified according to the Institute of Air Quality Management (IAQM) guidance (IAQM, 2012)[2]. The risk assessment for the Chelsea Embankment Foreshore site is presented in paras. 4.5.17-4.5.27.
RB of Kensington and Chelsea, Position Paper, February 2011	Site travel plan should be provided considering how workers will travel to the site, the construction vehicles and how they will be used?	A *Project Framework Travel Plan* for construction workers has been developed and accompanies the application for development consent.
RB of Kensington and Chelsea, April 2011	Agree air quality monitoring locations with RB of Kensington and Chelsea	Locations agreed with RB of Kensington and Chelsea Pollution Strategy Officer.
RB of Kensington and Chelsea, July 2012	Odour complaints in the area should be considered	Sent through by RB of Kensington and Chelsea Projects and Information Officer.
RB of Kensington and Chelsea, phase two consultation, February 2012	Paragraph 4.2.3 states that the peak vehicle movements in year 3 would be 70 lorry movements per day averaged over a month, but paragraph 12.5.25 states an average peak of 92 vehicle movements a day is expected. Again there is a discrepancy on the average daily lorry visits shown in the leaflet for the site. The leaflet states a maximum number of 33. This discrepancy should be clarified. We would like to understand what figures are going to be used as part of the air quality modelling	These discrepancies have been rectified for the *Environmental Statement*. Consistent figures are now presented between Section 4 and Section 12 of this volume which have been used for the air quality modelling. The proportion of diesel vehicles is based on the London fleet compositions produced by the

Organisation	Comment	Response
	exercise and ensure they are consistent with the results of the transport survey. We would also like to know the proportion of diesel vehicles.	Department of Transport.
RB of Kensington and Chelsea, phase two consultation, February 2012	All transport data that feeds into the air quality modelling should be approved by our Transportation team before it is used.	The transport data used for the air quality modelling are included in Vol 13 Appendix B.1.
RB of Kensington and Chelsea, phase two consultation, February 2012	We disagree with the statement in paragraph 4.4.10 about the classification that Ranelagh Gardens and Royal Hospital Gardens as having a low sensitivity to local air quality. It is quite feasible that people will use these parks and sit for more than hour at a time, especially during the summer months.	The Gardens should have been identified as medium sensitivity to air quality. The significance of effects in relation to the hourly objective has been made for these receptors in the *Environmental Statement*.
RB of Kensington and Chelsea, phase two consultation, February 2012	In paragraph 4.5.20 – construction dust, the development has been classified as a medium risk site with regard to dust potential. It is stated that these effects would be reduced by the implementation of measures contained in the *COCP* (Section 7) which would then result in minor adverse effects at residential properties and negligible effects elsewhere. The mitigation measures have not been included in any detail and therefore it is not possible to offer an opinion on whether this is likely to be the case.	Please refer to the *CoCP* (Section 7) which set out the general and site-specific control measures for the Chelsea Embankment Foreshore site.
RB of Kensington and Chelsea, phase two consultation February 2012	It has been identified that some congestion may arise on the roads through lane closures during construction. The transport assessment will need to provide sufficient information to quantify the times when any queuing around junctions may occur and to consider the potential impact of reducing the lane widths on traffic flows. Particular care should be taken in selecting appropriate traffic speeds. The modelling should also take account of other traffic flows in the area including flows generated by other	The local air quality assessment has modelled the traffic impacts in the peak construction year based on information provided in the *Transport Assessment*. Traffic associated with other Thames Water sites and committed developments are included in the traffic data that have been used for the air quality assessment.

Organisation	Comment	Response
	Thames Water sites and committed developments such as those at Lots Road Power Station, Chelsea Barracks, Battersea Power Station and Nine Elms.	
RB of Kensington and Chelsea, phase two consultation, February 2012	Paragraph 4.5.7 – Construction effects includes many conclusions made based on professional judgements. Whilst valuable, we will wait to see the results of the modelling assessments before we decide whether we agree with these. We will be keen to see the results reported as emissions as well as changes in concentrations.	The *Preliminary environmental information report* (PEIR) assessment was undertaken on the basis of professional judgement, as there was insufficient data at that time to assess quantitatively. A full quantitative assessment has now been undertaken which is reported in this *Environmental Statement*. With respect to emissions, it is the effect the emissions have on concentration levels that is the most important factor in relation to receptors. It is also noted that the construction effects are not permanent.
RB of Kensington and Chelsea, Section 48 Response, October 2012	The Council welcomes the reduction in lorry movements as set out in the *Transport Strategy*. The PDEIR states that the overall effect on air quality from construction road traffic, river barges and construction plant is likely to be negligible at all receptors. However, as stated in the response to the phase two consultation, the Council has not reviewed the air quality modelling undertaken so it is not possible to comment on whether we agree with these conclusions.	A full assessment with dispersion modelling has been undertaken for local air quality and the results of this assessment for the Chelsea Embankment Foreshore site are detailed in Section 4.5. The methodologies for the assessment are outlined in Vol 2 Section 4. The assessment concluded that there would be no significant air quality effects in the vicinity of the Chelsea Embankment Foreshore site.
RB of Kensington and Chelsea, Section 48	In paragraphs 4.5.20 of the phase two consultation, the development was classified as a medium risk site with regard to dust potential, which would be reduced to minor adverse through	A full dust assessment has been undertaken using the IAQM guidance. The effects of construction dust are predicted to be

Organisation	Comment	Response
Response, October 2012	mitigation measures set out in the *CoCP*; this is not mentioned in paragraph 12.3.4 of the PDEIR. In this document, it states that construction dust is likely to have a negligible impact at all locations. The reduction in impact is likely to be the result of changes made to the proposals at this site. However, the Council has not yet been able to review the assessment carried out it is not possible to offer an opinion on whether this is the case.	negligible at all receptors in the vicinity of the Chelsea Embankment Foreshore site.
RB of Kensington and Chelsea, Section 48 Response, October 2012	The effects of odour released from the ventilation column, during tunnel operation are predicted to be negligible and mitigation is not required. Detailed results of the odour risk assessment have not yet to be presented to local authorities, which will presumably form part of the *Environmental Statement*. The Council will therefore wait until the results are made available before making further comments.	The odour effects from the vents have been assessed in the *Environmental Statement*.

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 Chelsea 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). With regard to local air quality, the effect of all relevant traffic associated with the 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 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 900m by 500m centred on the Chelsea 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 Chelsea Embankment Foreshore site are fully assessed. A distance of 200m is generally considered sufficient (Highways Agency, 2007)[3] 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 3 of construction) has been used as the year of assessment for construction effects (construction road and river transport, construction plant and construction dust) in which the development case (with Thames Tideway Tunnel project) has been assessed against the base case (without Thames Tideway Tunnel project) to identify likely significant effects of the Thames Tideway Tunnel project.

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 13 Appendix N), there are four other new developments (Royal Hospital, Bull Ring Gate, South Grounds and Chelsea Barracks) identified within the air quality assessment area. Two of these developments are for temporary uses (Christmas tree sales at Bull Ring Gate and Art and Antiques Fair or Show in June/July, South Grounds) in the grounds of the Royal Hospital. These two locations have not been considered as sensitive receptors due to their temporary nature and because there is another selected receptor in the Hospital Grounds (CEFR4) which is closer to the Chelsea Embankment Foreshore site. The other two developments (residential property in the Royal Hospital grounds and residential properties in Chelsea Barracks) have been assessed as sensitive receptors. Trips associated with all four developments are taken into account in the traffic data used for the air quality assessment.

4.3.9 Of the four developments identified, one (Chelsea Barracks) would be under construction at the same time as construction works at the Chelsea Embankment Foreshore site (in the peak construction year). This development is therefore considered in the cumulative construction assessment.

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 Chelsea 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 750m by 750m centred on the Chelsea 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 13 Appendix N), there are four other new developments (Royal Hospital, Bull Ring Gate, South Grounds and Chelsea Barracks) identified within the odour assessment area. Two of these are for temporary uses (Christmas tree sales at Bull Ring Gate and Art and Antiques Fair or Show in June/July, South Grounds) in the grounds of the Royal Hospital. These two locations have not been considered as sensitive receptors due to their temporary nature and because there is another selected receptor in the Hospital grounds (CEFR4) which is closer to the Chelsea Embankment Foreshore site. The other two developments (residential property in the Royal Hospital grounds and residential properties in Chelsea Barracks) have been assessed as sensitive receptors. Due to the nature of the developments, there are no cumulative operational odour effects to assess.

Assumptions and limitations

Assumptions

Construction

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

4.3.16 The site specific assumptions in terms of model inputs for the local air quality dispersion modelling are set out in Vol 13 Appendix B.1.

Operation

4.3.17 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.

4.3.18 Odour dispersion modelling only includes emissions from the ventilation structure and does not take account of background concentrations due to other sources. Background odour concentrations in the area are assumed to be low as there have been only two complaints in the surrounding area over recent years (see para. 4.4.11) and seasonal spot measurements of hydrogen sulphide (H_2S) carried out in 2011/12 indicate that concentrations are typical of urban areas (Michigan Environmental Science Board, 2000)[4].

4.3.19 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 identified parameter plan (see Site parameter plan, separate volume of figures – Section 1), the impact would not be worse than that reported in Section 4.6.

Limitations

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

Construction

4.3.21 As there are no suitable PM_{10} monitoring sites located within the vicinity of the Chelsea Embankment Foreshore site, it has not been possible to verify PM_{10} modelling results[iii]. The adjustment factor derived for NO_X (from a comparison of modelled and monitored NO_X data) has therefore been applied to the PM_{10} modelling results.

Operation

4.3.22 There are no additional 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. Future 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 (UK Government, 1995)[5], 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 is one continuous monitoring station and five diffusion tubes which collect data pertinent to the Chelsea Embankment Foreshore site and associated construction traffic routes operated by RB of Kensington and

[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.

Chelsea and one diffusion tube operated by London Borough (LB) of Wandsworth. The location of these is shown in Vol 13 Figure 4.4.1 (see separate volume of figures). Monitoring data for these sites for the period 2007-2011 are contained in Vol 13 Table 4.4.1. There are no PM10 monitoring sites within 1.8km of the Chelsea Embankment Foreshore site.

Vol 13 Table 4.4.1 Air quality – measured NO_2 concentrations

Monitoring site	Site type	Annual mean (µg/m^3)					Number of exceedances of hourly standard				
		2011	2010	2009	2008	2007	2011	2010	2009	2008	2007
Continuous monitoring site											
Kings Road Chelsea (KC4)	Roadside	**91**	**87**	**93**	**93**	**91**	**76**	**43**	**72**	**122**	**76**
Diffusion tube monitoring sites											
Dovehouse Street (KC34)	Urban centre	**43**	**45**	**47**	**46**	**48**	NM				
Chelsea Physic Gardens 1 (Gate) (KC50)	Roadside	**56**	**58**	**59**	**53**	**56**	NM				
Chelsea Physic Gardens 2 (Met Station) (KC51)	Urban background	33	37	37	36	38	NM				
Chelsea Old Town Hall (KC56)	Roadside	**84**	**81**	**82**	**88**	**89**	NM				
Newton Preparatory School (W3)	Roadside	**63**	**53**	**59**	**67**	**64**	NM				

Note: NM indicates not measured. Emboldened figures indicate an exceedance of the objective / limit value which is 40µg/m^3 for the annual mean and 200µg/m^3 for the hourly mean which can be exceeded 18 times per year. Codes in brackets represent monitoring site identifiers used in Vol 13 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 was exceeded at both roadside and urban centre sites over the five years, but not at the background site at Chelsea Physic Gardens 2 (Met Station). The hourly mean NO_2 objective was exceeded in all five years at the Kings Road Chelsea roadside site.

4.4.6 As a result of previous exceedances of air quality objectives, the Royal Borough (RB) of Kensington and Chelsea has declared the whole borough an AQMA for both NO_2 and PM_{10}.

4.4.7 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 Chelsea Embankment Foreshore site. This monitoring comprises six diffusion tubes based at the locations identified in Vol 13 Table 4.4.2. 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 a continuous monitoring site in Putney (site PEFM4 – see Vol 7); for additional precision, a triplicate site was established at one of the monitoring sites (CEFM2); otherwise all the monitoring locations have single tubes.

Vol 13 Table 4.4.2 Air quality – additional monitoring locations

Monitoring site	Grid reference	Site type	2010 NO_2 annual mean ($\mu g/m^3$)
Embankment Gardens (CEFM1)	527948, 177783	Roadside	**71.0**
A3212 Chelsea Embankment (CEFM2)	528103, 177821	Kerbside	**85.6**
A3216 Chelsea Bridge Road (CEFM3)	528544, 177979	Roadside	**110.2**
A3212 Grosvenor Road (CEFM4)	528838, 177947	Roadside	**82.5**
A3216 Queenstown Road (CEFM5)	528600, 177653	Roadside	**75.2**
B313 Ebury Bridge Road (CEFM6)	528438, 178081	Kerbside	**97.8**

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

4.4.8 All six 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 central London.

4.4.9 This monitoring has been used in conjunction with existing RB of Kensington and Chelsea monitoring to define the baseline situation and also to provide input to model verification.

4.4.10 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 (Defra, 2012)[6]. 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 Chelsea Embankment Foreshore site are given in Vol 13 Table 4.4.3 for 2010 (baseline year).

Vol 13 Table 4.4.3 Air quality – 2010 background pollutant concentrations

Pollutant*	2010
NO_2 (µg/m^3)	41.1
PM_{10} (µg/m^3)	22.9

** Annual mean for 1km grid square centred on 528500, 177500.*

Odour

4.4.11 The RB of Kensington and Chelsea has received several odour complaints for the local area over recent years but none were within 200m of the site and their cause was not clear (RB of Kensington and Chelsea, 2012) [7]. The Thames Water complaints database was reviewed for an area within a 500m radius of the zone identified for the proposed ventilation column. Over the last five years (2007–2011) two complaints were received relating to odour.

4.4.12 Data gathering for the EIA included spot measurements of H_2S made near the site, the results of which are summarised in Vol 13 Table 4.4.4 and the monitoring locations shown in Vol 13 Figure 4.4.2 (see separate volume of figures). The highest concentrations, up to 30.0µg/m^3, were measured on 12 October 2011 during westerly wind conditions. These levels are typical of urban areas4 when a faint odour may be detectable on occasions (WHO, 2000)[8] [iv].

[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 13 Table 4.4.4 Odour – measured H_2S concentrations

Location	Grid reference	Date	Time	H_2S concentration ($\mu g/m^3$)
Chelsea Embankment (CEFS1)	528220, 177836	28/08/11	11:16:39	5.5
		28/08/11	11:17:09	0.0
		12/10/11	14:25:11	30.0
		12/10/11	14:26:28	6.2
		30/10/11	10:47:31	7.1
		30/10/11	10:48:00	4.9
		04/01/12	11:23:42	6.5
		04/01/12	11:26:03	6.2
		04/01/12	11:27:29	7.4
		20/02/12	16:46:08	7.1
		20/02/12	16:47:14	6.3
Chelsea Embankment (CEFS2)	528278, 177856	28/08/11	11:18:45	0.0
		28/08/11	11:19:15	0.0
		12/10/11	14:28:18	7.9
		12/10/11	14:29:16	6.6
		30/10/11	10:48:59	0.0
		30/10/11	10:49:27	4.6
		04/01/12	11:31:27	8.4
		04/01/12	11:33:03	9.0
		20/02/12	16:48:40	5.9
		20/02/12	16:50:16	5.2
Chelsea Embankment (CEFS3)	528366, 177877	28/08/11	11:21:02	0.0
		28/08/11	11:21:37	5.4
		12/10/11	14:31:04	10.4
		12/10/11	14:32:08	10.4
		30/10/11	10:50:40	0.0
		30/10/11	10:51:07	0.0
		04/01/12	11:35:53	8.7
		04/01/12	11:37:05	6.5
		20/02/12	16:51:43	5.3
		20/02/12	16:53:10	5.3

Location	Grid reference	Date	Time	H_2S concentration ($\mu g/m^3$)
Chelsea Embankment (CEFS4)	528501, 177925	28/08/11	11:23:32	0.0
		28/08/11	11:24:03	0.0
		12/10/11	14:34:40	5.8
		12/10/11	14:35:44	12.0
		30/10/11	10:52:09	5.0
		30/10/11	10:52:37	4.3
		04/01/12	11:39:56	28.1
		04/01/12	11:41:03	8.0
		20/02/12	16:55:32	4.8
		20/02/12	16:56:36	4.5
Meteorological conditions: 28/08/11 partially cloudy, rain on previous day. 12/10/11 W wind up to 1.3m/s, partially cloudy. 30/10/11 SW wind at 0.5m/s, cloudy, last rain on 27/10/11 04/01/12 W wind up to 7.5m/s, partially cloudy. 20/02/12 W wind up to 6.0m/s, partially cloudy.				

Receptors

4.4.13 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 13 Figure 4.4.3 (see separate volume of figures) and the table below (Vol 13 Table 4.4.5) for the Chelsea 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.

4.4.14 It is noted that Vol 13 Table 4.4.5 includes receptors associated with the proposed developments at Royal Hospital (residential property) and Chelsea Barracks (see site development schedule in Vol 13 Appendix N) for consideration in the air quality and odour assessments.

Vol 13 Table 4.4.5 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 - Embankment Gardens (CEFR3)	100m northwest	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Residential - Chelsea Gardens (CEFR9)	115m northeast	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Residential - Chelsea Barracks (CEFR10)*	205m northeast	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Residential - Royal Hospital property (CEFR2)*	220m northwest	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Hospital - Lister Hospital (CEFR8)	110m northeast	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Hospital - Royal Chelsea Hospital (CEFR1)	250m northwest	High (exposure relevant for annual mean, daily mean and hourly mean standards)	Medium	High
Recreational - River Thames (CEFR5)	Adjacent	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 - Thames Path (CEFR6)	Adjacent	Low (exposure is relevant for the hourly mean standard only)	Low	Low
Recreational - Ranelagh Gardens (CEFR7)	Adjacent	Medium (exposure is relevant for the hourly mean standard only)	Medium	Medium
Recreational - Royal Hospital Gardens (CEFR4)	12m north	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

4.4.15 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.

4.4.16 For road vehicles, there would be an increase in the penetration of new Euro emissions standards (Defra, 2012)[9] to the London vehicle fleet between the current situation and Site Year 3 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.

4.4.17 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) (Defra, 2009)[10]. Background pollutant concentrations for Site Year 3 of construction (peak construction year) used in the modelling are shown in Vol 13 Table 4.4.6.

4.4.18 The background NO_2 concentration has been derived from the 2010 annual mean measured at the urban background site in Chelsea Physic Gardens (KC51) while the background PM_{10} concentration has been taken from the Defra mapped background data6. The Defra map has been used for the PM_{10} background, as there are no suitable PM_{10} monitors within the relevant assessment area.

Vol 13 Table 4.4.6 Air quality – annual mean background pollutant concentrations

Pollutant	Baseline (2010)	Peak construction year (Site Year 3 of construction)
NO_2 (µg/m^3)*	37.0	27.0
PM_{10} (µg/m^3)**	22.6	20.6

** Derived from KC51 2010 monitoring. **Taken from Defra mapped 1km grid square centred on 528500, 177500. Adjusted to ensure local A roads are not double counted.*

4.4.19 As indicated in para. 4.3.8, the base case in Site Year 3 of construction takes into account the proposed developments in the Royal Hospital Grounds and at Chelsea Barracks, including them as receptor locations in the air quality assessment. These are included in the receptor list provided in Vol 13 Table 4.4.5.

Operational base case

4.4.20 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.

4.4.21 As indicated in para. 4.4.14, the base case for the odour assessment takes into account the new developments in the Royal Hospital Grounds and at Chelsea Barracks, including them as receptor locations in the air quality assessment. These developments are included in the receptor list provided in Vol 13 Table 4.4.5.

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 3 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 13 Table 4.4.5).

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. A model verification exercise has been undertaken at the Chelsea Embankment Foreshore site in line with the Defra guidance LAQM.TG(09). This checks the model performance against measured concentrations, using the six monitoring sites established for this assessment (CEFM1 – CEFM6, see Vol 13 Table 4.4.2) and one of the local authority monitoring sites (KC50). Further details regarding the verification process are included in Vol 13 Appendix B.1. The model adjustment factor derived from the verification process was applied to all model results for both NO_2 and PM_{10}.

4.5.3 The model inputs for the local air quality assessment for the Chelsea Embankment Foreshore site are also detailed in Vol 13 Appendix B (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

4.5.4 Predicted annual mean NO_2 concentrations for the modelled scenarios are shown in Vol 13 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 13 Figures 4.5.1-4.5.3, 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 13 Figure 4.5.4 (see separate volume of figures).

4.5.5 The modelled concentrations in Vol 13 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 increases over the base case at the modelled receptors due to the construction works.

4.5.6 Exceedances of the annual mean objective / limit value (40µg/m^3) are predicted for all receptors in all scenarios. In line with LAQM.TG(09), modelled annual mean concentrations in the peak construction year above 60µg/m^3 indicate exceedances of the hourly NO_2 air quality objective / limit value. This is considered likely at Chelsea Gardens (CEFR9), Lister Hospital (CEFR8) and Thames Path (CEFR6) in both the base case and development case.

Vol 13 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					
Embankment Gardens residential (CEFR3)	**84.4**	**59.6**	**59.7**	0.0	Negligible
Chelsea Gardens residential (CEFR9)	**89.8**	**67.4**	**67.4**	0.0	Negligible
Chelsea Barracks residential (CEFR10)*	**78.5**	**58.0**	**58.0**	0.0	Negligible
Royal Hospital residential	**50.4**	35.9	35.9	0.0	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		
(CEFR2)*					
Lister Hospital (CEFR8)	**92.7**	**69.7**	**69.7**	0.0	Negligible
Royal Chelsea Hospital (CEFR1)	**54.8**	39.6	39.6	0.0	Negligible
Receptors where the annual mean objective / limit value does not apply					
River Thames (CEFR5)	**59.2**	**41.8**	**42.8**	1.0	Small
Thames Path (CEFR6)	**104.0**	**73.8**	**74.4**	0.7	Small
Ranelagh Gardens (CEFR7)	**71.7**	**51.6**	**51.9**	0.3	Negligible
Royal Hospital Gardens (CEFR4)	**61.2**	**43.1**	**43.3**	0.2	Negligible

*Note: Emboldened figures indicate an exceedance of the criteria which is 40µg/m^3 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.*

4.5.7 The highest predicted increase in annual mean concentration as a result of the construction works at the Chelsea Embankment Foreshore site is 1.0µg/m^3 which is predicted at the River Thames receptor (CEFR5). However, the annual mean objective / limit value (40µg/m^3) does not apply here. There are no increases at receptors of relevant exposure to the annual mean concentration. The impacts are therefore described as negligible magnitude according to the criteria detailed in Vol 2 Section 4.

4.5.8 The significance of the effect at all the residential properties and the Lister Hospital (CEFR8) and Royal Chelsea Hospital (CEFR1), which have a high sensitivity to local air quality, is **negligible** (according to the criteria detailed in Vol 2 Section 4). At the non-residential receptors, which have a low sensitivity to local air quality, the significance of the effect would also be **negligible**, except at the Thames Path receptor (CEFR6), where the significance of the effect would be **minor adverse**, as the magnitude of impact is small and the hourly objective / limit value is predicted to be exceeded.

PM_{10} concentrations

4.5.9 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 13 Table 4.5.2. This table details the forecast PM_{10} concentrations at specific sensitive receptors. Additionally, contour plots are provided (Vol 13 Figures 4.5.5-4.5.7, 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 13 Figure 4.5.8 (separate volume of figures).

4.5.10 The modelled concentrations in Vol 13 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 very small increases over the base case at the modelled receptors due to construction activities at the Chelsea Embankment Foreshore site.

Vol 13 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					
Embankment Gardens residential (CEFR3)	31.9	27.9	27.9	0.0	Negligible
Chelsea Gardens residential (CEFR9)	32.8	27.8	27.8	0.0	Negligible
Chelsea Barracks residential (CEFR10)*	30.0	25.9	25.9	0.0	Negligible
Royal Hospital residential (CEFR2)*	24.6	22.1	22.1	0.0	Negligible

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		
Lister Hospital (CEFR8)	33.5	28.1	28.1	0.0	Negligible
Royal Chelsea Hospital (CEFR1)	25.4	22.7	22.7	0.0	Negligible
Receptors where the annual mean objective / limit value does not apply					
River Thames (CEFR5)	26.1	23.4	23.6	0.2	Negligible
Thames Path (CEFR6)	36.9	31.8	32.0	0.2	Negligible
Ranelagh Gardens (CEFR7)	28.6	25.1	25.1	0.1	Negligible
Royal Hospital Gardens (CEFR4)	26.5	23.7	23.7	0.0	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.*

4.5.11 The largest predicted increase in the annual mean concentration as a result of construction at the Chelsea Embankment Foreshore site is 0.2µg/m^3, predicted at the River Thames receptor (CEFR5) and the Thames Path receptor (CEFR6). There are no increases at receptors of relevant exposure to the annual mean concentration. The impacts are therefore described as negligible magnitude according to the criteria detailed in Vol 2 Section 4.

4.5.12 With no exceedances of the annual mean PM_{10} standard (40µg/m^3), the significance of the effects is **negligible**.

4.5.13 With regard to the daily mean PM_{10} concentrations, Vol 13 Table 4.5.3 shows the predicted number exceedances of the daily PM_{10} standard (50µg/m^3) for each modelled scenario. The objective / limit value allows no more than 35 exceedances in a year.

4.5.14 The results in Vol 13 Table 4.5.3 show that the number of daily exceedances of PM10 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. The predicted results for the development case show a maximum increase of one day per year with concentrations above 50µg/m3 compared with the base case at the modelled receptors due to construction works at the Chelsea Embankment Foreshore site.

4.5.15 At all other receptors, the significance of the effects would be **negligible**.

Vol 13 Table 4.5.3 Air quality - predicted 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					
Embankment Gardens residential (CEFR3)	35	20	20	0	Negligible
Chelsea Gardens residential (CEFR9)	**39**	20	20	0	Negligible
Chelsea Barracks residential (CEFR10)*	28	15	15	0	Negligible
Royal Hospital residential (CEFR2)*	11	6	6	0	Negligible
Lister Hospital (CEFR8)	**42**	21	21	0	Negligible
Royal Chelsea Hospital (CEFR1)	13	8	8	0	Negligible
Receptors where the objective / limit value does not apply					
River Thames (CEFR5)	15	9	9	0	Negligible
Thames Path (CEFR6)	**60**	35	35	1	Small
Ranelagh Gardens (CEFR7)	23	13	13	0	Negligible
Royal Hospital Gardens (CEFR4)	16	9	10	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

4.5.16 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 13 Appendix N), it is possible that as a result of the one year delay, some of the Chelsea Barracks development may be completed and occupied. However, it is not expected that any new receptors would experience different effects to those receptors assessed above, rather it would be a case of the potential for some additional receptors to experience the same or lesser effects (due to their distance from the Chelsea Embankment Foreshore site) than those that have already been identified.

Construction dust

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

4.5.18 Dust sensitive receptors have been identified in the vicinity of the Chelsea Embankment Foreshore site in accordance with the criteria in Vol 2 Section 4, as described in Vol 13 Table 4.4.5. A summary of the approximate numbers of receptors in distance bands from the Chelsea Embankment Foreshore site is detailed in Vol 13 Table 4.5.4.

Vol 13 Table 4.5.4 Air quality - numbers of dust sensitive receptors

Buffer distance (m)	Number of receptors*	Receptor type
<20	fewer than 10	Open space (Royal Hospital Gardens, Ranelagh Gardens)
20-50	fewer than 10	Open space, South Grounds Royal Hospital and Bull Ring Gate
50-100	fewer than 10	Open space
100-350	100-500	Large number of buildings within 350m buffer. Residential, offices, hospitals and open space.

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

4.5.19 In line with the IAQM guidance, 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.

4.5.20 The demolition for the Chelsea 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.

4.5.21 The earthworks have been assessed to be a 'large' dust emission class as the total material to be moved is more than 100,000 tonnes. With the nearest receptor within 20m, the site is assessed to be high for earthworks.

4.5.22 The construction proposed for the Chelsea Embankment Foreshore site has a 'medium' dust emission class. This classification is based on the use of concrete, although the volume of the material used is less than 25,000m^3. The risk category for construction activities is therefore assessed to be high risk.

4.5.23 There would be 50-100m of unpaved haul roads on site, and the number of construction lorries per day would be between 25-100 construction lorries per day, 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.

4.5.24 The risk categories for the four activities are summarised in Vol 13 Table 4.5.5. This summary of these risks does not take into account the measures outlined in the *CoCP* (Section 7).

Vol 13 Table 4.5.5 Air quality - summary of construction dust risks

Source	Dust soiling / PM10 effects
Demolition	Medium risk site
Earthworks	High risk site
Construction	High risk site
Trackout	Medium risk site

Note: without CoCP (Section 7) measures

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

4.5.26 The receptor sensitivity (with respect to construction dust nuisance) is identified as medium for all receptors apart from footpaths and rivers (as identified in Vol 13 Table 4.4.5) and due to the site being surrounded by gardens, the overall sensitivity of the area has been defined as 'medium'. The sensitivity has been elevated to 'high' due to the cumulative construction effects from the Chelsea Barracks development.

4.5.27 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* (Section 7)are applied, the significance of the effect would be reduced to **minor adverse** for receptors within 20m of the Chelsea 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 13 Table 4.5.6.

Vol 13 Table 4.5.6 Air quality - significance of construction dust effects

Receptor	Significance of effect
Embankment Gardens residential (CEFR3)	Negligible
Chelsea Gardens residential (CEFR9)	Negligible
Chelsea Barracks residential (CEFR10)*	Negligible
Royal Hospital property residential (CEFR2)*	Negligible
Lister Hospital (CEFR8)	Negligible
Royal Chelsea Hospital (CEFR1)	Negligible
River Thames (CEFR5)	Minor adverse
Thames Path (CEFR6)	Minor adverse
Ranelagh Gardens (CEFR7)	Minor adverse
Royal Hospital Gardens (CEFR4)	Minor adverse

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

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 Section 4. Vol 13 Table 4.6.1 shows the predicted maximum ground level odour concentrations at the Chelsea 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. In accordance with the odour benchmark set by the Environment Agency, results are presented for the 98^{th} percentile of hourly average concentrations in the year (or the 176^{th} highest hourly concentration in the year) and the number of hours in a year with concentrations above $1.5ou_E/m^3$. Achieving the 98^{th} 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 13 Table 4.6.1 Odour - impacts and magnitude – operation

<table>
<tr><th>Year</th><th colspan="2">Maximum at ground level locations</th><th>Impact magnitude and justification</th></tr>
<tr><td rowspan="2">Typical</td><td>98^{th} percentile (ou_E/m^3)</td><td>0</td><td rowspan="2">Negligible
98^{th} percentile concentration is less than $1ou_E/m^3$</td></tr>
<tr><td>No. of hours > $1.5ou_E/m^3$</td><td>6</td></tr>
</table>

4.6.2 In Vol 13 Table 4.6.1 above, the 98th 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 would occur within 10m of the ventilation column. There would be six hours in the year with odour concentrations greater than $1.5ou_E/m^3$. As such, there could be a detectable odour close to the ventilation columns on the site. Odour concentrations decrease rapidly to below $1.5ou_E/m^3$ within 15m of the vent. Beyond this distance, there would be no detectable odour on an hourly basis. If the vents were positioned at the northern edge of the site, an odour might be detectable at the very edge of Ranelagh Gardens and on Chelsea Embankment. No odour would be detectable at residential properties or the hospital as predicted concentration are well below the detection threshold of $1ou_E/m^3$ at these distances.

4.6.4 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 similar concentrations to the typical use year and occasional detectable odours close to the ventilation column.

4.6.5 With regard to the significance of effects given that the predicted odour concentrations at all locations would not exceed the 98th 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 Of set out in Section 4.3, the Chelsea Barracks development would be under construction at the same time at the Chelsea Embankment Foreshore site. This cumulative effect has been taken into account by increasing the sensitivity of the area to construction dust. The traffic effects from these developments have already been accounted for in the traffic data used for the air quality assessment. Therefore, the effects on air quality would remain as described in Section 4.5 above.

4.7.2 In the event that the programme for the Thames Tideway Tunnel is delayed by approximately one year, some of the Chelsea Barracks 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

4.7.3 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* (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) indicating 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 RB of Kensington and Chelsea prior to commencement of construction at the Chelsea 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 13 Table 4.10.1 Air quality - summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential - Embankment Gardens (CEFR3)	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 - Chelsea Gardens (CEFR9)	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 - Chelsea Barracks (CEFR10)*	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 - Royal Hospital (CEFR2)*	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
Hospital - Lister Hospital (CEFR8)	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
Hospital - Royal Chelsea	Local air quality – effects from construction	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Hospital (CEFR1)	road traffic, tugs for river barges and plant emissions			
	Effects from construction dust	Negligible	None	Negligible
Recreational - Royal Hospital Gardens (CEFR4)	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 (CEFR5)	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 - Thames Path (CEFR6)	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 - Ranelagh Gardens (CEFR7)	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

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

Vol 13 Table 4.10.2 Odour - summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential - Embankment Gardens (CEFR3)	Odour	Negligible	None	Negligible
Residential - Chelsea Gardens (CEFR9)		Negligible	None	Negligible
Residential - Chelsea Barracks (CEFR10)*		Negligible	None	Negligible
Residential - Royal Hospital (CEFR2)*		Negligible	None	Negligible
Hospital - Lister Hospital (CEFR8)		Negligible	None	Negligible
Hospital - Royal Chelsea Hospital (CEFR1)		Negligible	None	Negligible
Recreational - Royal Hospital Gardens (CEFR4)		Negligible	None	Negligible
Recreational - River Thames (CEFR5)		Negligible	None	Negligible
Recreational - Thames Path (CEFR6)		Negligible	None	Negligible
Recreational - Ranelagh Gardens (CEFR7)		Negligible	None	Negligible

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

References

[1] Greater London Authority and London Councils. *Best Practice Guidance: The Control of Dust and Emissions from Construction and Demolition* (November 2006).

[2] Institute of Air Quality Management. *Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance* (January 2012).

[3] Highways Agency, Design Manual for Roads and Bridges, Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 pg D-1 HA207/07 Air Quality, May 2007.

[4] Michigan Environmental Science Board. *Health Effects of Low-Level Hydrogen Sulfide in Ambient Air* (2000).

[5] UK Government. *Environment Act 1995*. Available at: http://www.legislation.gov.uk/ukpga/1995/25/contents. Accessed June 2012.

[6] Defra. *Background Maps.* Available at: http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html. Accessed June 2012.

[7] RB of Kensington and Chelsea. *Personal Communication*, July 2012.

[8] World Health Organization. *Air Quality Guidelines for Europe Second Edition* (2000), Chapter 6.6.

[9] Defra. *Emissions*. Available at: http://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html#eft. Accessed June 2012.

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

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 5: Ecology - aquatic

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 5: Ecology – aquatic

List of contents

Page number

List of plates

Page number

List of tables

Page number

5 Ecology – aquatic

5.1 Introduction

5.1.1 This section presents the findings of the assessment of the likely significant effects on aquatic ecology of the proposed development at the Chelsea 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 reduced discharges of untreated sewage into the tidal reaches of the River Thames (tidal Thames) at this location. There would also be permanent in-river structures at this site. Significant construction and operation 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 Ranelagh 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 addresses the localised effects at a site-specific level for the Ranelagh CSO.

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

a. The installation of sheet piling for a temporary cofferdam on the foreshore for the CSO interception works as shown in the Construction Phases: Phase 1 Site Setup; Construction Phases: Phase 2 Shaft Construction and Tunnelling and Construction Phases: Phase 3 Construction of Other Structures figures (see separate volume of figures – Section 1), and subsequent removal of the temporary cofferdam.

b. Installation of permanent sheet piling to support a realigned river wall.

c. The installation of cofferdams would be accomplished using a jack-up barge or similar equipment.

d. 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 includes silt, peat and other materials. Removal of this 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. All soft material within permanent cofferdams would be removed to ensure sound foundations for permanent construction.

e. 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.

f. The placement and removal of a temporary campshed of approximately 400m^2 on the foreshore outside the cofferdam, suitable for a 800t barge.

g. Regular barge movements and resting on the campshed (up to six barge movements per day at the peak).

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 the *Scour and Accretion Monitoring and Mitigation Plan for Temporary Works in the Foreshore* (Vol 3 Appendix L.4).

Code of Construction Practice

5.2.4 The *Code of Construction Practice (CoCP)*[i] context sets out the standards, procedures, and measures for managing and reducing construction effects. 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 shall be controlled to reduce extent of potential environmental impacts. The design of facilities such as campsheds will consider the need to minimise environmental impacts and should consider the use of lattice structure barge grids where appropriate. In-river structures, including campsheds, will be removed on completion of the works unless otherwise agreed. Where concrete is used, such as campsheds, a membrane is required to protect the underlying riverbed. The method for reinstatement of the temporary works area will be subject to a method statement that will consider requirements for impact 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 levels 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).

---

[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).

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

g. 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).

h. 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).

i. 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 Chelsea Embankment Foreshore.)

j. The contractor shall 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 will 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).

k. Appropriate measures will 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).

l. 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).

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

5.2.6 The *CoCP Part B* at Chelsea Embankment Foreshore commits to the following measure that is of relevance to aquatic ecology:

a. A site specific lighting plan is required. The lighting will address the impact on terrestrial and aquatic ecology and include the use of low level directional lighting where possible whilst meeting safe work requirements. The Lighting plan is to be submitted and agreed with the RB of Kensington and Chelsea (*CoCP Part B* Section 4).

b. Membrane to be installed between 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 as was present prior to the works (*CoCP Part B* Section 11).

c. The site will adhere to standard working hours, except for the connection of the Ranelagh connection tunnel when continuous working hours will be employed. Standard hours on this site are in accordance with the Royal Borough of Kensington and Chelsea's (RBKC) normal working hours of 08:00 to 18:30 Monday to Friday, and 08:00 to 13:30 Saturday. Mobilization is only permitted from 07:30 to 08:00 for staff arrival and briefings, unless otherwise agreed with RBKC (*CoCP Part B* Section 4).

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 Ranelagh CSO would be intercepted as part of the project. Based on the base case (which includes permitted Thames Tideway 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[ii] from the Ranelagh CSO are anticipated to increase to 306,000m^3 per annum over 29 spills/events by 2021. The discharge is predicted to reduce to 19,000m^3 per annum over two discharge events from the Ranelagh CSO once the Thames Tideway Tunnel project is operational. This represents an approximately 94% 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, its effects would be ongoing for its full 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.

[ii] 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.

5.2.11 Improvements in water quality are anticipated both in the local area around the discharge point for the Ranelagh CSO and in the wider tidal Thames. The assessment of operational effects on the tidal Thames as a whole are contained within Vol 3 Section 5.

Environmental design measures

5.2.12 Generic design principles of relevance to aquatic ecology at Chelsea Embankment Foreshore are as follows:

a. Scour protection shall 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 shall seek to avoid or minimise adverse effects on aquatic ecology.

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

c. Lighting shall 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).

d. No lighting shall be proposed in the tidal Thames or directed riverward unless required for navigational purposes.

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

5.2.13 Specific design principles of relevance to aquatic ecology at Chelsea Embankment Foreshore are as follows:

a. The river wall and parapet materials will match the stone and brick of the existing wall.

b. The foreshore structure shall incorporate terraces that provide either inter-tidal habitat (Option A) or floodable public realm which incorporates planting (Option B). The terraces would be enclosed within the parapet walls surrounding the permanent structure. Water would enter the terrace via pipes through the wall at high tide. The design shall aim to minimise maintenance requirements and the risks of litter accumulation. The two options are assessed in Section 5.6.

c. Pre-established planting shall be used in the terraces.

d. Timber fenders are not appropriate to the character of this stretch of the river wall and will not be provided.

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 13 Table 5.3.1.

Vol 13 Table 5.3.1 Aquatic ecology – stakeholder engagement for Chelsea Embankment Foreshore

Organisation	Comment	Response
RB of Kensington and Chelsea (January 2012)	The construction of permanent structures on the foreshore will result in a permanent medium adverse effect through the loss of intertidal habitat. There is limited mitigation available for this loss of habitat.	The footprint of the permanent structure has been minimised as far as possible to accommodate the necessary works therefore further mitigation is not possible (see Section 5.8). Compensation for project-wide permanent loss of foreshore habitat is detailed in Vol 3 Section 5
RB of Kensington and Chelsea (Section 48 response, 2012)	Biodiversity enhancements should be fitted to the river wall along the Chelsea Wharf (from Chelsea Creek to the Chelsea yacht and boat club), thus enhancing the flora and fauna of the intertidal habitat and providing refuge for juvenile fish.	The compensation strategy is described in Vol 3 Section 5 and Vol 3 Appendix C.5
Environment Agency (phase two consultation response – February 2012)	Encroachment onto the foreshore on this site is large. To minimise the encroachment into the river Thames alternatives exist: a) move the whole arrangement nearer to the position of the current CSO outfall b) bring the projected ‘semi circular’ curve closer to the river wall if there is not essential infrastructure on or under it. c) omit the intertidal habitat terraces, which create further encroachment.	The footprint of the permanent structure has been minimised as far as possible to accommodate the necessary works therefore further reductions in size or other forms of mitigation is not possible (see Section 5.8).
	Smelt may use the subtidal gravel areas in this reach for spawning in high flow years. This may need to be considered in the *Environmental Statement*.	Noted and incorporated into this assessment
	The loss of 0.4ha of foreshore and 0.1ha subtidal habitat should be considered in terms of connectivity of habitats and fish movements, this needs to be covered in the *Environmental*	Noted and incorporated into this assessment

Organisation	Comment	Response
	Statement.	
Environment Agency (Section 48 response, 2012)	It is not acceptable to encroach further into the foreshore for the sake of creating intertidal habitat terraces.	The curved structures which connect the permanent structure to the river wall are required in order to minimise the visual impact of the structure at this location which is a highly sensitive townscape receptor and which falls within the setting of Ranelagh Gardens and Chelsea Bridge (see Section 7 and Section 11 of this volume).
	Foreshore habitat loss will need to be compensated for.	The compensation strategy is described in Vol 3 Section 5 and Vol 3 Appendix C.5
	Where there are temporary campsheds, foreshore should be reinstated.	Areas of foreshore used for temporary works would be restored to similar condition and material prior to the works (para. 5.2.6).

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 Chelsea Embankment Foreshore as possible have been selected. Details of the background data sets are provided in Vol 2 Section 5.

5.3.4 Surveys for fish and invertebrates were undertaken during October 2010 at Chelsea Embankment Foreshore, within the site and within a 100m radius of the site boundary. During these surveys the intertidal habitats present were recorded. Surveys for algae were undertaken at each of the foreshore sites, including Chelsea Embankment Foreshore, in May 2012. Surveys for juvenile fish were also undertaken at five sampling locations along the tidal Thames six times between May and September 2011 including Chelsea Embankment Foreshore. Surveys for algae were undertaken at eight sampling locations in May 2012, including at Chelsea 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, i.e. 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 arising from the construction of the proposed development at the Chelsea Embankment foreshore site. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on aquatic ecology receptors within the construction assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

5.3.7 The Riverlight, Tideway Industrial Estate mixed use development, located 1km upstream, would be operational and includes a riverside walkway, which may lead to increased light spill. However given that the distance of the scheme from the Chelsea Embankment Foreshore site no change to the aquatic ecology baseline from this scheme is considered likely. All other developments 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.

5.3.8 In terms of the cumulative assessment, the site development schedule (Vol 13 Appendix N) identifies that at Battersea Power Station, 0.47km downstream of Chelsea Embankment Foreshore there would be development from 2017. Although parts of the inland development would already be operational during Thames Tideway Tunnel project construction, it is possible that works including modifications to the existing jetty and adjustment to the existing river wall would be ongoing during Thames Tideway Tunnel project construction works at Chelsea Embankment Foreshore. This is therefore considered within the cumulative effects section of this assessment. There are no other schemes listed in the site development schedule (Vol 13 Appendix N) which would be under construction and either in-river, adjacent to the river or discharging to the river, thus no other schemes form part of the cumulative assessment.

5.3.9 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

5.3.10 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.

5.3.11 Section 5.6 details the likely significant effects arising from the operation of the proposed development at the Chelsea 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.

5.3.12 As stated in para. 5.3.7 the operation of Riverlight, Tideway Industrial Estate is unlikely to change the aquatic ecology baseline due to the distance from the site. The Battersea Power Station scheme (para. 5.3.7) would be operational at the same time as the Thames Tideway Tunnel project. The Power Station scheme would involve an altered jetty structure, and therefore there is potential for slightly altered patterns of river flow past the site which may alter the aquatic ecology baseline. All other developments 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.

5.3.13 In terms of cumulative schemes, there are no other schemes listed in the site development schedule (Vol 13 Appendix N) under construction which would be in-river, adjacent to the river or discharging to the river. Therefore no cumulative assessment has been undertaken.

5.3.14 As with construction (para. 5.3.9), 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

5.3.15 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

5.3.16 It has been assumed that:

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

b. The campshed would be a concrete structure.

c. Campsheds would be constructed using the method similar to that described in paragraph 5.2.2 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.

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

e. There would be no dredging at the construction site.

f. There would be illumination at this facility and campshed given the need for winter working and occasional 24 hour working.

g. The trigger level for implementing scour protection measures (para. 5.2.12) 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

5.3.17 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 and around the site. 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 marine 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 River Thames is part of the proposed Thames Estuary Marine Conservation Zone (MCZ no. 5) the details of which were submitted to Government in early 2012. If adopted, it will be designated as a national statutory site under the Marine and Coastal Access Act 2009. Species include smelt (*Osmerus eperlanus*), European eel (*Anguilla anguilla*) and tentacled lagoon worm (*Alkmaria romijnii*) (Balanced Seas, 2001) [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 Chelsea Embankment Foreshore falls within the non-statutory River Thames and Tidal Tributaries Site of Importance for Nature Conservation

(Grade III of Metropolitan importance)[iii]. The SINC is designated by the Greater London Authority (GLA) and adopted by all boroughs which border the tidal Thames. It recognises the range and quality of estuarine habitats including mudflat, shingle beach, reedbeds and the river channel itself. The SINC citation notes that over 120 species of fish have been recorded in the Tideway, 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 (*Platichthys 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] and the targets prescribed for this *HAP* are reflected in the RB of Kensington and Chelsea *BAP* (The RB of Kensington and Chelsea, undated)[6]. 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 waters 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 The Chelsea Embankment Foreshore lies toward the downstream limit of the freshwater zone of the river, which means that the fish and invertebrate communities which occur within the river at this location consists of a mixture of more saline-tolerant 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 The intertidal habitat is narrow in this section of the river due to development on either bank. Mud and shingle are exposed at low tide at Chelsea Embankment Foreshore, and there is a small sand beach at Battersea Bridge. The site is located within an area of UK *BAP* priority habitat 'mudflats' (Natural England, undated)[7].

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

5.4.11 There was an area of gravel foreshore exposed at the time of the survey in 2010 (low tide) within the limits of the survey site. The substrate was dominated by pebbles, with some sand, shingle and hard bottom, but there was also a zone with a high proportion of silt. River walls were present on this site. Principal habitats present included sublittoral sands, gravels and pebbles and the river wall.

5.4.12 There was no marginal vegetation and relatively little intertidal habitat.

5.4.13 A summary of habitat types present, and other features of interest recorded during October 2010 survey are presented in Vol 13 Table 5.4.1. The survey area is presented in Vol 13 Figure 5.4.1 (see separate volume of figures).

Vol 13 Table 5.4.1 Aquatic ecology – principal habitat, substrate and other features of interest at Chelsea Embankment Foreshore

UK *BAP* target habitats present and features of interest	Substrate present in intertidal zone (approximate cover)	Substrate present in subtidal samples
Gravel foreshore Sublittoral sand and gravels River wall	Pebbles (50%) Shingle (20%) Sand (15%) Silt (15%)	Sand, gravel, pebbles, hard bottom

Evaluation of habitats for Chelsea 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 that only one seal (unknown species) has been observed in the close vicinity of this site.

Evaluation of marine mammals for Chelsea 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 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 A single day survey was undertaken at Chelsea Embankment Foreshore during October 2010. Full details of the methodology and rationale for the timing of surveys are presented in Vol 2 Section 5. The area covered by the survey is illustrated in Vol 13 Figure 5.4.1 (see separate volume of figures).

5.4.19 Fish are routinely categorised into 'guilds' according to their tolerance to salinity and habitat preference(Elliot and Taylor, 1989[8] Elliot and Hemingway, 2002[9]) 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 moderate fish abundance in the area of Chelsea Embankment Foreshore, with 116 individuals captured in total. The range of species recorded and the number of individuals is presented in Vol 13 Table 5.4.2

Vol 13 Table 5.4.2 Aquatic ecology – results of fish surveys at Chelsea Embankment Foreshore

Common name	Scientific name	Number of individuals Oct 2010	Guild
Common bream	*Abramis brama*	5	Freshwater
Roach	*Rutilus rutilus*	2	Freshwater
Three-spined stickleback	*Gasterosteus aculeatus*	1	Freshwater
Smelt	*Osmerus eperlanus*	73	Diadromous
Common goby	*Pomatoschistus microps*	10	Estuarine resident
Flounder	*Platichthys flesus*	18	Estuarine resident
Dace	*Leuciscus leuciscus*	7	Freshwater

5.4.21 There is relatively high salinity at this mid-tidal Thames location, which is towards the downstream end of the freshwater zone, where salinity is relatively close to the tolerance threshold of freshwater species. However, freshwater dace, common bream and roach are known to be present in the tidal Thames from Teddington to Thamesmead, extending furthest downstream in wetter years. The distribution of salinity- sensitive species may shift seasonally and from year-to-year, depending on fluvial inputs, so that community composition can vary. The low abundance of freshwater species at Chelsea Embankment Foreshore such as roach, bream and dace is explained by the site location.

5.4.22 Smelt is a species listed under Section 41 of the Natural Environment and Rural Communities Act 2006 and is a priority UK *BAP* species. Colclough *et al.* (2002)[10] have identified smelt spawning sites on gravel shores in the tidal Thames, upstream of Battersea. The spawning period is March-April and thereafter smelt drift progressively downstream from spawning sites towards Greenwich. Catches may be expected along the tidal Thames.

Juvenile fish data

5.4.23 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.

5.4.24 Surveys for juvenile fish were undertaken at Chelsea 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 survey was to record juvenile fish migrations through the tidal Thames 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 Chelsea Embankment Foreshore is presented in Vol 13 Table 5.4.3.

Vol 13 Table 5.4.3 Aquatic ecology – results of 2011 juvenile fish surveys at Chelsea Embankment

Common name	Scientific name	Number of individuals					
		Survey					
		1 May	2 late May	3 June	4 July	5 Aug	6 Sept
Flounder	*Platichthys flesus*	10	375	98	3	1	2
Smelt	*Osmerus eperlanus*	0	0	0	0	0	2
Eel	*Anguilla anguilla*	3	2	5	1	1	2
Common bream	*Abramis brama*	0	0	0	3	0	4

Common name	Scientific name	Number of individuals					
		Survey					
		1 May	2 late May	3 June	4 July	5 Aug	6 Sept
Dace	*Leuciscus leuciscus*	2	2	1	0	0	0
Roach	*Rutilus rutilus*	0	0	30	0	0	1
Perch	*Perca fluviatilis*	0	25	3	0	0	0
Goby	*Pomatoschistus* spp.	0	0	38	472	369	470
Sea bass	*Dicentrarchus labrax*	0	0	6	162	149	23
3-spined stickleback	*Gasterosteus aculeatus*	0	0	5	1	0	2
Sand smelt	*Atherina presbyter*	0	0	0	0	2	0

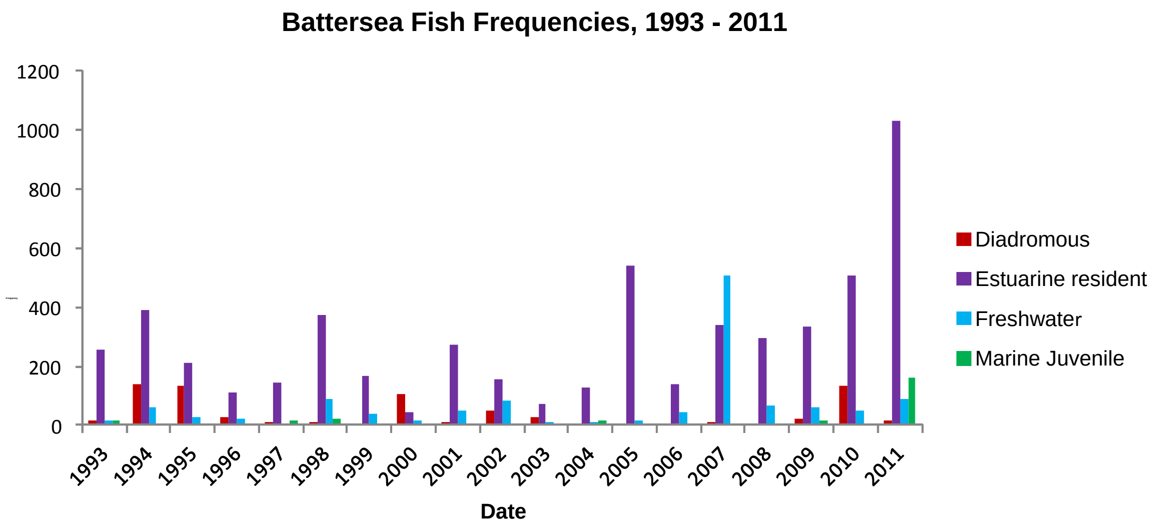
5.4.25 Post-larval flounders dominated the catch from surveys two and three confirming a widespread upper estuary colonisation. Goby numbers increased considerably from survey four onwards, peaking at 472 individuals in survey four. Sea bass (*Dicentrarchus labrax*) numbers also increased in surveys four and five. The survey area results indicate that the area 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. The intertidal and subtidal gravel habitat may offer a spawning substrate for smelt, although it lies downstream of the spawning zone for this species.

Environment Agency (EA) background data

5.4.26 The surveys described in paras. 5.4.18 to 5.4.25 provide up-to-date baseline information directly relevant to fish community composition at Chelsea 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 Chelsea, but records show that this was only surveyed in 1992 and 1993. The EA data for Chelsea indicates that the most well represented species are dace and flounder, roach, bass, bream and eels. Thin-lipped grey mullet (*Liza ramada*) are also recorded. This broadly concurs with the October 2010 baseline surveys.

5.4.27 A more comprehensive survey dataset exists for Battersea, located approximately 2.5km upstream, where EA surveys have been carried out every year from 1993 to 2011. Fifteen fish species have been recorded at Battersea. These show fairly steady catches in trawls but some indication of increasing seine-net catches in recent years. Catches are dominated by estuarine resident fish (Vol 13 Plate 5.4.1) such as common goby, flounder and sand smelt, freshwater species including dace, common bream, perch (*Perca fluviatilis*) 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. This concurs well with the more limited Chelsea Embankment EA data and gives a better view of the overall status of fish populations in the vicinity of the Chelsea Embankment Foreshore site. 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 into the tidal Thames and lower salinity conditions which allowed them survive.

Vol 13 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)[11] recorded 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 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 study area 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 5.6).

5.4.30 The Tideway Fish Risk Model (TFRM) was developed to evaluate DO standards for the tidal Thames (Turnpenny *et al*., 2004)[12] 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 and Vol 3 Appendix C.3. The TFRM considers fish distribution and the effects of low DO 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 'lifestage 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 on hypoxia related fish mortalities in the tidal Thames. This is because the TFRM provides outputs 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/lifestage 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 Chelsea Embankment Foreshore

5.4.33 The fish community at Chelsea Embankment Foreshore site is considered to be of medium-high (metropolitan) importance due to the high numbers of juvenile goby, flounder and sea bass recorded and the fact that the site is a component of the migratory route of all resident tidal Thames fish populations and was relatively good for smelt, a *BAP* species.

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 for invertebrates in October 2010 at Chelsea Embankment foreshore. The area covered by the survey is illustrated in Vol 13 Figure 5.4.1 (see separate volume of figures.). Details of the sampling methods used can be found in Vol 2 Section 5. Two intertidal and two subtidal samples were taken.

5.4.37 The invertebrates collected during the October 2010 field surveys are presented in Vol 13 Table 5.4.4. The Community Conservation Index (CCI) score, (Chadd and Extence, 2004)[13] 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[14] , Shirt, 1987[15]) 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 13 Table 5.4.4 Aquatic ecology – invertebrate fauna sampled at Chelsea Embankment Foreshore October 2010

Taxa	CCI Score	No. of individuals - subtidal samples		No. of individuals - intertidal samples		
Sample numbers		**Air lift 1**	**Air lift 2**	**Kick sample**	**Sweep net 1**	**Sweep net 2**
Theodoxus fluviatilis	3	16	0	3	0	0
Potamopyrgus antipodarum	1	60	1	0	0	4
Radix balthica	1	63	5	2	40	11
Oligochaeta	-	25	150	0	200	120
Glossiphonia complanata	1	0	0	0	1	0
Erpobdella testacea	5	7	0	0	0	0
Crangon crangon	-	1	0	0	0	0
Apocorophium lacustre	8	140	65	0	0	1
Gammarus zaddachi	1	295	36	5	6	0
Number of taxa	-	8	5	3	4	4

5.4.38 The samples on Chelsea Embankment were dominated by a moderately low diversity of common pollution tolerant taxa, such as Oligochaeta, *Erpobdella* sp., *Potamopyrgus antipodarum* and *Radix balthica*, as well as more sensitive groups including *Theodoxus, Gammarus* and *Corophium*.

5.4.39 Higher abundance of the most pollution sensitive groups (*Gammarus*, *Corophium* and *Theodoxus*) was generally confined to the subtidal samples (possibly due to the CSO discharge CS14X).

5.4.40 The intertidal samples were notable for the low abundance of *Gammarus zaddachi*. Although Gammaridae are considered to be one of the most pollution sensitive of the invertebrates sampled in the tidal Thames, they are relatively mobile, can colonise rapidly and can move to avoid pollution. Indeed Gammaridae had relatively high abundance in subtidal areas of Chelsea Embankment Foreshore and they may have migrated to more favourable locations away from CSO discharges.

5.4.41 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 the presence of species such as *G. zaddachi* (a brackish species of shrimp) and *Crangon crangon* (shrimps, typical of estuarine and brackish conditions).

5.4.42 The only species of high nature conservation importance was the mudshrimp *A, lacustre* (CCI 8), a RDB species, which was present in subtidal samples at this 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.

Environment Agency (EA) background data

5.4.43 Chelsea Embankment Foreshore is located approximately 2.8km downstream of the EA sampling site at Battersea, which is the nearest sampling location with recent data (2005-2011). 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 50 taxa were recorded at Battersea over the seven 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 *P. 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 Chelsea 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 at Chelsea Embankment Foreshore are likely to reflect subtle differences in habitat, seasonal and sampling variation.

5.4.46 *A. lacustre*, the notable species of mud shrimp sampled at Chelsea Embankment foreshore, appears to be similarly abundant at Battersea.

5.4.47 In addition to the native *G. zaddachi,* the amphipod *Gammarus tigrinus*, of North American origin, was recorded at Battersea (one individual) in 2006. The species was not sampled at Chelsea Embankment Foreshore sampling in 2010. It is believed that this s*pecies of amp*hipod arrived *in English waters* via ballast water from ships. It lives in fresh and brackish waters and can expand rapidly, outcompeting local amphipods. However, based on available data, it appears to be much less abundant than the native *G. zaddachi* within the tidal Thames.

Water quality and current invertebrate baseline

5.4.48 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.5. 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 Chelsea Embankment Foreshore, are indicative of polluted conditions because they are able to tolerate the low DO conditions and multiply rapidly in the enriched sediments.

5.4.49 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 Chelsea Embankment Foreshore site is located.

5.4.50 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)[16]. This is generally attributed to the fact that relatively few invertebrates are adapted to significant fluctuations in salinity. Other factors such as poor water quality and lack of habitat diversity, particularly in central London, are also likely to contribute.

5.4.51 Redundancy analysis (RDA)[iv] 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

[iv] Redundancy analysis is a form of regression analysis which provides information on the influence of environmental variables on the composition/abundances of the invertebrate assemblages.

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 Chelsea Embankment Foreshore

5.4.52 The Chelsea Embankment Foreshore site is considered to be of medium (borough) importance due to the dominance of the invertebrate community by pollution tolerant species. Only a single species of conservation importance (*A. lacustre*) was recorded, and it is ubiquitous within the tidal Thames.

Algae

5.4.53 Algae occur 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

5.4.54 A single day survey was undertaken in May 2012 at Chelsea Embankment Foreshore. All records are shown in Vol 13 Table 5.4.5.

Vol 13 Table 5.4.5 Aquatic ecology – marine algae sampled at Chelsea Embankment Foreshore

Species	Survey observations	Species presence within the Thames Estuary
Blidingia marginata	Occasionally present.	Widespread and abundant.
Blidingia minima	Dominant at the upper levels of the river wall and occasionally present at the lower levels.	Abundant in tidal Thames.
Cladophora glomerata	Abundant on the lower river wall.	Widespread and abundant in the estuary.
Rhizoclonium riparium	Occasionally present at all but the uppermost level of the river wall.	Common in the estuary.
Ulothrix flacca	Occasionally present at the top of the river wall. Grows epiphytically on other algae.	Not uncommon in the estuary.
Ulva prolifera	Occasionally present on the lower river wall.	Widespread in the estuary.
Vaucheria sp.	Occasionally present at the	The *Vaucheria sp*

Species	Survey observations	Species presence within the Thames Estuary
	bottom of the river wall.	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

5.4.55 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 Chelsea Bridge, with the records all shown in Vol 13 Table 5.4.6.

Vol 13 Table 5.4.6 Aquatic ecology – marine algae sampled at Chelsea Bridge between early 1970s and 1999

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

Water quality and algal communities

5.4.56 Algae depend on the nutrients nitrate and phosphate for growth. 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 (para. 5.1.3); this process is known as eutrophication. Excessive levels of algae can disrupt other elements of the ecosystem by smothering them.

5.4.57 Studies of the pelagic algae (para. 5.4.53) 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)[17]. 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 lead to a gradual process of recovery (Tittley, 2009)[18], although pollution tolerant species such as the green algal species still dominate the community.

Evaluation of algal community for Chelsea Embankment Foreshore

5.4.58 None of the species recorded in Vol 13 Table 5.4.5 and Vol 13 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

5.4.59 Using the baseline set out in paras. 5.4.1 to 5.4.58 the value accorded to each receptor considered in this assessment is set out in Vol 13 Table 5.4.7. The definitions of the receptor values and sensitivities used in this evaluation are set out in Vol 2 Section 2.4.

Vol 13 Table 5.4.7 Aquatic ecology – summary of receptors and their values/sensitivities during construction at Chelsea Embankment Foreshore

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

Construction base case

5.4.60 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 Ranelagh CSO, would continue to spill and no significant changes in habitat quality are anticipated the fish baseline for the Chelsea 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.

5.4.61 The invertebrate analysis demonstrates that more pollution sensitive groups such as shrimps (Gammaridae) are subject to considerable 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 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 Chelsea 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.

5.4.62 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)[19] 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)[20] 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 the current baseline from other developments is considered likely.

Operational base case

5.4.63 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 due to the reduced number of hypoxia events. However as noted in para. 5.4.60 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 Ranelagh 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 Vol 13 Section 14 of this volume). Therefore recovery due to water quality improvements will be suppressed at Chelsea Embankment Foreshore. As a result there are unlikely to be significant 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.

5.4.64 At a river wide scale invertebrate communities will be likely to include more pollution sensitive components as noted in para. 5.4.61, 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.

5.4.65 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.

5.4.66 The Battersea Power Station scheme (para. 5.3.7) would be operational at this stage. The works would involve an altered jetty structure, and therefore there is potential for slightly altered patterns of river flow past the site. However, these aren't considered to be material to this assessment so the base case would be as per the baseline.

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 3250m^2 of temporary landtake from intertidal habitats and 485m^2 from subtidal habitats associated with cofferdam and the campshed. This represents 0.016% of the River Thames and Tidal Tributaries SINC (Grade M). Material from within the temporary cofferdam would be removed and a geotextile membrane used to separate the underlying substrate from the imported granular fill material. The structures would be in place for a total of three years, which is therefore the duration of this temporary landtake.

5.5.3 For those areas around the permanent structure where scour protection is not required (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 similar profile of the surrounding foreshore.

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. At Chelsea Embankment Foreshore this represents a total area of approximately 12205m^2 (of which approximately 4635m^2 would be intertidal habitat and approximately 7570m^2 would be subtidal habitat) outside the temporary cofferdam 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 Chelsea Embankment Foreshore there would be up to six barge movements per day at the peak.

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 is summarised in 5.2.3. It consists of monitoring the structures and implementing mitigation only if trigger levels of scour are reached, as per the *Scour and Accretion Monitoring and Mitigation Plan for Temporary Works in the Foreshore* (Vol 3 Appendix L.4). No deposition currently occurs within the vicinity. With the temporary structure there would be sediment accumulation only immediately upstream and downstream of the temporary works, with occasional sediment accumulation only immediately upstream and downstream of the temporary works.

5.5.8 These predicted areas of sediment and accumulation are illustrated in Vol 13 Section 14 of this volume. Based on the assumption that scour associated with the temporary structures would not be permitted to penetrate beyond the existing substrate layer (para. 5.3.16g) impacts are considered to be low negative, probable and temporary, and impacts of temporary accretion are considered to be negligible, probably and temporary.

Change to flow velocity

5.5.9 The presence of a temporary cofferdam at Chelsea Embankment Foreshore would result in alterations to the hydraulic regime. It would completely obstruct channel flow along the intertidal foreshore for up to four years, and would extend up to approximately 40m into the river, of which 5m would be into the subtidal zone. Hydraulic modelling shows that there would be an increase in maximum velocity of 10% on mean spring tides with normal fluvial flow. There would be areas of low velocity water extending around 100m downstream on the ebb tide and 1200m upstream on the flood tide. The impact on flow velocity is considered to be negligible.

Waterborne noise and vibration

5.5.10 There would be approximately 450m of sheet piling installed for the permanent and temporary cofferdam. It has been assumed that 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* and *Part B* (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 Ranelagh connection tunnel works. As stated in para. 5.2.5i 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 campshed, piling operations, and barge movements/loading are likely to lead to localised increases in suspended sediment and potentially contaminants with the possibility for effects on local and downstream habitats.

5.5.14 During chemical analysis of sediment, a variety of individual PAH compounds were recorded above the Probable Effects Level in at least one sample tested (and in some cases all three). Lead was also above the PEL in three samples (160-380 mg/kg compared with 112 mg/kg). Mercury was also above the PEL in one sample (2.7 compared to 0.7 mg/kg). 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. There would be small quantities of sediment liberated during cofferdam installation; however these would be negligible compared to the 40,000t (or 20,000m^3 assuming an in-situ density of 2t per m^3) of sediment (HR Wallingford, 2006)[21] that are carried on a spring tide.

5.5.15 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. However, the tidal Thames is already a high sediment environment. 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)[22]. 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 The following 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 2.3. 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 approximately 3250m^2 of intertidal habitat, and approximately 485m^2 of subtidal habitat through cofferdam and a campshed, coupled with localised losses due to scour. The habitats affected by temporary landtake are presented in Vol 13 Table 5.4.1 and include gravel foreshore, sublittoral sand and gravels, mudflats and a 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 SINC is small.

5.5.19 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). Habitats within the area occupied by the campshed would be expected to recover more rapidly since the level of disturbance would be lower. 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

5.5.20 The intertidal habitats at Chelsea Embankment Foreshore are dominated by pebbles and shingle with some sand and silt with subtidal habitat comprising pebbles, gravel and sand with a hard bottom (Vol 13 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.

5.5.21 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. However, fine material (silt and sand) is already present in the habitats at this site and accreted material is unlikely to change the relative proportion of the substrates present.

5.5.22 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

5.5.23 There would be disturbance and consolidation of approximately 12205m^2 outside the cofferdam 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

5.5.24 Noise, vibration and lighting have the potential to disturb marine mammals and deter them from passing the site. However, given the low-medium (local) value of the receptor, the low negative impact magnitude, localised extent of any lighting, 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), (see Section 5.2 above) this is considered to be a **negligible** effect.

Fish

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

5.5.25 The site is not considered to offer suitable spawning habitat for smelt, or any other fish species, but 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 would result in a **minor adverse** effect on a medium-high (metropolitan) value receptor.

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

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

Potential disturbance due to illumination of the river

5.5.27 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.

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

5.5.28 Scour is 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. Whilst the site lies downstream of the zone in which smelt and dace are known to spawn, the key habitat for spawning is in the subtidal zone. There is predicted to be accretion in the intertidal zone only, immediately upstream and downstream of the temporary cofferdam, therefore there is no risk of smothering of spawning habitats due to sediment accretion. Effects are thus considered to be **negligible** due to the medium-high (metropolitan) value of the receptor and the negligible magnitude of the impact.

Interference with the migratory movements of fish

5.5.29 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.

5.5.30 In general, encroachment of structures such as cofferdam 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 daily 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.

5.5.31 The river is heavily constricted by the existing river defences at Chelsea 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 the base case. Detail of the study, including the modelling methods, are presented in Vol 3 Section 5.

5.5.32 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

5.5.33 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 key source at Chelsea Embankment foreshore is the driving of sheet piles for the cofferdam. The driving of sheet piles for the cofferdam would be undertaken using techniques that minimise the level of noise and vibration. However the period of piling for the temporary cofferdam would be sufficiently brief (assumed for the purposes of this assessment to be approximately 11 weeks). Removal of the piles 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 6) (see Section 5.2 above).

5.5.34 The site is not considered to support particularly sensitive spawning habitat, but, during surveys undertaken during 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**.

Blanketing of feeding areas for fish and reduction in water column visibility due to suspended sediment

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

5.5.36 Given the length and extent of cofferdam actually in contact with the tidal flow (approximately 200m of temporary cofferdam), 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. 5.5.31 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. Taking account the low negative magnitude of impact, the effects on juvenile fish, a medium-high (metropolitan) value receptor, are considered to be **minor adverse**.

Invertebrates

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

5.5.37 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 low negative magnitude of impact and medium (borough) value of the receptor.

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

5.5.38 The area beneath the temporary cofferdam would also be lost as burrowing and feeding habitat for invertebrates during the entire construction period (four years). 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.

5.5.39 The overall effect is considered to be **negligible**, based on a low negative impact on a medium (borough) value of the receptor, and given the relatively limited loss of a burrowing and feeding resource, and the presence of possible new habitat provided by the temporary structures.

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

5.5.40 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).

Potential disturbance due to illumination of the river

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

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 negligible magnitude of the impact and the medium (borough) importance of the receptor.

Reduction in water quality due to suspended sediment

5.5.44 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.

5.5.45 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.

5.5.46 Effects are thus considered to be **negligible** given the medium (borough) value of the receptor and the low impact magnitude.

Algae

Loss of habitat due to temporary landtake

5.5.47 The construction of temporary cofferdam would mean that any algae would be lost from the area of wall within the structures, as the algae require regular inundation with water in order to survive. However, given the low negative impact, the low-medium (local) value of the receptor and the fact that algae are likely to re-colonise rapidly following removal of the cofferdam, the effect is considered **negligible**.

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

5.5.48 As stated in para. 5.5.35, 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.

5.5.49 Given the length and extent of cofferdam in contact with the tidal flow as described in para. 5.5.36, 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

5.5.50 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 (Section 5.5). As described in para. 5.3.7, the Riverlight development which includes a riverside walkway would already be operational. Other developments in the site development schedule (Vol 13 Appendix N) do not comprise in-river development, development adjacent to the river or development discharging into the river. On this basis, the construction effects on aquatic ecology would not be likely to change with a programme delay of approximately one year.

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 In total there would be approximately 1,230m^2 of landtake from intertidal habitats associated with the cofferdam for the permanent foreshore structures and permanent advancement of the river wall. The impact of a permanent apron, through habitat modification, is considered in para. 5.6.5. The permanent landtake would extend up to approximately 40m into the channel, and would be entirely contained within the intertidal area. This would result in loss of feeding and resting habitat for fish and invertebrates. As noted in para. 5.2.13b there are two options in terms of the final land use of the terraces to be incorporated into the foreshore structure. The overall impact of landtake, taking account of each option, is detailed below.

Option A creation of inter-tidal habitat

5.6.3 Under this option intertidal habitat would be created behind the parapet wall which surrounds the structure. Water would enter the terrace via pipes through the wall. The terrace would support vegetation characteristic of the intertidal zone in this stretch of the river and therefore would have value as habitat. Given that it would be separated from the river by the parapet wall it is considered to have limited value for fish and invertebrates. The terraces would offset some of the permanent landtake although this is not considered sufficient to reduce the magnitude of the impact. Therefore the overall impact from permanent landtake with this option in place is considered to be certain and is considered to have a medium negative impact since, although the scale is smaller than the temporary landtake, it would be permanently lost.

Option B floodable public realm incorporating planting

5.6.4 Under this option, which would not provide any aquatic habitat, landtake would be as per para. 5.6.2. Again the overall impact from permanent landtake with this option in place is considered to be certain and is considered to have a medium negative impact since, although the scale is smaller than the temporary landtake, it would be permanently lost.

Modification of habitat as a result of scour protection measures

5.6.5 The outfall at Chelsea Embankment Foreshore would include an 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 scour protection. A total area of $790m^2$ of intertidal habitat and $260m^2$ of subtidal habitat would be affected by scour protection at the Chelsea Embankment Foreshore site.

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

Change to scour and accretion patterns

5.6.7 The permanent foreshore structures would extend approximately 40m into the channel. Hydraulic modelling has shown that the cofferdam would impact on scour patterns.

5.6.8 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 shall seek to avoid or minimise adverse effects on aquatic ecology.

5.6.9 With the permanent structure in place, no sediment accumulation or deposition has been predicted. These predicted areas of sediment and accumulation are illustrated in Vol 13 Section 14 of this volume.

5.6.10 Impacts on the intertidal and subtidal habitats and associated flora and fauna due to scour 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, unlikely and permanent.

Change to flow velocity

5.6.11 The presence of a permanent foreshore structure would result in alterations to the hydraulic regime. On a mean spring tide, maximum velocities are predicted to increase by 3% on normal fluvial flows. There would be a zone of reduced velocities adjacent to the works and in their wake along the left foreshore. The impact is considered to be negligible.

Increases in dissolved oxygen concentrations in the vicinity of the CSO

5.6.12 In the projected Typical Year, 94% decrease in the volume of discharges (see para. 5.2.8) compared against the base case, 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 relative large magnitude of the Ranelagh CSO, and impacts would be near certain and permanent.

Reduction in sediment nutrient levels

5.6.13 Elevated concentrations of nutrients (phosphate and nitrate) are likely to have accumulated in the sediments in proximity to the existing CSO 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

5.6.14 Sewage derived litter from the CSO can be expected to reduce by approximately 94%, from approximately 77t to 4.6t, 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

5.6.15 The following section describes the effects of these impacts on aquatic ecology receptors based on the significance criteria set out in Vol 2 Section 2.3. Only those impacts which are considered relevant to each receptor are assessed, in accordance with the methodology presented in Vol 2 Section 5.

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

Designated sites and habitats

Permanent loss of intertidal habitats

Option A creation of inter-tidal habitat terraces

5.6.17 There would be permanent landtake of 1230m^2, although 130m^2 of this area would become floodable intertidal terrace. The terrace would be planted with species typical of the intertidal zone in this section of the tidal Thames and would represent vegetated high tide habitat which is uncommon in this stretch of the tidal Thames. However, given that the habitat would be separated from the river by a parapet wall and is therefore unlikely to have value for fish and invertebrates it is considered to have limited value as intertidal habitat.

Option B floodable public realm incorporating planting

5.6.18 Under this option, which would not provide any aquatic habitat there would be permanent landtake from the full area of the footprint (1230m^2)

5.6.19 Under both options there would be a permanent loss of approximately 1050m^2 (790m^2 from intertidal and 260m^2 from subtidal habitat) associated with a permanent apron, that would consist of buried rip rap which would be overlaid with an appropriate substrate material.

5.6.20 The effect under both options is considered to be **moderate adverse** due to the magnitude of the impact (medium negative) and the value of the receptor (medium-high (metropolitan)) although Option A is the most favourable.

Change in intertidal and subtidal habitat due to accretion

5.6.21 The modelling results have predicted no changes in sediment accumulation 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

5.6.22 The predicted increases in DO concentrations and reductions in BOD, ammonia and nutrients within the sediment would result in localised improvements in habitat quality. This may be characterised by increased levels of photosynthesis by microscopic algae within the sediments, termed primary production. These algae form the basis of the estuarine food chain, providing a food source for fish and invertebrates. The gradual breakdown of superficial deposits of organic material and 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 low positive magnitude of impact and the medium-high (metropolitan) value of the receptor, 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

5.6.23 No changes are anticipated on marine mammals as a result of the water quality improvements associated with interception of a single CSO discharge. 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 to be **negligible** based on a low positive impact on a low-medium (local) value receptor.

Fish

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

5.6.24 The site is not considered to offer suitable spawning habitat for fish species, but during surveys undertaken in 2011, it was found to provide nursery habitat for juvenile fish. Loss of 1230m^2 of foreshore habitat is considered to be a medium negative impact. Given that the receptor is medium-high (metropolitan) value, the effect on fish is considered to be **moderate adverse**. Under option A there may be limited use by fish of the intertidal terraces although this is not considered sufficient to reduce the level of effect.

Modification of intertidal feeding and subtidal habitat for fish

5.6.25 In addition to landtake, the permanent structure would have scour protection that would consist of buried rip rap which would be overlaid with an appropriate substrate material. At Chelsea Embankment Foreshore, scour protection would occupy an area of approximately 1050m^2. 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 *et al*, 1991)[23].

5.6.26 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.

5.6.27 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

5.6.28 The modelling results have predicted no changes in sediment accumulation 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.

Interference with migratory movements of fish

5.6.29 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 flounder were significantly affected when comparing the base case and the proposed development. This is likely to be influenced by the structures offering refuges for juvenile fish against adverse currents, and thus offsetting the slightly increased velocities resulting from the presence of permanent structures. The effect is therefore considered to be **negligible**, given the negligible magnitude of impact and the medium-high (metropolitan) value of the receptor.

Reduction in the occurrence of dissolved oxygen related fish mortalities

5.6.30 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 (i.e., less than 10% mortality as a result of hypoxia(Turnpenny *et al*, 2004)[24]), 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).

5.6.31 Interception of the Ranelagh CSO would contribute to tidal Thames-wide improvement, 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 considered to be **moderate beneficial**.

Increase in the distribution of pollution sensitive fish species

5.6.32 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 a significant factor in determining colonisation (Maitland and Hatton-Ellis, 2000)[25]. 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.

5.6.33 EA data and project surveys have indicated no records of rare fish species in the vicinity of Chelsea Embankment foreshore and habitat quality at this site is limited by confinement of the river channel between vertical river walls, which limits the extent of intertidal habitat and lead to increased current velocities. 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

5.6.34 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. 5.6.22, and the invertebrate community becomes more diverse (paras. 5.6.40 to 5.6.45) 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 and subtidal feeding and burrowing habitat for invertebrates due to landtake

5.6.35 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**. The effect would be the same for either option.

Modification of intertidal and subtidal habitats for invertebrates by scour protection

5.6.36 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.

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

5.6.38 The overall effect on invertebrates is considered to be **negligible**, given the low positive magnitude of impact and the medium (borough) value of the receptor.

Change to burrowing and feeding habitat due to accretion

5.6.39 The modelling results have predicted no changes in sediment accumulation as a result of the permanent foreshore structure. 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

5.6.40 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 will occur under the base case due to the Lee Tunnel and STW 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.

5.6.41 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 Palaemonidae may be expected to increase in abundance.

5.6.42 Improvements in water quality could theoretically selectively enhance colonisation by invasive, non-native species. However, studies on mitten crabs, for example, have determined that improvement of water quality does not necessarily lead to an increased distribution (Veilleux and de Lafontaine, 2007)[26].

5.6.43 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

5.6.44 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 a significant 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.

5.6.45 EA data and bespoke project surveys have indicated no records of rare invertebrate species in the vicinity of Chelsea 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

5.6.46 The algae that have previously been found on the river wall at the Chelsea Embankment Foreshore site can be expected to recolonise the new river wall (i.e. the outer wall of the permanent structure) relatively quickly following the completion of construction (within five years). The impact is considered to be medium negative and the value of the receptor is low-medium (local). As none of these species are uncommon the effect is considered to be **negligible**. The effect is considered to be the same for either option.

Changes in algal communities

5.6.47 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.

5.6.48 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

5.6.49 As with construction, a delay to the Thames Tideway Tunnel project of approximately one year would not be likely to materially change the operational assessment findings reported above (Section 5.6). It is already assumed that the Battersea Power Station scheme (para. 5.3.12) which involves an altered jetty structure would be operational at the same time as the Thames Tideway Tunnel project. A programme delay of approximately one year is not anticipated to change the assessment findings reported in Section 5.6.

5.7 Cumulative effects assessment

5.7.1 As described in para. 5.3.12 above, during the construction phase the only scheme within the site development schedule (see Vol 13 Appendix N) that would have an impact on aquatic ecology receptors would be the Battersea Power Station scheme located 0.47km downstream of Chelsea Embankment Foreshore. During construction of this scheme, there would be works on the jetty that would require both capital and maintenance dredging, and construction of a floating pontoon with steel mono piles. Therefore there could be impacts on aquatic ecology receptors through increased waterborne noise and vibration, and increased sediment loads. The extent and duration of piling at Battersea Power Station would be limited, and given that the site is 0.47km from Chelsea Embankment Foreshore, effects on receptors are considered to remain unchanged from the assessment of the Thames Tideway Tunnel project alone.

5.7.2 Therefore the construction effects on aquatic ecology would remain as described in Section 5.5. As described in para. 5.3.13 no operational cumulative assessment has been undertaken.

Sensitivity test for programme delay

5.7.3 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately one year, the cumulative effects assessment described above would remain unchanged. Para. 5.7.1 identifies that the distance between the sites and that the extent and duration of the works would be limited. A programme delay of approximately one year would increase the temporal separation between the Thames Tideway Tunnel project with the Battersea Power Station scheme and thus a programme delay would be unlikely to change the above assessment findings.

5.8 Mitigation and compensation

Mitigation

5.8.1 The approach to mitigation has been informed by the ‘Mitigation and Compensation Hierarchy’ consulted on with the Thames Tideway Tunnel project EA 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.

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

5.8.3 The temporary landtake and temporary blanketing of feeding areas for fish and reduction in water column visibility due to suspended sediment would lead to a moderate adverse effect during piling, reducing to minor adverse for the remainder of the construction period. It is not possible to reduce the level of effect any further. All *CoCP Part A* and *Part B* measures of relevance to aquatic ecology are summarised in Section 5.2.

5.8.4 The permanent loss of intertidal foreshore is considered to be a moderate adverse effect in itself, and on feeding and resting habitat for fish. The footprint of the permanent structure has been minimised as far as possible to accommodate the necessary works.

5.8.5 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

5.8.6 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 offsite 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 mitigation measures are proposed, 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 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 sites along the route of the Thames Tideway Tunnel project to compensate for adverse effects on aquatic ecology. The loss of habitat at Chelsea 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 13 Table 5.10.1 Aquatic ecology – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Designations and habitats	Loss of intertidal habitat due to temporary landtake	Minor adverse	None	Minor adverse
	Disturbance and consolidation of intertidal and subtidal habitat	Minor adverse	None	Minor adverse
	Changes in intertidal and subtidal habitat due to scour and accretion	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
	Potential disturbance due to illumination of river	Negligible	None	Negligible
	Change in feeding, resting and nursery habitat for fish due to scour and accretion.	Negligible	None	Negligible
	Interference with migratory movements of fish	Negligible	None	Negligible
	Effects of waterborne noise and vibration on fish	Minor adverse	None	Minor adverse
	Reduction in water quality due to suspended sediment.	Minor adverse	None	Minor adverse
Invertebrates	Direct mortality of invertebrates due to temporary landtake, sediment disturbance and consolidation	Negligible	None	Negligible
	Loss of feeding/burrowing habitat for invertebrates due to	Negligible	None	Negligible

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

Vol 13 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 designated intertidal habitat (with Option A creation of inter-tidal habitat terraces)	Moderate adverse	Moderate adverse	Compensation for this project-wide permanent loss of foreshore habitat is considered in Vol 3 Section 5.	Moderate adverse (at the site level)	Compensation would be provided through a suite of off-site habitat creation schemes which are described Vol 3 Section 5

Receptor	Effect	Significance of effect		Mitigation	Significance of	Compensation
	Permanent loss of designated intertidal habitat (with Option B floodable public realm incorporating planting)	Moderate adverse	Moderate adverse	Compensation for this project-wide permanent loss of foreshore habitat is considered in Vol 3 Section 5.	Moderate adverse (at the site level)	Compensation would be provided through a suite of off-site habitat creation schemes which are described in 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.	Moderate adverse	Moderate adverse	Compensation would be provided through a suite of off-site habitat creation schemes which are described in Vol 3 Section 5.	Moderate adverse (at the site level)	Compensation would be provided through a suite of off-site habitat creation schemes which are described in Vol 3 Section 5
	Modification of intertidal	Negligible	Negligible	None	Negligible	None

Receptor	Effect	Significance of effect		Mitigation	Significance of	Compensation
	feeding and subtidal habitat for fish					
	Change in feeding, resting and nursery habitat for fish due to accretion	Negligible	Negligible	None	Negligible	None
	Interference with migratory movements of fish	Negligible	Negligible	None	Negligible	None
	Reduction in the occurrence of low 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 for invertebrates due to landtake.	Minor adverse	Minor adverse	Site-specific mitigation measures are being considered as part of an overall mitigation strategy. This is reported in Vol 3 Section 5.	Minor adverse	None
	Modification of intertidal and subtidal habitats for invertebrates by scour protection	Negligible	Negligible	None	Negligible	None
	Change to burrowing and	Negligible	Negligible	None	Negligible	None

Receptor	Effect	Significance of effect		Mitigation	Significance of	Compensation
	feeding habitat due to accretion					
	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 the original river wall	Negligible	Negligible	None	Negligible	None
	Changes in algal communities	Negligible	Negligible	None	Negligible	None

References

[1] National Policy Statement for Waste Water (2012) Department of Environment, Food and Rural Affairs. http://www.defra.gov.uk/publications/files/pb13709-waste-water-nps.pdf last accessed November 2012

[2] Environment Agency. Undated. Pollution Prevention Guide 05: Works in, near or liable to affect water courses

[3] CIRIA. 2001. C532: Control of water pollution from construction sites: Guidance for consultants and contractors

[4] Balanced Seas. *Marine Conservation Zone project – final recommendations* (September 2011).

[5] Thames Estuary Partnership Biodiversity Action Group. *Tidal Thames Habitat Action Plan*. *Thames Estuary Partnership* (undated).

[6] The Royal Borough of Kensington and Chelsea. *Biodiversity Action Plan* (*BAP*). www.rbkc.gov.uk. Accessed 19th January 2012.

[7] Natural England. Nature on the Map (undated). Available at: http://www.natureonthemap.co.uk/map.aspx?m=bap. Last accessed January 2012.

[8] Elliott, M and Taylor, CJL. *The structure and functioning of an estuarine/marine fish community in the Forth estuary, Scotland*. Proc. 21st European Marine Biological Symposium (Gdansk). Polish Academy of Sciences, Institute of Oceanology, Warsaw, Poland, 227-240. (1989)

[9] Elliott, M and Hemingway, KL. *Fishes in Estuaries*. Blackwell Science (2002).

[10] Colclough, S.R, Gray, G, Bark, A & Knights, B. *Fish and fisheries of the tidal Thames: management of the modern resource, research aims and future pressures*. Journal of Fish Biology 61 (Supplement A), 64-73. . (2002).

[11] Wheeler, AC). *The Tidal Thames. The History of a River and its Fishes*. Routledge and Kegan Paul, London. (1979.

[12] Turnpenny, A.W.H., Clough, S.C., Holden, S.D.J., Bridges, M., Bird, H., O'Keeffe, N.J., Johnson, D., Edmonds, M., Hinks, C.. *Thames Tideway Strategy: Experimental Studies on the Dissolved Oxygen Requirements of Fish Consultancy Report no.FCR374/04 to Thames Water Utilities, Ltd*. Fawley Aquatic Research, Fawley Southampton (April, 2004).

[13] Chadd, R and Extence, C. *The conservation of freshwater macroinvertebrate populations: a community based classification scheme*. Aquatic Conserv. Mar. Freshw. Ecosyst. 14: 597-624. (2004).

[14] Bratton, J.H. (editor). *British Red Data Books: 3. Invertebrates other than insects*. JNCC, Peterborough (1991).

[15] Shirt, D.B. (editor). *British Red Data Books: 2 Insects*. Peterborough: Nature Conservancy Council (1987).

[16] Bailey-Brock J.H., Paavo B., Barrett B.M. and Dreyer J.. *Polychaetes associated with a tropical ocean outfall: synthesis of a biomonitoring program off O'ahu Hawai'i*. Pac. Sci. 56: 459-479. (2002).

[17] English Nature. *Thames Estuary European Marine Site: English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats & c.) Regulations 1994*. (2001).

[18] Tittley. *The Marine Algae (Seaweeds) of the Tidal Thames: a Floristic Account*. The London Naturalist. No.88. (2009).

[19] Greater London Authority. *London Plan 2011.* Available at www.london.gov.uk/priorities/planning/londonplan Last accessed May 2012.

[20] Environment Agency National Encroachment Policy for Tidal Rivers and Estuaries (2005)

[21] ‘HR Wallingford. *Thames Estuary 2100, Morphological changes in the Thames Estuary, Technical Note EP6.8, The development of an historical sediment budget. Report for the Environment* (2006)

[22] HR Wallingford (2012) Effect of Thames Tunnel construction activities on morphology of ThamesEstuary Designated Habitats. Technical Note DDM6485-02

[23] Grove, R.S., Nakamura, M., & Sonu, C.J.. *Design and engineering of manufactured habitats for fisheries enhancement in artificial habitats for marine and freshwater fisheries* (eds W. Seaman & L.M. Sprague), pp. 109-152. Academic Press, San Diego, California. (1991).

[24] Turnpenny, A.W.H., Clough, S.C., Holden, S.D.J., Bridges, M., Bird, H., O’Keeffe, N.J., Johnson, D., Edmonds, M., Hinks, C. . See citation above.

[25] Maitland, PS and Hatton-Ellis, TW. *Ecology of the Allis and Twaite Shad*. Conserving Natura 2000 Rivers Ecology Series No. 3. English Nature, Peterborough (2003).

[26] Veilleux, E. and de Lafontaine, Y. *Biological synopsis of the Chinese mitten crab (Eriocheir sinensis)*. Fisheries and Oceans, Canada (2007).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 6: Ecology - terrestrial

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 6: Ecology – terrestrial

List of contents

Page number

List of tables

Page number

This page is intentionally blank

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 Chelsea Embankment Foreshore site.

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

a. vegetation clearance, and subsequent habitat reinstatement and creation

b. construction and site activities

c. barge movements and associated facilities within the foreshore

d. 24 hour working associated with excavation of the Ranelagh connection tunnel (activity below ground, with vehicle and people movements, and lighting above ground).

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 complies 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. The presence of invasive plants listed on Schedule 9 of the Wildlife and Countryside Act 1981 (WCA 1981) as no invasive plants were recorded on or within 10m of the site during site surveys (para. 6.4.20).

c. Designated sites relevant to terrestrial ecology, except Ranelagh Gardens Site of Importance for Nature Conservation (SINC Grade III of Metropolitan importance). This is because other designated sites that lie within 250m of the site are isolated from the site. No likely effects on these sites due to proposed construction works have been identified. However, the baseline includes details of all 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

[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*).

(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.

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 (Volume 13 Chelsea 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 and pruning of London plane *(Platanus x acerifolia)* trees along Chelsea Embankment, and of introduced shrub, native scrub and amenity grassland from the southern boundary of Ranelagh Gardens

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

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

d. use of barges and the associated campshed on the foreshore

e. construction of a permanent operational structure within the foreshore including either intertidal habitat (Option A) or floodable public realm (Option B)

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

Code of Construction Practice

6.2.3 The *Code of Construction Practice* (*CoCP*) is formed of Part A covering measures to be applied at all sites and *Part B* covering site specific measures. 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 works to identify any ecological constraints in addition to those discussed in this *Environmental Statement*.

c. supervision of works by a suitably qualified ecologist where works could affect sensitive ecological receptors

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 restrictions to working hours

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 Site-specific measures contained in the *CoCP* Part B (Section11) for terrestrial ecology are detailed below:

a. planting of replacement trees along Chelsea Embankment and replacement shrub planting within Ranelagh Gardens

b. protection of retained vegetation

c. protection of the river bed during construction and restoration of the foreshore after works.

Embedded environmental measures

6.2.6 The following measures to minimise adverse effects or provide biodiversity enhancements have been incorporated into the scheme design:

a. creation of intertidal habitat with pre-established planting (Option A) or floodable public realm with landscape planting (Option B).

b. planting of semi-mature London plane trees to replace those removed along Chelsea Embankment.

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 terrestrial ecology are presented in Vol 13 Table 6.3.1.

Vol 13 Table 6.3.1 Terrestrial ecology – stakeholder engagement

Organisation	Comment	Response
Royal London Borough of Kensington and Chelsea (phase two consultation response, February 2012)	The construction of permanent structures on the foreshore will result in a permanent medium negative effect through the loss of intertidal habitat. There is limited mitigation available for this loss of habitat.	The significance of effects on terrestrial ecology receptors associated with intertidal habitat (wintering birds) is addressed in Section 6.5. The significance of effects on aquatic ecology receptors associated with intertidal habitat is addressed in the aquatic ecology assessment in Section 5.5 of this volume.
	The impact on the avenue of trees, which runs more or less continuously from World's End to the City of London, would be fairly limited. We note that 2 new trees would be planted on the new area which protrudes into the river and this would help to mitigate tree losses.	Replacement tree planting would be provided for London plane trees and introduced shrub vegetation removed during construction. The effects of habitat loss are assessed in Section 6.5.
	In terms of ecology, it is considered that some aspects to safeguard the Ecology can be conditioned such as the need for repeat ecological surveys if more than one year lapses between the last survey and construction works. However, these elements may be addressed in the *Environmental Statement* and associated management plans.	Pre-start checks of each site are included within the *CoCP* Part B (Section 11) and would form part of *Ecology and Landscape Management Plan* for the Chelsea Embankment Foreshore site (para. 6.2.3).

Organisation	Comment	Response
	Planning conditions should also be used to secure the ecological enhancements used to assess the impact.	

Baseline

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

a. desk study

b. a Phase 1 Habitat Survey was undertaken on 29 October 2010

c. bat triggering (remote recording) bat surveys were undertaken over three nights between 21 and 23 April 2011

d. wintering bird surveys were undertaken on 15 December 2010, and 24 January, 23 February, 24 March, 17 October and 11 November 2011

e. invasive plant surveys were undertaken on 19 October 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 are 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, and 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] are 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 For species, 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 Chelsea 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 will be complete and operational at Site Year 1 of construction and would change the baseline conditions at Site Year 1 of construction due to their proximity to the site:

a. Royal Hospital Chelsea and Masterpiece London, South Grounds of the Royal Hospital, Royal Hospital Road, Chelsea 35m to the north of the Chelsea Embankment Foreshore site (erection of a temporary marquee and associated access and welfare facilities over nine days in June and July).

b. Installation of a site/pay office and storage container for use for Christmas trees sales at Bullring Gate, South Grounds of the Royal Hospital 40m to the north of the proposed development site (temporary lighting for a period of 28 days in any one year).

6.3.9 No change to the base case conditions for terrestrial ecology are considered likely from any other proposed developments listed in Vol 13 Appendix N, due to the isolated location of these developments from the proposed development site within the urban context:

6.3.10 No likely significant cumulative effects have been identified as the developments listed in Vol 13 Appendix N that would be under construction during the construction phase at the Chelsea Embankment Foreshore site are isolated from the proposed development site within the urban context.

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 described below.

Assumptions

6.3.13 It is assumed for the purposes of assessment that the current use of the Chelsea Embankment Foreshore site (described in Vol 13 Section 2) will continue as at present.

Limitations

6.3.14 No site specific limitations for the Chelsea Embankment Foreshore site have been identified.

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 13 Chelsea Embankment Foreshore Figures (see separate volume of 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 13 Figure 6.4.1 (see separate volume of figures):

a. The site is within and adjacent to the River Thames and Tidal Tributaries SINC (Grade M[ii]) and comprises inter-tidal habitat and river channel. This designated site is included in the aquatic ecology assessment in Section 5 of this volume and therefore is not considered further in this assessment.

b. A small area in the north of the proposed development site falls within Ranelagh Gardens SINC (Grade B[iii]), which extends beyond the proposed development site to the north. It comprises amenity grassland, scattered trees and semi-improved grassland. This site is of medium (borough) value.

c. Battersea Park SINC (Grade M) is located approximately 180m south of the site. It comprises woodland, mature trees, scrub, grassland and waterbodies. The site supports a range of woodland bird species and an important assemblage of invertebrates. It is of medium-high (metropolitan) value.

Habitats

6.4.3 Habitats recorded within the survey area during the Phase 1 Habitat Survey are described in Vol 13 Table 6.4.1 and shown on Vol 13 Figure 6.4.2 (see separate volume of figures).

Vol 13 Table 6.4.1 Terrestrial ecology – Phase 1 Habitat Survey

Habitat type / feature of note	Habitat description
Trees	An avenue of scattered trees is present on either side of Chelsea Embankment and within a small area between the road and the foreshore. Scattered trees to the north of the development site within Ranelagh Gardens.
Introduced shrubs	An area of introduced shrub is present in the area of vegetation to be removed from Ranelagh Gardens in the north of the development site.
Dense scrub and introduced shrubs	The area of dense scrub and introduced shrub to the southeast of the proposed development site includes the non-native invasive species Japanese knotweed *(Fallopia japonica).*

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

Habitat type / feature of note	Habitat description
Amenity grassland	There is an area of species-poor amenity grassland within Ranelagh Gardens on site, extending to the north off site. Amenity grassland covers much of the south grounds of the Royal Hospital to the north of the site. A small circle of amenity grassland is present on site at the centre of the mini-roundabout.
River wall	A stretch of river wall lies within the survey area.
Hardstanding	The majority of the site is occupied by hardstanding (the road and adjacent footpaths).
Bare ground	A small area of bare ground lies to the north of the site within Ranelagh Gardens.
Running water and intertidal	A section of the River Thames intertidal zone lies within the survey area. This habitat type is part of the aquatic ecology assessment (Section 5 of this volume).
Mixed - plantation woodland	There is a small area of mixed plantation woodland outside the site to the northwest within the survey area.

6.4.4 Both the river wall and the hardstanding on site are not considered to have biodiversity value as habitats, and therefore are both considered to be of negligible value. Similarly, the amenity grassland is limited in extent and not considered to offer value to the local habitat resource, and therefore is also of negligible value.

6.4.5 The scattered trees on and immediately adjacent to the site include some native species, which are of limited intrinsic value and are not UK or London BAP priority species. However, they are mature and afford a semi-natural ecological resource within an urban setting. Consequently the trees are considered to be of low-medium (local) ecological value.

6.4.6 The area of introduced scrub in the north of the site, within Ranelagh Gardens mainly comprises non-native species and is limited in extent. Therefore, this habitat is considered to be of negligible value.

6.4.7 The area of dense scrub and introduced shrub to the south east of the proposed development site offers some biodiversity value, as areas of dense scrub are limited within the wider urban landscape. However, this habitat includes the non-native invasive species Japanese knotweed (a noxious and invasive plant species) This habitat is considered to be of low (site) value.

6.4.8 The other features of note recorded in Vol 13 Table 6.4.1 are not relevant to the assessment of effects on habitats and are therefore not valued in their own right, however they form part of habitat available within the survey areas for notable species.

Notable species

6.4.9 Survey results are set out in a notable species report, which is included in Vol 13 Appendix D. A summary of the results and an assessment of the value of species associated with the site are set out below.

Bats

6.4.10 The trees, introduced shrub and amenity grassland to the north of the site and the tall ruderal, introduced shrub and dense scrub habitats to the south of the site were identified as having potential for foraging and commuting bats during the Phase 1 Habitat Survey. 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 (bat triggering) surveys were undertaken for bats.

6.4.11 All bats are European Protected Species (EPS) under the Conservation of Habitats and Species Regulations 2010. Seven of the 18 bat species that regularly occur in England are listed as priority species on the UK BAP. Nine bat species are listed on the London BAP including common pipistrelle *(Pipistrellus pipistrellus)*, and soprano pipistrelle *(Pipistrellus pigmaeus)*. These two species were recorded on site. Detailed survey results are provided in Vol 13 Appendix D and on Vol 13 Figure 6.4.3 (see separate volume of figures).

6.4.12 The common pipistrelle bat is the UK's most common bat species, and is a widespread species in Greater London. 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 al., 1995)[4]. Both species are in decline mainly due to habitat loss.

6.4.13 A maximum count of six common pipistrelle bats was recorded in any one night. This activity mainly took place late at night, between midnight and dawn. There was one record of common pipistrelle within one hour of dawn. Given the low numbers of bat passes recorded, it is considered that common pipsitrelle bats occasionally pass through the site while foraging and commuting. The presence of a roost in close proximity to the site is considered unlikely due to the low levels of activity recorded over the three nights. With consideration to the conservation status of the common pipistrelle and that low numbers were recorded, the common pipistrelle population associated with the site is considered to be of low (site) value.

6.4.14 One soprano pipistrelle bat pass was recorded over the three nights of the remote recording survey. This indicates that soprano pipistrelle bats may occasionally pass through the site. It is considered to be unlikely that a roost is present in close proximity to the site. With consideration to the conservation status of soprano pipistrelle and that only one individual was recorded, the soprano pipistrelle population associated with the site is considered to be of low (site) value.

Breeding birds

6.4.15 The scattered trees and introduced shrub on site, and the trees, dense scrub and introduced shrub adjacent to the site to the north and south east were considered to provide a foraging and nesting resource for common breeding bird species. The habitat on and immediately adjacent to the site is limited in extent and it is considered unlikely that these habitats support rare or scarce breeding bird species. Therefore, it was not considered necessary to undertake breeding bird surveys.

6.4.16 Any birds that are likely to nest within vegetation on site are likely to comprise bird species common to the area, such as those recorded in the desk study (Vol 13 Appendix D), including some that are listed as London and UK BAP priority species. However, the number of nests that vegetation on site is considered likely to support is limited. Street trees in the surrounding area are also likely to support nests. The bird resource associated with the site and immediate surrounds is considered to enrich the local biodiversity resource and is therefore of low-medium (local) value.

Wintering birds

6.4.17 The foreshore on and adjacent to the site was considered to have potential to support wintering bird species. Therefore, wintering bird surveys were undertaken. Details of the wintering bird survey results are provided in Vol 13 Appendix D and shown on Vol 13 Figure 6.4.4 (see separate volume of figures).

6.4.18 A total of 11 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 3 (RSPB, 2009)[5] Red or Amber List[v] and/or UK and London BAP as priority species (Vol 13 Table 6.4.2):

a. one individual teal *(Anas crecca)* was recorded foraging on the foreshore on one survey visit in November 2011

b. two gadwall *(Anas strepera)* were recording foraging on the muddy foreshore on one survey visit in March 2011

[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.

c. mallard *(Anas platyrhynchos)* were recorded foraging on the muddy foreshore and along the water's edge as the tide receded

d. black-headed gull *(Larus ridibundus)*, common gull *(Larus canus)*, lesser black-backed gull (*Larus fuscus)* and herring gull *(Larus argentatus)* were recorded resting on the combined sewer overflow (CSO) spillway.

6.4.19 All seven notable waterbird species listed in Vol 13 Table 6.4.2 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]. The populations on site are small relative to their London populations. Therefore, any population of one individual species of conservation concern is considered to be of low-medium (local) value. The remaining four waterbird species that are not considered to be notable would each be of no more than low (site) value.

Vol 13 Table 6.4.2 Terrestrial ecology – wintering birds of nature conservation importance recorded at Chelsea Embankment Foreshore

Common name	Scientific name	Nature conservation designation[vi]	Comments	Value
Gadwall	*Anas strepera*	Amber List	Recorded only in March 2011, when two were present.	Low-medium (local)
Teal	*Anas crecca*	Amber List	Recorded only in November 2011, when one was present.	Low-medium (local)
Mallard	*Anas platyrhynchos*	Amber List	Recorded on five survey visits, with a maximum count of 46 in November 2011 and numbers varying between four and 18 in other months.	Low-medium (local)

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

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

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

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

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

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

Common name	Scientific name	Nature conservation designation[vi]	Comments	Value
Black-headed gull	*Larus ridibundus*	Amber List	Recorded on five survey visits, with a maximum count of 76 in October 2011 and numbers varying between 10 and 58 in the other months.	Low-medium (local)
Common gull	*Larus canus*	Amber List	Recorded on five survey visits, with a maximum count of five in March 2011 and numbers varying between one and three in other months.	Low-medium (local)
Lesser black-backed gull	*Larus fuscus*	Amber List	Recorded on each survey visit, with a maximum count of 11 in October 2011 and numbers varying between one and five 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 a maximum count of 37 in March 2011 and numbers varying between four and 16 in other months.	Low-medium (local)

Invasive plants

6.4.20 No invasive plant species listed on Schedule 9, part II of the Wildlife and Countryside Act 1981 (as amended) were recorded on or within 10m of the proposed development site as shown in Vol 13 Figure 6.4.5 (see separate volume of figures). Japanese knotweed was identified during the Phase 1 Habitat Survey approximately 60m east from the site near Chelsea Bridge, shown as introduced shrub on Vol 13 Figure 6.4.2 (see separate volume of figures), and is unlikely to affect the proposed development site.

Noise, vibration and lighting

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

6.4.22 Current noise levels on site are high with road traffic noise from Chelsea Embankment, Chelsea Bridge and other more distant roads around the site. Levels of vibration around the site are low at present (see Section 9 of this volume).

6.4.23 At night the site is lit by street lighting along Chelsea Embankment Road which runs through the site. Consequently, the baseline light levels at night are moderate to high.

Construction base case

6.4.24 Assuming use of the site continues as at present, the base case conditions during the construction phase on the site would be the same as the current baseline conditions.

6.4.25 Taking into account the development described in para. 6.3.8, for nine days during June and July each year, there would be additional noise and movement of people adjacent to the site due to the presence of the Masterpiece London Art and Antiques Fair. For 28 days prior to Christmas there would be an increase in light levels to the north of the site due to lighting associated with the Christmas tree sales office. Although this would lead to elevated noise and light levels for the duration of these activities this would not change the overall baseline conditions at this site, where noise and light levels are already moderate to high (see paras.6.4.21 to 6.4.23)

6.4.26 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 vibration around the site are considered unlikely to change between the present time and the base case.

6.5 Construction effects assessment

Construction impacts

Site clearance and habitat creation

6.5.1 Five London plane trees would be removed from the avenue of trees along Chelsea Embankment and several others on or adjacent to the site would be pruned as part of site clearance. The trees to be removed are of low-medium (local) value and would be replaced after completion of the proposed construction activities at this site. A further six trees would be removed from the boundary of Ranelagh Gardens. An area of introduced shrub, and amenity grassland would be removed from the northeastern area of the site at the location of the proposed utility diversion works and the ventilation shaft. The removal of this vegetation would result in the temporary loss of a small area of bird nesting habitat. Due to the low levels of bat activity associated with the site, the loss of trees and introduced shrub is not considered likely to affect the forgaging resource for bats. Tree protection measures would be in place to prevent impacts on trees adjacent to the site and replacement planting would be provided on completion of works, as detailed in the *CoCP* Part B (Section 11).

6.5.2 There would be temporary loss of foreshore habitat for wintering birds during construction from the temporary in-river structure and campshed. The foreshore would be reinstated following removal of the campshed and temporary structure at the end of construction. A small area of foreshore would be permanently lost to the structure proposed within the foreshore. Intertidal habitat with pre-established planting (Option A) would provide habitat for resting wintering birds.

Noise, vibration and lighting

6.5.3 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, which could disturb wintering birds. There would also be a slight increase in noise levels in Ranelagh Gardens, which could cause disturbance to nesting birds. Noise and vibration from construction activities are unlikely to affect bats as the majority of the works would be undertaken during the day and bats fly through the site at night.

6.5.4 As vehicle movement along Chelsea Embankment is currently high, the movement of vehicles and site workers on site is unlikely to increase the level of disturbance to birds adjacent to the site.

6.5.5 Construction would require there to be some lighting in the early morning and evening during the winter months to facilitate the extension of 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 and Part B (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.

Barging and associated activity

6.5.6 Although light spill would be minimised through measures in the *CoCP* Part A and Part B (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.

6.5.7 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

Designated sites

6.5.8 A small area of introduced shrub, small trees and amenity grassland would be removed from the Ranelagh Gardens SINC (Grade B), trees would also be subject to pruning works adjacent to the site within Ranelagh Gardens. The habitat would be replaced following completion of works. There would be no loss of ecosystem integrity as a result of the temporary loss of this small area of habitat and this designated site would not be reduced in extent in the long-term. Therefore, the effect on Ranelagh Gardens SINC is probable, **negligible** and not significant.

Habitats

6.5.9 The removal of eleven trees and an area of introduced shrub from site that would be replaced following completion of works is unlikely to have a significant effect on the habitat resource in the long term and the effect is considered to be probable, **negligible** and not significant.

Species

Bats

6.5.10 The loss of foreshore habitat as a result of temporary works within the foreshore (including the installation of a temporary campshed), permanent loss from the permenant structures is considered unlikely to alter the function of the River Thames as a commuting corridor and foraging resource for the small numbers of common pipistrelle and soprano pipsitrelle bats recorded at this site. Therefore, it is considered unlikely that the change in foreshore habitat would result in a decline in bat populations. The effect is considered to be probable, **negligible** and not significant.

6.5.11 The presence of the barge facilities and small changes in light levels are 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 slight changes in the behaviour of soprano and common pipistrelle bats as they would need to commute over or around the barge facilities. The River Thames is a wide corridor at this point, and the function of this habitat is likely to be maintained. It is considered unlikely that changes in light levels and 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.

Breeding birds

6.5.12 Habitat would be reinstated on site after completion of the works, including replacement tree planting of both London Plane and native species. The temporary small change in habitat is considered unlikely to result in perceptible changes in breeding bird populations during construction. Therefore, the effect of temporary habitat loss is considered to be probable, **negligible** and not significant.

6.5.13 Birds adjacent to the site are likely to habituate to small changes in noise levels, and disturbance from lighting would be minimised through measures outlined in the *CoCP*. Some displacement of nesting birds from habitat immediately adjacent to the site, due to small increases in disturbance from lighting and noise, is considered unlikely to adversely affect breeding bird populations as alternative habitat is available in the wider area. 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 effects of disturbance on breeding bird populations are considered to be probable, **negligible** and not significant.

Wintering birds

6.5.14 There would be both a temporary and permanent loss of foraging and resting habitat on the foreshore for wintering birds due to construction activities within the foreshore, the presence of the temporary campshed and the permanent structure. It is considered likely that waterbirds would be displaced to other areas of foreshore adjacent to the site during construction and operation. Following the partial reinstatement of the foreshore, wintering birds are considered likely to return to the site. The provision of the intertidal habitat in Option A would provide a small additional resting resource for wintering birds although the increase is very small relative to the overall resource available to wintering birds. No perceptible change in wintering bird populations associated with the site are anticipated as a result of changes to the foreshore habitat from the works, in view of the availability of alternative inter-tidal habitat in proximity to the site. This would be the same with both Option A and Option B. Therefore, the effect on wintering bird populations at the site is considered to be probable, **negligible** and not significant.

6.5.15 Birds may be displaced from adjacent foreshore habitat due to small changes in disturbance from noise, vibration and the movement and wash of barges. Occasional displacement of birds is expected where sudden noises occur, with small numbers of wintering birds from adjacent intertidal habitat temporarily moving away from the habitat and returning shortly after. This displacement and return of wintering birds has been observed on the foreshore at other sites on the Thames, particularly where people walk along the foreshore. It is considered unlikely that this displacement would result in a perceptible change in wintering bird populations. Therefore, the effect of disturbance on wintering bird populations is considered to be probable, **negligible** and not significant.

6.5.16 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

6.5.17 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 - 6.5.16). This is because there are no developments in the site development schedule (see Vol 13 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. 6.4.24 - 6.4.26.

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

Construction effects

6.7.1 No likely significant cumulative effects on terrestrial ecology have been identified as a result of construction activities from those developments identified in para. 6.3.10. Therefore, the effects on terrestrial ecology would remain as described in Section 6.5.

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 were identified in Section 6.5 at this site, no further mitigation measures are required.

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

6.10.1 This topic assessment has considered both access Options A and B and given that there are not anticipated to be any differences in the assessment outcomes, the assessment summary table reflects both options

Vol 13 Table 6.10.1 Terrestrial ecology – summary of construction assessment effects

Receptor	Effect	Significance	Mitigation	Significance of residual effect
Designated sites				
Ranelagh Gardens SINC	No loss of ecosystem integrity and no long-term reduction in site extent.	Negligible	None	Negligible
Habitats				
Trees, introduced shrubs and amenity grassland	No significant change in habitat on site as trees, introduced shrubs and amenity grassland removed during construction would be reinstated following completion of works.	Negligible	None	Negligible
Notable species				
Bats	No significant change in bat populations as a result of temporary loss and permanent loss of foreshore habitat for commuting and foraging bats.	Negligible	None	Negligible
	No significant changes to bat populations as a result of disturbance from lighting.	Negligible	None	Negligible
Breeding birds	No significant change in breeding bird populations due to temporary habitat loss on site as birds would be displaced to alternative habitat in the surrounding area.	Negligible	None	Negligible
	No significant change in bird populations as result of low levels of disturbance from noise and lighting.	Negligible	None	Negligible
Wintering birds	No significant changes in wintering bird populations due to	Negligible	None	Negligible

Receptor	Effect	Significance	Mitigation	Significance of residual effect
	temporary and permanent loss of foreshore habitat on site due to construction works within the foreshore			
	No significant change in wintering bird populations as a result of low levels of disturbance from noise	Negligible	None	Negligible
	No significant changes in populations of wintering birds due to increases in light levels during construction activities.	Negligible	None	Negligible

References

[1] Department of Environment, Food and Rural Affairs. *National Policy Statement for Waste Water* (2012) . Available at: http://www.defra.gov.uk/publications/files/pb13709-waste-water-nps.pdf. Last accessed November 2012

[2] IEEM. *Guidelines for Ecological Impact Assessment in the United Kingdom* (2006).

[3] London Bat Group. *Greater London Bat Action Plan* (2012). Available online at: http://londonbats.org.uk/lbpsap.htm. Accessed 19 January 2012.

[4] Harris S., Morris, P., Wray, S. & Yalden, D. *A review of British mammals: population estimates and conservation status of British mammals other than cetaceans*. JNCC, Peterborough (1995).

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

[6] London Natural History Society. *London Bird Report 2008*. London Natural History Society (2011).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 7: Historic environment

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 7: Historic environment

List of contents

Page number

List of tables

Page number

This page is intentionally blank

7 Historic environment

7.1 Introduction

7.1.1 This section presents the findings of the assessment of the likely significant effects on the historic environment of the proposed development at the Chelsea 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 below 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 heritage assets presented first, followed by above-ground assets.

7.1.2 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.

7.1.3 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.

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

7.1.5 An assessment of effects from ground movement resulting from the Thames Tideway Tunnel itself is covered in Volume 3 Project-wide effects assessment. No effects are predicted on historic receptors in the vicinity of this site, therefore no assessment of ground movement effects is presented.

7.1.6 Two design options are proposed for the new permanent river wall; an inter-tidal habitat and floodable public realm. In terms of the historic environment both would have the same impact and effect. The options are therefore not presented or reported separately for this topic.

7.1.7 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.

7.1.8 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 13 Chelsea 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 of effects on buried heritage because they would potentially truncate or entirely remove any archaeological assets within the footprint of the works. These are described below.

7.2.3 Site fencing would be erected, supported by timber posts in concrete foundations. The site set-up would also entail the provision of services and the construction of new service trenches up to approximately 1.5m deep (see Construction phase 1 plan [see separate volume of figures - Section 1]).

7.2.4 A short section of the late 19th century (unlisted) stone parapet of the river wall along the Chelsea Embankment within the site would be removed permanently. To either side of this, sections of the parapet would be dismantled, and reinstated at the end of the construction period. Three associated ornamental lamp stands would be permanently removed, along with one tree on the embankment. The existing late 19th century outfall apron that extends across the foreshore in front of the existing outfall would be removed (see Demolition and site clearance plan 1 of 2 [see separate volume of figures - Section 1]).

7.2.5 Part of the southern brick boundary wall of the Grade II registered Ranelagh Gardens would be dismantled and reinstated at the end of the construction period, with the addition of a permanent entrance gate for utility company maintenance access to a diverted gas main (see Permanent works layout [see separate volume of figures - Section 1]). Several trees would be removed from within the southern edge of the gardens and from the pavement outside the gardens to the south (see Demolition and site clearance plan 2 of 2 [see separate volume of figures - Section 1]).

7.2.6 A temporary cofferdam would be constructed in the foreshore, using sheet piling, with a permanent cofferdam constructed within it. 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 includes silt, peat and other materials. 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. All soft material within the permanent cofferdam would be removed to ensure sound foundations for permanent construction. 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 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 5.3m, 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 (see Demolition and site clearance plan; Construction phase 1 [see separate volume of figures - Section 1]).

7.2.7 The cofferdams would be constructed from a jack-up barge located in the River Thames in the foreshore. The supports of the jack-up barge would sit on the river bed and extend into the foreshore deposits. Office, storage and welfare facilities and cranes would be erected within the area of the cofferdam. It is proposed to pump out water from within the footprint of the cofferdam.

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 would be reinstated with suitable material to match the pre-existing river 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. A new outfall apron would be constructed, in the form of 1m depth of stone placed up to 0.5m below the existing foreshore level, as assumed for the purposes of this assessment.

7.2.9 A campshed would be constructed at the southern end of the temporary cofferdam for barge deliveries. It is assumed for the purposes of this assessment that soft deposits would be removed from the foreshore within the footprint of the campshed to an approximate depth of 0.3m, as assumed for the purposes of this assessment, to provide a stable base (see Construction phase 1 [see separate volume of figures - Section 1]).

7.2.10 Within the footprint of the permanent cofferdam, a combined sewer overflow (CSO) drop shaft would be constructed, along with an interception chamber and a valve chamber and a connection culvert to the existing Ranelagh Sewer. Other structures which would be built within the cofferdam fill include a passive filter chamber, a ventilation duct, and below ground elements of two electrical control kiosks (see Site works parameter plan [see separate volume of figures - Section 1]).

7.2.11 An overflow weir chamber over the line of the existing Low Level Sewer No 1 would be built near the northeastern edge of the site. The footprint of this structure would straddle the line of the Ranelagh Gardens boundary wall but would mostly be to the south of it. The overflow weir chamber would be connected to the CSO by a deep bored connection culvert extending south to the river wall and then westwards beneath the foreshore (see Site works parameter plan [see separate volume of figures - Section 1]).

7.2.12 Part of the brick boundary wall along the southern edge of Ranelagh Gardens and its railings would be dismantled and reinstated on completion of works to match the existing wall (see Demolition and site clearance plan 2 of 2 [see separate volume of figures - Section 1]).

7.2.13 The construction activities which would give rise to effects on the historic character, appearance and setting of heritage assets are:

a. the temporary cofferdam structure

b. establishment of hoardings around the boundary of the construction site

c. use of cranes and other plant during shaft construction sinking and secondary lining of the main tunnel

d. provision of welfare facilities.

Code of Construction Practice

7.2.14 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.

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 shall 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. 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'.

g. 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.

h. Procedures in the event of the discovery of human remains.

i. Procedures under the Treasure Act Code of Conduct 1997, to address the discovery of any artefacts defined in the Treasure Act 1996.

7.2.1 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).

7.2.2 Site-specific measures incorporated in the *CoCP* Part B (Section 12) include:

a. The retention of a proportion of the brickwork of the river wall as well as all of the granite parapet stones for reinstatement and reuse in accordance with the procedures set out within the *Heritage Statement*.

b. The retention of historic materials and reuse or reinstatement where possible. The railings that form the boundary of the Grade II Registered Ranelagh Gardens would be carefully removed, stored and reinstated.

c. Protective measures to mitigate against potential strike damage to the Grade II listed Chelsea Royal Hospital Gardens park gates, the boundary of the Grade II Registered Ranelagh Gardens, and the Chelsea Embankment river wall.

7.2.3 All the measures detailed above form part of the 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

7.2.4 The proposed operation of the infrastructure at Chelsea Embankment Foreshore site 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 kiosks.

7.2.5 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, including design iterations, are fully detailed in Section 3 of this volume.

Historic environment design measures

7.2.6 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 at this site include:

a. All the principles for the integration of functional components relevant to the site including those relating to 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 relevant to the site. 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 relevant to the site regarding appearance and functionality.

d. All the landscape principles relevant to the site relating to the quality of soft and hard landscaping, materials and public accessibility.

e. All the lighting design principles relevant to the site relating to heritage and sensitive settings. These include matters relating to safety, the aesthetic effect of the lighting and the quality of fittings.

7.2.7 The following site-specific design principles are also relevant:

a. The new river wall and parapet materials would match the stone and brick of the existing wall.

b. The trees removed along the embankment would be replaced with the same number of semi-mature London Planes along the Embankment or in the Bull Ring, retaining a gap to facilitate views between the river and the Royal Hospital.

c. The ventilation columns, electrical and control kiosks and trees would not be located on the axis of Monument Walk

d. The carriageway and ‘roundabout’ between the Bull Ring gates and the Chelsea Embankment would be repaved to match the new foreshore structure in natural stone. To the north of the Bull Ring the existing bollards would be retained in position and new paving to the footway will match the existing.

e. The landscape design would minimise the amount of visual clutter and street furniture.

f. Timber fenders would not be provided as they are inappropriate to the character of this stretch of the river wall.

g. The existing parish boundary marker would be reinstated on the new river wall

h. So that clear views to and from the river/Royal Hospital are not interrupted, no railings would be provided on top of the new river wall parapet.

i. The kiosks would be integrated into the design of the new river wall parapet to minimise visual clutter.

j. Interpretive historical material/information referencing the lost river (Westbourne) would be carefully designed and integrated into the site.

k. The landscape works around and above the low level sewer connection would be graded to blend in with existing levels.

l. The boundary treatment of Ranelagh Gardens would include a gate for utility company maintenance access. The new wall, railings and gate would be designed to match the existing walls and railings.

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 (ES)*. 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 13 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, several changes were made in response to consultations with the Royal Borough of Kensington and Chelsea and English Heritage. The CSO drop shaft structure was initially located on the foreshore, to the east of its proposed location, away from the interception structure in Ranelagh Gardens. The two elements were separated in order to lessen the impact on the historic environment. The option of moving the drop shaft into Ranelagh Gardens was explored, but as a result of further design development it was concluded that the foreshore was preferable for operational and safety reasons.

7.3.3 In response to consultation, the positioning of the foreshore structure on the main axis of the Grade I listed Royal Hospital Chelsea (the most significant heritage asset in the vicinity) was designed to emphasise the historic axis and enhance its setting and re-establish its relationship with the River Thames, as intended in Wren’s original design. The connection with the river was diminished when Chelsea Embankment was built in the 1850s to 1870s.

7.3.4 The foreshore structure was designed to extend, mirror and emphasise the curve of the Bull Ring Gate and the Bull Ring. The design of the new public realm was also important to enable the principal axis of the Royal Hospital to be appreciated, to better reveal its significance in accordance with the *NPS*.

7.3.5 The appearance of the foreshore structure and the need to harmonise it with the river wall on either side were also important design considerations, as discussed with consultees, to minimise the impact on river views, the character and appearance of the Thames Conservation Area and the setting of the listed Chelsea Embankment, Chelsea Bridge, Battersea Park Conservation Area and Battersea Park. This was addressed through the development of the structure's form and the choice of materials.

Vol 13 Table 7.3.1 Historic environment – consultation response

Organisation and date	Comment	Response
Heritage and design workshop (December 2011)	A member of the Chelsea Society noted that Ranelagh Gardens has considerable historic value and development could damage the gardens.	The impact of the proposed development on the gardens is assessed in the *ES* and appropriate.
Minutes of meeting with English Heritage on 1st February 2012	While Ranelagh Gardens remains an option it is preferred by English Heritage to the foreshore site (a preference previously made clear on the grounds of its visual impact and concern over maintenance)	As detailed in para 7.3.2 the option within Ranelagh Gardens was discounted for operational and safety reasons.
English Heritage phase two consultation response (February 2012)	EH considers that further archaeological work will be necessary to mitigate the impact of development, including foreshore excavation.	A range of mitigation measures are proposed as set out in Section 7.8 below.
	Potential scour impacts to be considered.	Effects of scour have been considered in the assessment. Scour protection is part of the embedded mitigation in the operational design of the permanent structures. Potential scour effects from temporary structures would be monitored and

Organisation and date	Comment	Response
		mitigated as required during construction.
	Battersea Park Registered Garden and associated conservation area to be added to report.	Effects on these receptors are assessed in the *ES.*
Royal Borough (RB) of Kensington and Chelsea phase two consultation response (February 2012)	Potential impact upon the setting of listed buildings and structures should be assessed.	The *ES* assesses the effects of both construction and operational phases on the historic character, appearance and setting of listed buildings.
	Images in Appendix too narrowly focussed and need wider setting elements.	Additional images have been included in the setting assessment in the *ES*.
Meeting with English Heritage and Westminster City Council (16th May 2012)	English Heritage have removed their objection to the foreshore site over Ranelagh Gardens due to health and safety concerns associated with constructing connections in the geological conditions of the Lambeth Group	This is noted
RB of Kensington and Chelsea Section 48 publicity comments (October 2012)	RBKC welcome the general design approach but request that the disruption to the linearity of the embankment wall and foreshore be balanced against the celebration of the axial alignment of the Royal Hospital and its gardens. The quality and future maintenance of the proposed space will be very important to this balance.	The ES assesses the likely significant effects of the construction and operation phases upon the fabric and setting of heritage assets, including the Royal Hospital, its gardens and the embankment.

Organisation and date	Comment	Response
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 heritage assets differ from the townscape impacts.	Where these differences exist, the ES includes an explanation in the assessment for each asset.
	English Heritage would welcome more information about the significance of the Grade I listed Royal Hospital and its designed setting, and the Grade II* Registered Battersea Park and its setting.	The ES sets out the history of the Royal Hospital and its designed setting, and of Battersea Park, and describes their significance.

Baseline

7.3.6 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. In terms of site-specific variations, the results of archaeological monitoring of geotechnical investigations carried out within the site have been incorporated in the baseline.

7.3.7 Baseline conditions for heritage assets are described within a 350m-radius area around the centre point of the site, which is considered through professional judgement to be most appropriate to characterise the historic environment potential of the site. There are occasional references to assets beyond the baseline area, for example, a mid to late Saxon settlement, approximately 1km to the southwest of the site, which contribute to current understanding of the site and its environs in the early medieval period.

7.3.8 The assessment area for the assessment of effects on the 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 350m 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 Royal Hospital Conservation Area Proposals Statement (RBKC), the Thames Conservation Area Proposals Statement (RBKC), the Battersea Park Conservation Area Appraisal & Management Strategy (Draft, LB Wandsworth, 2007), and from professional judgement based on observation and understanding of historic context and architectural purpose and design.

7.3.9 A site visit was carried out at very low tide in April 2011 to identify assets on or adjacent to the site and a further site visit was carried out in January 2012 to identify assets for inclusion within the assessment of effects on setting.

7.3.10 The temporary use of the Royal Hospital Grounds for the Chelsea Flower Show for up to three months each summer changes the character of certain receptors. However, for the purpose of this assessment neither the works associated with this event, nor the other temporary structures erected in the vicinity at various times of year, are considered. This is to ensure the effects of the Thames Tideway Tunnel project construction are not underestimated.

Construction

7.3.11 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.

7.3.12 In terms of physical effects on above ground or buried heritage 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.

7.3.13 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 drop 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 each assessment). The construction assessment area is as described in para. 7.3.8.

7.3.14 Section 7.5 details the likely significant effects arising from the construction at the Chelsea 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 (Cremorne Wharf Depot to the west and Kirtling Street to the east) are too distant from Chelsea Embankment Foreshore 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.

7.3.15 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 is assumed to be as per the baseline.

7.3.16 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. Furthermore none of the schemes included in the site development schedule (Vol 13 Appendix N) would lead to physical changes in above ground or buried heritage assets within the Chelsea Embankment Foreshore site. Therefore any changes to the surrounding baseline would not affect the assessment and are not detailed further within the construction base case.

7.3.17 None of the schemes included in the site development schedule (Vol 13 Appendix N) would change the existing baseline in terms of character and setting of above-ground assets, given the distance of these schemes from the site and the presence of intervening structures. This includes the consented development within the Royal Hospital, for Gordon House, the Orangery and Creek Lodge, as this has no visual relationship with the site due to intervening buildings and trees. There is a consent for a temporary marquee, plant and parking during June and July, on the Royal Hospital Grounds 35m north of the site, which is likely to recur every year; there is also a consent for a temporary storage container and sales office for Christmas trees within the Bull Ring for a maximum of 28 days, which is likely to recur annually. While these schemes would change the base case during the year of construction, they would only be in place for a short period of time in comparison to the Thames Tideway Tunnel construction activity. As a consequence the base case is assumed to remain as per the baseline detailed in Section 7.4, so as to ensure any effects from the construction of the Thames Tideway Tunnel project are not underestimated.

7.3.18 None of the schemes included in the site development schedule (Vol 13 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 Chelsea Embankment Foreshore site and those schemes listed in the development schedule (Vol 13 Appendix N). Therefore no assessment of cumulative effects has been undertaken for physical effects on assets in the construction phase.

7.3.19 In terms of the assessment of cumulative effects on the character and setting of historic assets, as detailed in the site development schedule (Vol

13 Appendix N) two schemes have been identified within 1km of the site which meet the criteria (set out in Vol 2 Section 3.8) for inclusion in the cumulative assessment. These comprise:

a. Chelsea Barracks residential scheme, approximately 200m to the northeast

b. Battersea Power Station development, approximately 470m to the southwest.

7.3.20 Cumulative effects from these schemes together with the Thames Tideway Tunnel project on the character and setting of historic assets have therefore been assessed.

7.3.21 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

7.3.22 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 each assessment). The operational assessment area is as described in para. 7.3.8 above.

7.3.23 As stated in para. 7.3.14 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.

7.3.24 None of the schemes included in the site development schedule (Vol 13 Appendix N) would change the existing baseline in terms of the character and setting of above-ground heritage assets given the distance of these schemes from the site and the presence of intervening structures. This includes the consented development within the Royal Hospital, for Gordon House, the Orangery and Creek Lodge, as this has no visual relationship with the site due to intervening buildings and trees. There is also a consent for a temporary marquee, plant and parking during June and July, on the Royal Hospital Grounds 35m north of the site, which is likely to recur every year; there is also a consent for a temporary storage container and sales office for Christmas trees within the Bull Ring for a maximum of 28 days, which is likely to recur annually. While these schemes would change the base case during the year of operation, they would only be in place for a short period of time in comparison to the Thames Tideway Tunnel operational infrastructure. As a consequence the base case is assumed to remain as per the baseline detailed in Section 7.4, so as to ensure any effects from the operation of the Thames Tideway Tunnel project are not underestimated.

7.3.25 In terms of cumulative effects, all of the schemes included in the site development schedule (Vol 13 Appendix N) would be complete and operational by the operational phase assessment year, with the exception of part of Phase 5 (RS-6) and Phase 7 of the Battersea Power Station development. However these parts of that development would not have a visual relationship with the site due to intervening structures, and so they would not have a significant cumulative effect on the historic character and setting of above-ground heritage assets.

7.3.26 The assessment of operational effects on the character, appearance and setting 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

7.3.27 The assumptions and limitations associated with this assessment are presented in Vol 2. Site-specific assumptions and limitations are detailed below.

Assumptions

7.3.28 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 [see 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 located any buried heritage assets of 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.

7.3.29 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.

7.3.30 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.

7.3.31 The assessment of effects on above-ground assets is similarly based on the above-ground structures being located anywhere within the zones 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 surrounding townscape.

Limitations

7.3.32 Whilst a foreshore walkover survey has been carried out within the site, and several investigations undertaken within the baseline area, a limitation of the assessment is that no intrusive archaeological investigation has been carried out on the site in the past. Nevertheless the assessment is considered to be robust and in accordance with best practice.

7.3.33 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 350m- radius 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, 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 (see Vol 13 Figure 7.4.1, see separate volume of figures) shows the location of known above-ground and buried historic environment features within the 350m-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 13 Appendix E.1. Heritage assets whose historic character and / or settings would be affected by the proposed development are shown on Vol 13 Figure 7.4.2 (see separate volume of figures) along with Views of Heritage Value (VHV), as described in para. 7.3.8. 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.

Designated assets

International and national designations

7.4.3 The northeastern part of the site incorporates the southern boundary of the Royal Hospital, Chelsea and Ranelagh Gardens (HEA 1F), a Grade II registered park and garden located on the northern side of Chelsea Embankment road. The site does not contain any other nationally or internationally designated (statutorily protected) heritage assets, such as scheduled monuments, or listed buildings. The significance of assets is described further in the 'Statement of significance: above-ground heritage assets' below, in paras. 7.4.33–7.4.51.

7.4.4 The closest listed structures to the site comprise the Grade II listed Bull Ring Gate on Royal Hospital Road (HEA 12), immediately north of the site; and a Grade II listed memorial obelisk in the grounds of the Royal Hospital (HEA 15), approximately 75m to the northwest. The Grade II listed Chelsea Embankment, from Battersea Bridge to a point opposite the southwestern corner of The Royal Hospital Grounds (HEA 46), lies 90m to the west of the site. A Grade II listed Bazalgette sewer vent at northern end of Chelsea Bridge (HEA 14), lies approximately 45m to the southeast of the site. The Grade II listed Chelsea Bridge lies approximately 85m to the east (HEA 18). Battersea Park, a Grade II* registered park and garden, is located across the river from the foreshore site. There are no internationally designated heritage assets near the site.

Local authority designations

7.4.5 The site is located within two conservation areas (see Vol 13 Figure 7.4.2 in separate volume of figures): the majority of the site lies within the Thames Conservation Area, whilst the northern edge and Low Level Sewer no.1 connection site lies within the Royal Hospital Conservation Area. The site contains no locally listed buildings, nor does it lie within an archaeological priority area. On the south side of the Thames (approximately 80m to the south of the site) is the Battersea Park Conservation Area as designated by the London Borough of Wandsworth.

Known burial grounds

7.4.6 There are no known burial grounds within the site or adjacent to it.

Site location, topography and geology

7.4.7 The street level of Chelsea Embankment in the north of the site is flat at approximately 105.0m ATD (above Tunnel Datum); the foreshore is at 100.3m ATD to 97.0m ATD along the southern boundary.

7.4.8 At the eastern end of the site, the ground rises up steeply (artificially) towards the northern approach to Chelsea Bridge, from 105.0m to 107.5m ATD. Within Ranelagh Gardens in the northern part of the site, the ground level is flat at 104.0m ATD.

7.4.9 The underlying geology of the site is alluvial silts and clays overlying sand and gravel deposits. The eastern half of the site lies at the edge of an ancient delta associated with the Tyburn and Tachbrook rivers, at their confluence with the Thames. The Kempton Park gravel terrace abuts the site on the western extremity and survives as a remnant ‘island’ of gravel terrace 400m to the east.

7.4.10 Few geotechnical borehole records exist for the site itself. The previous borehole data from the surrounding area suggests that the surface of Pleistocene gravel could lie at around 97.0m ATD, overlain by 4.0–5.0m of alluvium, to 101.0–102.0m ATD. Thus, at the southern boundary of the site it is unlikely that any deposits of archaeological interest survive below the riverbed, which is likely to lie directly on Pleistocene gravel. Further north, up the foreshore, and beneath the existing river embankment, a thicker sequence of alluvium might exist, and at the base of this sequence (perhaps between 97.0m and 98.0m ATD), evidence for a prehistoric land surface, that became waterlogged as river levels rose in later prehistory, is likely to survive (as sampled at HEA 1A). The site topography and geology is discussed in more detail in Vol 13 Appendix E.2.

Past archaeological investigations

7.4.11 The foreshore within and beyond the site was surveyed in the 1990s as part of the ‘Alpha Survey’ of the Thames Archaeological Survey (TAS). This noted, within the site, the existing late 19th century outfall and apron of the Ranelagh Sewer (HEA 1C), a possible post-medieval drain comprising a line of timber posts at right angles to the river (HEA 1B), a deposit of peat/organic clay, which was sampled and found to be of Neolithic date (HEA 1A), and a post-medieval mooring timber (HEA 1E).

Other than the mooring timber, the site visit noted that these features were still present.

7.4.12 Three small scale archaeological investigations, all around 150m to the northeast of the site (HEA 2; 3; 47) recorded 20th century remains as well as elements of the alluvial sequence and historic subsurface in the area. As a result of the limited investigation, current understanding of human activity is limited, in particular for the prehistoric and Roman periods, for which there is no historical information.

Archaeological and historical background of the site

7.4.13 The following section presents a chronological summary of the archaeological and historical background of the site. Further detail is included in Vol 13 Appendix E.4.

7.4.14 The site is located at a point where the floodplain of the Thames widens. The high ground of the river terrace just beyond the northwest corner of the site, could have provided a focal point for settlement or occupation, and overlooked a mosaic of islands within a network of streams, pools and marshes, which existed across the floodplain, providing a wide range of natural resources. Tides were lower in the prehistoric period (700,000 BC–AD 43), and it is possible that prehistoric deposits or land surfaces may be exposed on the site at low tide. Plant roots observed in nearby boreholes suggest dry land surfaces may have existed on the higher ground. Neolithic peat observed on the foreshore on the site (HEA 1A) may represent waterlogging of an early dry land surface. Evidence of this period from the baseline area is limited to residual chance finds recovered from the Thames (HEA 6 and 9) near Chelsea Bridge, which may reflect the limited amount of past archaeological investigation. It is likely that some of the river finds were deliberately deposited in the Thames as votive offerings, possibly during funerary rites, as seen elsewhere along the river.

7.4.15 During the Roman period (AD 43–410), the site lay within low-lying intertidal marshland which was probably frequently flooded. Toward the higher ground at the western end of the site, a more transitional zone probably existed between tidal mudflat and seasonally flooded meadow land. The site lay some distance from known settlements. The gravel terrace north of the site would have been a rural landscape, possibly used for farming, with a scatter of farmsteads. The riverfront, including the area of the site, may have been exploited for a range of resources. Finds from the baseline area comprise residual chance finds from the Thames (HEA 6 and 9).

7.4.16 In the early medieval period (Saxon) period (AD 410–1066), the site lay within the manor (estate) of Chelsea, first mentioned in the Anglo-Saxon Chronicle in AD 785. Chelsea may have been a significant Royal estate. There is archaeological evidence of a mid and late Saxon settlement in the vicinity of Chelsea Old Church, approximately 1km to the southwest of the site. There is no evidence for any Saxon activity close to the site, which would have been intertidal foreshore, possibly used for fishing (eg, fish traps). The adjacent gravel terrace was possibly cultivated or used for pasture.

7.4.17 Throughout the later medieval period (AD 1066–1485) the site was located approximately 1km to the northeast of the main settlement at Chelsea, on the Thames foreshore. A river wall would have been constructed to the north of the site in this period, and intertidal marshes drained and reclaimed and brought under cultivation.

7.4.18 At the beginning of the post-medieval period (from AD 1485), the site would have been on the Thames foreshore. By the mid 17th century, the area began to develop.

7.4.19 The Royal Chelsea Hospital to the north of the site was founded by King Charles II to provide for old or injured soldiers. It was designed by Sir Christopher Wren in 1682–1691, with continued development until 1702. The main hospital buildings comprise seven three-storey connected blocks (listed Grade I) in a symmetrical layout. The northern part of the site includes the principal entrance to the hospital from the south, originally accessed from river stairs along a tree-lined avenue. In 1850, the existing Grade II listed entrance gates on Royal Hospital Road (HEA 12) were added (immediately outside the site), along with a central island and turning circle in the western half of the site.

7.4.20 The northeastern part of the site extends across the southern boundary of the Chelsea and Ranelagh Gardens (HEA 1F), which are Grade II registered. The gardens were designed in c. 1860 by John Gibson as a naturalistic landscape with undulations, mounds and shrubberies, enclosed and separated from the rest of the gardens by iron railings. This followed extensive changes to the original 17th century landscaped gardens due to the construction in the existing Chelsea Embankment to the south in mid and late 19th century.

7.4.21 In the mid and late 19th century two major public works changed the character of the riverfront as it exists today and extended the riverfront southwards to its current location: the construction of the first Chelsea suspension bridge to the east of the site in the 1850s, which entailed alterations to the riverfront, and the Metropolitan Board of Works' sewage system. This included the construction, between 1871 and 1874, of the Chelsea Embankment to a design by Sir Joseph Bazalgette. The embankment was designed for the low level intercepting sewer and a grand thoroughfare. The embankment is statutorily designated Grade II (HEA 46), however this designation stops short of (c 90m west of) the site. The unlisted section of the embankment within the Thames Tideway Tunnel project site (HEA 1I) is formed of brick topped with a granite parapet and boundary wall with lamp standards located at regular intervals. Further to the east, within the Thames Tideway Tunnel project site, the foreshore retaining wall is capped with a row of granite stones with a wall of blue engineering brick, with railings behind. At the Chelsea Bridge approach to the east of the site, the road and pavement veer away from the riverside, and at this point the wall is capped with a row of granite stones. The funds for the Chelsea Embankment were considerably restricted and therefore the ornamentation and detail that is visible to the west, was not continued as far east as the site. The embankment includes a low-level intercepting sewer from Battersea Bridge to Chelsea Hospital and an outfall and apron (HEA 1C) is located in the centre of the main site. This was originally the outfall of the pre-Bazalgette Ranelagh Sewer, but was expanded and partially rebuilt in 1883 as part of the King's Scholars' Pond Storm Relief sewer.

7.4.22 The site has changed little since the late 19th century. By the end of the 19th century a jetty was located in the site, named Victoria Pier, which was removed in the late 19th or early 20th century. In 1934–37, the existing Grade II listed Chelsea Bridge (HEA 18) was built to the east of the site. This self-stabilising suspension bridge replaced the earlier 1850s bridge, using new high tensile steel technology.

Statement of significance: buried heritage assets on the site

Introduction

7.4.23 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 from historic maps, the site walkover survey, and information on the likely depth of deposits.

7.4.24 In accordance with the *National Policy Statement for Waste Water*[1], *National Planning Policy Framework*[2] and *PPS5 Planning Practice Guide*[3] (which remains extant), 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

7.4.25 Based on the predicted levels of natural geology, the surface of Pleistocene gravel (the maximum depth of archaeological remains, ie, prehistoric or palaeoenvironmental remains) lies at around 97.0m ATD, overlain by 4.0–5.0m of alluvium, to 101.0–102.0m ATD. In the foreshore area at the southern edge of the site it is unlikely that any remains predating the post-medieval period would survive, based on the current riverbed levels. Alluvium here (and any early archaeological deposits within it) has probably been removed by fluvial erosion from natural causes and from passing river traffic.

7.4.26 Further north, up the foreshore, and in particular beneath the existing 19th century river embankment, a thicker sequence of alluvium might survive beneath up to 3m of 19th century riverfront consolidation and dumping.

Asset potential and significance

7.4.27 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

7.4.28 The site has a high potential to contain palaeoenvironmental remains. The potential for survival of ancient ground surfaces and features is likely to be high on the upper part of the foreshore and beneath the river embankment. A deposit of Neolithic peat was noted by TAS in the 1990s, in the western part of the site, and organic clay has been recorded in a nearby geotechnical borehole. Plant remains are significant in respect of enhancing our knowledge of the character of the local environment of this area of London during the Mesolithic and Neolithic periods. The flood and backwater alluvial deposits have high potential for the preservation of remains that can be used to reconstruct past environments. Such remains would be of low or medium significance depending on their nature and degree of preservation. This would be derived from the evidential value of such remains.

Prehistoric

7.4.29 The site has an uncertain, possibly moderate, potential to contain prehistoric remains. Little past archaeological investigation has been carried out in the vicinity, and therefore current understanding of human activity on the site during this period is limited. There have been chance finds from the Thames, possibly ritually deposited, and the site has a general background potential for such finds within the river or foreshore. peat exposed on the foreshore within the site has been dated to the Neolithic, indicating the potential for survival of Neolithic land surfaces. The wetland and floodplain could have been exploited for hunting or fishing, and associated remains may be present within any alluvial deposits including potentially organic survival eg, timber structures. Redeposited finds would be of low significance. Evidence of settlement or timber structures could potentially be of moderate to high significance, depending on extent and state of preservation, although the presence of such remains is unlikely. Taking into consideration the potential and likelihood of prehistoric remains being found on this site, their overall significance may be considered medium. This would be derived from the evidential value, in providing evidence of past environments and human activity.

Roman

7.4.30 The site has low potential to contain Roman remains. The site is at some distance from known centres of Roman settlement, and finds of this period from the baseline area to date comprise residual chance finds only. This stretch of the river bank may have been used for economic activities exploiting the resources of the river. Isolated artefacts and features would be of low significance.

Medieval

7.4.31 The site has a low potential to contain early and later medieval remains. The site would have been on the intertidal foreshore of the Thames. The foreshore deposits might contain fish traps or other evidence of low-level riverfront activity as found elsewhere on the foreshore in Greater London. The medieval settlement of Chelsea lay around 1km to the southwest and much of the gravel terrace to the north was probably open fields, possibly under cultivation or used as pasture. The site itself would have been in the river channel and foreshore throughout this period. Archaeological remains have been recorded in the vicinity but are not indicative of settlement. Remains of fish traps would be of medium or high significance, depending the nature and extent of the remains, based on their likely evidential value in providing evidence of past environments and human activity.

Post-medieval

7.4.32 The site has high potential to contain buried post-medieval heritage assets. This would include ground consolidation behind the 19th century embankment wall. In the area of the foreshore, historic maps indicate that a pier (Victoria pier) was located within the site in the late 19th century and remains of this structure may be encountered, along with remnants of a post-medieval timber structure and foreshore consolidation. It is also possible that artefacts are preserved on the site, relating to maritime activity. Such remains would be of low significance derived from their evidential and historical group value. The northeastern part of the site has the potential for buried remains associated with landscaping of the 18th and 19th century Ranelagh Gardens. Such remains would be of medium significance.

Statement of significance: above-ground heritage assets

Introduction

7.4.33 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 above-ground 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.

7.4.34 This section also describes the significance, historic character 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 and settings may be affected by the proposed development. Such assets are shown in Vol 13 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

Thames Conservation Area

7.4.35 The proposed development site lies within the Thames Conservation Area, which incorporates the river frontage and foreshore between Chelsea Creek to the west and Chelsea Bridge to the east, taking in the length of the riverside within Royal Borough of Kensington and Chelsea. The purpose of the designation is to protect significant views to and from the Chelsea Embankment along the northern bank of the River Thames. Its character is largely defined by the linear embankment, with its parapet wall, trees, lamp standards and York stone paving. The character of the river front is variable with areas of house boats to the west of Albert Bridge, and un-obscured river wall to the east. The atmosphere of the embankment is dominated for most of the day by the fast moving traffic. The avenue of London Planes along Chelsea Embankment and the linear river wall and the rhythm of its lamp standards and parapet piers form part of the character of the conservation area. There are far reaching views along Chelsea Embankment and across the River Thames to Battersea Park, illustrated by View of Heritage Value 2 (see Vol 13 Figure 7.4.2 in separate volume of figures). There are views to the Thames Conservation Area from Chelsea Bridge, illustrated by View of Heritage Value 3, and from Battersea Park, illustrated by View of Heritage Value 4. There are also views towards the area from trains crossing the railway bridge to the west of Chelsea Bridge, illustrated by View of Heritage Value 10. The Thames Conservation Area is of high significance as a heritage asset for its historical, communal, and aesthetic value, relating to its location on the River Thames and proximity to other heritage assets, which form part of its historic character and setting. The drop shaft site occupies an area on the embankment which, offers views along the river to east and west, to Battersea Park to the south, and to the Royal Hospital to the north.

Royal Hospital Grounds & Ranelagh Gardens Grade II Registered Park & Garden (includes South Grounds)

7.4.36 The site partially extends into Ranelagh Gardens (HEA 1F), part of the Grade II Registered Park & Garden. The Gardens were first developed in the 18th century and were remodelled, along with the Royal Hospital Gardens in the middle of the 19th century. The layout of the South Grounds and Ranelagh Gardens relate to the 19th century alterations contemporary with the construction of the Chelsea Embankment, removing the earlier, 17th century formal gardens. On the recommendation of the Director of the Board of Works, due to the changes that the embankment would make to the gardens, they were remodelled and opened to the public in 1849. Ranelagh Gardens were once again redesigned in c. 1860 by John Gibson to create a more naturalistic landscape with undulations, mounds and shrubberies, all enclosed and separated from the rest of the gardens by iron railings on a low brick wall. The northeastern part of the site straddles the 19th-century brick wall and railings of the Gardens. Ranelagh Gardens, including the boundary wall, is of high significance as a heritage asset for its historical, communal, and aesthetic value.

7.4.37 Whilst the South Grounds and adjacent Ranelagh Gardens are contemporary in date, they form separate and distinct areas. The South Grounds are characterised by open lawns, formal planting, ornaments and drives, whilst Ranelagh Gardens is characterised by more informal planting with extensive mature tree planting and screening to create discrete tranquil areas within the gardens. Due to the extent of surrounding vegetation and mature planting, Ranelagh Gardens is largely inward looking and screened from the surrounding area. This is illustrated by Views of Heritage Value 5 and 6 (see Vol 13 Figure 7.4.2 in separate volume of figures). There are no intended views from within Ranelagh Gardens towards the river or the proposed development site. The South Grounds, which are more open, are partly screened from the river, albeit with intended views along the main axis from the Bull Ring Gate to the

Chilianwalla Memorial Obelisk and central portico of the Royal Hospital building. The southern boundary of the park has a raised bank with trees that maintain the sense of enclosure. The Embankment Wall and river frontage form part of the setting of the South Grounds. The historic character and setting of Ranelagh Gardens makes a strong contribution to its overall significance, as the gardens are mostly inward looking, but their external boundary treatment of is distinctive. The interception site occupies part of the southern boundary wall and therefore the site contributes to the asset’s character and setting.

7.4.38 The South Grounds host the Royal Horticultural Society’s Chelsea Flower Show in May every year, which is made up of various temporary structures. First hosted here in 1913, this show is considered one of the most important events in Europe for horticultural enthusiasts. The staging of the show involves considerable site preparations, the erection of marquees and creation of temporary visitor facilities and plant areas, as well as the setting up and taking down of the garden displays. This results in a temporary change in the character of the Royal Hospital Grounds each year, from an open lawn to a dense group of structures forming a large visitor attraction which cuts the Royal Hospital off from the river and alters the setting of the nearby heritage assets. It should also be noted that the site is also being used this year for an art and antiques fair which may recur in subsequent years, drawing out the temporary occupation of the Grounds into June and July.

Chelsea Embankment

7.4.39 The site is located on Chelsea Embankment, one of Bazalgette’s most conspicuous projects, along with the Victoria and Albert Embankments. The historic importance of this scheme is recognised by the Grade II listing of the river wall, parapet and lamp standards to the west of a point opposite the south west corner of the Royal Hospital South Grounds (HEA 46). However, the site itself does not fall within the listed section, although it sits within the Thames and Royal Hospital Conservation Areas. At this point the scheme’s finances ran out and plans to face the wall in granite were abandoned. The length of the river wall within the main site (HEA 1I) is brick with a granite parapet, and with associated ornamental lamp standards at intervals. It contains the Bazalgette Main Drainage Low Level Intercepting Sewer (HEA 1G), which runs through the north of the site, and is considered by association with Bazalgette and the embankment scheme in general, to be of medium significance. The original sewer is also of medium significance. There are far reaching views from within the site along Chelsea Embankment, towards the central frontage of the Royal Hospital and across the River Thames to Battersea Park, illustrated by View of Heritage Value 2 (see Vol 13 Figure 7.4.2 in separate volume of figures). Given its location in relation to the River Thames, Royal Hospital Gardens, Ranelagh Gardens, Thames Conservation Area and Chelsea Bridge, setting makes a strong contribution to its overall significance. The drop shaft site is located along the river wall and foreshore, and therefore forms part of the wider setting of the embankment in views along the river; however this role is not as important as the role played by the listed section of the river wall some distance to the west.

7.4.40 Within the riverfront retaining wall is the CSO, a brick segmental headed arched tunnel with bull-nose brick reveals and associated brick apron with timber edging (HEA 1C). The tunnel divides internally with steel storm gates at the rear (Vol 13 Appendix E, Vol 13 Plate E.10). This feature is considered of medium asset significance, due to its historical and evidential value as part of the 19th century embankment and drainage scheme.

7.4.41 The northern part of the site encompasses the Royal Hospital entrance turning circle (the "Bull Ring") on Chelsea Embankment whilst the associated Grade II listed Bull Ring Gate entrance (HEA 12) lies immediately adjacent to the site. The turning circle forms part of the mid-19th century redevelopment of the area, although it is unclear as to whether it formed part of the original Bazalgette scheme for the embankment since its present form seems to date from the mid-late 20th century. Although it is outside the Royal Hospital Garden, the turning circle is of medium asset significance for its historical value as an associated part of both the Royal Hospital Gardens and Chelsea Embankment.

Royal Hospital Conservation Area

7.4.42 The site lies partially within the Royal Hospital Conservation Area. The conservation area incorporates the Royal Hospital Chelsea, Memorial Obelisk, Bull Ring Gate and the Royal Hospital and Ranelagh Gardens Registered Park and Garden. The setting of the Royal Hospital Conservation Area is characterised by the line of the Embankment Wall along the River Thames to the south, and the surrounding urban townscape. A distinct element of its setting is the direct alignment of the Royal Hospital on the Chilianwalla Memorial Obelisk, Bull Ring Gates and the turning circle in front of it, which offers strong views from the river frontage back towards the Grade I listed building. This is illustrated by Views of Heritage Value 1 and 2 (see Figure 7.4.2). The southern part of the conservation area is characterised by the designed landscapes of the Royal Hospital Grounds and adjacent Ranelagh Gardens. Generally the Grounds and Gardens adjacent to the embankment are set at a lower level than the embankment, so that views out of much of the southern part of the conservation area where its edge is not screened, is of the river wall, appearing as a narrow grey band beyond the park railings. The extent of surrounding vegetation limits views in and out of the conservation area. Views into the conservation area from Chelsea Bridge to the east and Battersea Park to the south are limited by the intervening presence of mature tree planting along the river frontage, which screens the area even during winter months. Overall, the conservation area is an asset of high significance, and the historic character and setting of the conservation area makes a strong contribution to this. The CSO drop shaft site is an important part of the wider setting of the conservation area as it stands on the Royal Hospital's axis and offers good views of the Royal Hospital complex, which is the most important part of the conservation area.

Within the assessment area

Listed embankment wall

7.4.43 The embankment (HEA 46) either side of Albert Bridge is statutorily designated Grade II, however as detailed in the list entry, this designation stops short of the site at a point opposite the southwestern corner of the Royal Hospital grounds. Bazalgette's Chelsea Embankment was designed not only to contain the low level intercepting sewer but also to protect the low lying areas around Cheyne Walk from flooding (Halliday, S., 2009)[4]. The embankment wall is of high asset significance, as it is part of the original Bazalgette scheme and therefore retains not only historic and evidential value, but also aesthetic and communal value. Given its location in relation to the River Thames, Royal Hospital Gardens, Ranelagh Gardens, Thames Conservation Area and Chelsea Bridge, setting makes a strong contribution to its overall significance. The retaining wall in this area is constructed from granite with a series of 64 lamp posts with decorative feet and shafts.

Listed sewer vent

7.4.44 A Grade II listed Bazalgette sewer vent is located at the northern end of Chelsea Bridge (HEA 13), approximately 35m to the east of the site. The significance of the sewer vent is high, derived from its historical and evidential value.

Bull Ring Gate

7.4.45 The main entrance to the Royal Hospital South Grounds is from Chelsea Embankment via the Grade II listed Bull Ring Gate. These iron gates are hung on stone piers and flanked by single wrought–iron gates and date to c. 1850, with the recent addition of further matching gate-leaves to widen the opening (the gates are only opened for events in the south grounds, with normal pedestrian and vehicle access via Royal Hospital Road). It is set back from the road and the Royal Hospital Grounds boundary railings curve in to meet it. In front of the gates is a turning circle, aligned on the central axis of the portico on the garden front of the Royal Hospital. The gate forms part of the overall design of the Royal Hospital grounds. There are intended views northwest along the drive towards the Royal Hospital, illustrated by View of Heritage Value 2. The Embankment Wall and associated mature planting aligned along the river frontage form part of the setting of the Bull Ring Gate. Given its location within the Royal Hospital Gardens, setting makes a strong contribution to its overall significance, which is high.

Chilianwalla Memorial Obelisk

7.4.46 The Grade II Listed Chilianwalla Memorial Obelisk lies to the southeast of the Royal Hospital on the drive leading to the Bull Ring Gate. It forms part of the formal layout of the Royal Hospital Grounds orientated on the central part of the Royal Hospital building. It is surrounded by level lawns and playing fields bounded by mature vegetation on all sides. It is visible through the trees from along the Embankment road and walkway. It partly inhibits views between the central portico of the Royal Hospital, the Bull Ring Gate and beyond, as it provides a focal point in the foreground located within these views, illustrated by Views of Heritage Value 1 and 2. The Chilianwalla Memorial Obelisk is a heritage asset of high significance.

Given its location within the Royal Hospital Gardens, setting makes a strong contribution to its overall significance.

The Royal Hospital

7.4.47 The Grade I Listed Royal Hospital (HEA 49) was designed by Sir Christopher Wren in 1682–1702, and was his first grand scale secular commission (Cherry, B. and Pevsner, N., 1991)[5]. The southern extent of the hospital was an important component of the design, and included detailed and elaborate landscaping set around a strong formal axis leading from the main portico to the river. However, the original contemporary landscape was gradually altered, infilled and then removed completely in the 19th century, in particular with the construction of the Chelsea Embankment, which introduced a separation (ie, road, low level sewer and a boundary railings/wall) between the gardens and the Thames, where previously the gardens extended to the river's edge with water gates and central stairs for access.

7.4.48 The setting of the Royal Hospital is largely characterised by the presence of the Royal Hospital Grounds. The frontage of the building is largely screened by a row of mature trees planting in parallel to the main elevation. The building's central Doric portico is orientated facing directly to the southeast along a formal drive leading to the Chilianwalla Memorial Obelisk and Bull Ring Gate beyond, which are themselves of high significance and form a group with the Royal Hospital and its wider landscape. The main central axis through the Royal Hospital, expressed in its surroundings is an important aspect of its intended classical design and its significance, as expressed in early depictions of the building. The presence of mature trees along the boundary of the grounds and river frontage limits views to and from the Royal Hospital, illustrated by Views of Heritage Value 1. Although the Royal Hospital building and its cupola can be seen through the trees in winter, the views are limited to glimpses. In general, however, due to the Royal Hospital's location at the centre of a purposely designed landscape, setting makes a strong contribution to its high significance.

Chelsea Bridge

7.4.49 Chelsea Bridge, to the east (HEA 17) of the site, is listed Grade II. It was constructed 1934–37 and was designed by London County Council Engineers under the leadership of Sir T Peirson Frank. Architecturally impressive, this self-stabilising suspension bridge is formed of 3 spans with two steel and concrete piers below and four tall towers above. The turrets are decorated with heraldic designs, golden galleons, crests of counties around London and doves holding olive branches. Painted white with red trim and greyish blue balustrades, the bridge incorporates five pairs of lampposts. Technologically, the use of high tensile steel within the bridge pre–dates the first British standard of the material. It is of unusual design and marked a major British breakthrough in the design of bridges, building from work undertaken by Continental and American engineers. The elegant profile of the bridge was designed to echo Albert Bridge further upstream. The new bridge did not deviate from the original form of the previous structure, retaining the Victorian character of the area. The list entry emphases the group value of the Chelsea Bridge in relation to the collection of 19th century architecture. This includes the Chelsea Hospital Garden; Albert Bridge (1873), and Battersea Park (1846). Chelsea Bridge is considered of high significance, relating the historical, evidential, communal and aesthetic value.

7.4.50 The setting of the Chelsea Bridge is partly defined by its relationship with the Embankment Wall along with the north bank of the River Thames and Battersea Park to the south west, which is contemporary with the original 1857 bridge. The bridge forms a prominent feature in views along the river from the site to the east. The relative lack of accretions such as boats, jetties and steps along the river banks to the west of the bridge is a feature of its setting, as are the views from the bridge towards the site, including the Embankment Wall and the mature vegetation behind, as well to the river frontage of Battersea Park and Albert Bridge beyond, illustrated by View of Heritage Value 3. There are also strong view alignments from either end of the bridge, illustrated by Views of Heritage Value 8 and 9, and views from the adjacent railway bridge, illustrated by View of Heritage Value 10. However Ranelagh Gardens and, to a large extent, the Royal Hospital Grounds are screened from the bridge by mature vegetation, even in winter. Given its prominent position on the River Thames, setting makes a strong contribution to the significance of Chelsea Bridge.

Battersea Park

7.4.51 The setting of the Grade II* Registered Battersea Park – a heritage asset of high significance - is partly defined by its river frontage which is characterised largely by mature vegetation, which to an extent screens the park along much of its riverside walkway and road even during winter months. The Embankment walls on the opposite bank in the location of the site appear distant from the riverside promenade of the park, with the distinction between the brickwork and the parapet visible. In the winter the Royal Hospital is largely screened from view, although there are glimpses of the building through the trees. The area of promenade immediately opposite the foreshore site has a tree and planting screen, which partly screens the view even in winter, so within the park clear views are only available from the modern riverside walkway next to Chelsea Bridge and from the eastern part of the promenade. This is illustrated by View of Heritage Value 4. Given its prominent position on the River Thames, setting makes a strong contribution to the significance of Battersea Park.

Construction base case

7.4.52 As detailed in para. 7.3.15 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 the assessment. Similarly as detailed in para. 7.3.16 no other non-Thames Tideway Tunnel project developments would change the baseline for buried heritage assets. therefore the base case is as per the baseline.

7.4.53 For the reasons outlined in para. 7.3.17, the base case in Site Year 2 of construction would remain as per the baseline for the assessment of effects on historic character, appearance and setting.

Operational base case

7.4.54 For the reasons outlined in para. 7.3.24 the base case in Year 1 of operation would remain as per the baseline for the assessment of effects on historic character, appearance and setting of heritage assets.

7.5 Construction effects assessment

Buried heritage assets

7.5.1 Effects of construction works on buried heritage assets 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 setup

7.5.2 The erection of hoardings and the diversion of existing services would locally truncate remains of 19th century ground consolidation behind the existing river wall, of low asset significance, reducing the asset significance to negligible within the affected area. Effects on earlier archaeological resources are not anticipated due to the shallow depth of these works. Given their localised nature these would comprise a low level of impact on this asset of low significance resulting in a **minor adverse effect**. The construction of office and welfare facilities would be within the cofferdam fill material and would have no impact on any heritage assets beneath.

Construction of cofferdams, campshed, permanent scour protection, outfall apron and CSO drop shaft, culverts and chambers

7.5.3 Multi-period archaeological remains are potentially located within the foreshore alluvium and possibly cut into the underlying gravels. Within the area of the temporary cofferdam, soft material (ie alluvium) would be excavated down to the gravels adjacent to the perimeter of the temporary cofferdams and existing river wall (see assumptions in para. 7.3.30), whilst foreshore deposits would be entirely removed from within the permanent cofferdam footprint. This would constitute a high magnitude of impact on any archaeological remains within and beneath the foreshore deposits.

7.5.4 The movement of small plant machinery used to lay the geotextile layer across the cofferdam footprints 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 temporary cofferdam footprint, through rutting and compaction, resulting in a localised high magnitude of impact.

7.5.5 The placement of temporary cofferdam fill material is predicted to have a high magnitude of impact. This would arise from the compression of any remaining buried heritage assets within the foreshore alluvium and gravels where such remains 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.

7.5.6 A jack-up barge would be used to insert the sheet pile walls. This would have a localised impact any buried heritage assets within the footprint of its supports. Within the area of the campshed, foreshore deposits would be removed to an approximate depth of 0.3m, as assumed for the purposes of this assessment. Excavation to a depth of 1.5m within the footprint of permanent scour protection and proposed outfall apron would remove any surviving buried heritage assets within the foreshore alluvium to this depth. These works would have a high magnitude of impact.

7.5.7 Excavation of the CSO drop shaft, culverts and chambers would entirely remove any surviving archaeological remains within the footprint of each construction, which had not previously been removed by the aforementioned activities (see paras 7.5.3–7.5.6) during construction of the temporary cofferdam.

7.5.8 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:

a. There is a high potential for palaeoenvironmental remains of low or medium asset significance. Their localised removal would comprise a **minor adverse effect**.

b. There is an uncertain, possibly moderate, potential for prehistoric artefacts, of low asset significance. Their removal would constitute a **minor adverse effect**.

c. There is an uncertain, possibly moderate, potential for prehistoric settlement or riverside timber structures, of medium or high asset significance, depending on the nature and extent of such remains. The removal of such remains would constitute a **major adverse effect**.

d. There is a low potential for Roman residual artefacts. Any such remains would be of low asset significance. Removal of such remains would constitute a **minor adverse effect**.

e. There is a low potential for medieval fish traps, which might be of medium or high asset significance, depending on their condition and degree of preservation. The removal of such remains, if present, would constitute a **major adverse effect**.

f. There is a high potential for post-medieval remains on the foreshore and riverfront, in the form of wharves, jetties, consolidation dumps and anchor points, of low asset significance. Removal of such remains could constitute a **minor adverse effect**.

Scour around temporary structures

7.5.9 Scour around the temporary cofferdam and campshed would have an impact upon any archaeological remains in the vicinity. The significance of any assets affected would be reduced to negligible, which would constitute a high magnitude of impact for these assets. The significance of effect on heritage assets would be as per that of the cofferdams described in paras. 7.5.3–7.5.6 above.

Construction of the Ranelagh connection tunnel

7.5.10 The Ranelagh connection tunnel between the CSO drop shaft and the existing Ranelagh Sewer, and the connecting culvert from the CSO drop shaft to the overflow weir chamber in the northeastern part of the site, would be bored at a level too deep to have any archaeological impact.

Construction of the Interception and Overflow Weir Chambers

7.5.11 The construction of the chamber on the southern edge of Ranelagh Gardens would be sufficiently deep to remove any archaeological remains from within its footprint. Upper post-medieval deposits in this area might include buried evidence of landscaping and planting for the 18th and 19th century Ranelagh Gardens, which would be of medium asset significance. The magnitude of impact would be low considering the extent of the gardens, the localised removal of such remains and the previous impact of the 19th century sewer. This would constitute a **minor adverse** effect.

Above-ground heritage assets

Physical effects on above-ground heritage assets

Chelsea Embankment

7.5.12 Alterations to the late 19th century (unlisted) river wall (of medium asset significance) including the permanent removal of a short section of the stone parapet (HEA 1I), three associated lamp standards, and trees (which would be replaced by semi-mature plane trees) along with the permanent concealment or loss of the arched outfall opening, would result in a **moderate adverse effect**. The temporary removal of sections of the parapet either side of this, prior to reinstatement, would also result in a temporary **moderate adverse effect**. The permanent removal of the late 19th century outfall apron (HEA 1C) on the foreshore, an asset of medium significance, would constitute a **major adverse effect**.

Royal Hospital Gardens Grade II Registered Park & Garden (includes Royal Hospital Grounds and Ranelagh Gardens)

7.5.13 Part of the brick boundary wall and its railings along the southern edge of Ranelagh Gardens would be dismantled and later reinstated on the completion of the construction works to match the existing wall, with the addition of an approximately 3m wide permanent entrance gate for service maintenance access. The temporary removal of part of this asset of high significance would result in a temporary **major adverse effect**. The permanent removal of a section of railings for a new entrance (low magnitude of impact) and the impact on the integrity of the asset as complete feature in its own right and as part of the Grade II registered park, would result in a **moderate adverse effect**.

Effects on historic character, appearance and setting of above-ground heritage assets

7.5.14 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.

Thames Conservation Area

7.5.15 The temporary removal of parts of the undesignated wall, piers, lamps and trees along the river frontage would alter the historic character and appearance of the Thames Conservation Area. The construction works would be visually intrusive, detracting from views along the embankment from both the east and west and introducing clutter along the river. The magnitude of change would therefore be medium. Given the high significance of the asset, the construction phase would have a **moderate adverse effect**.

7.5.16 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 setting on the heritage value of the entire conservation area, of which only a part is affected by the proposals while some key areas are completely unaffected; whereas the other considers the effect on the townscape character and particular views, which includes non-heritage factors.

Royal Hospital Gardens Grade II Registered Park & Garden (includes Royal Hospital Grounds and Ranelagh Gardens)

7.5.17 Within the site, the proposed development would entail the dismantling and reinstatement post-construction of a short section of the southern brick boundary wall of the Grade II registered Ranelagh Gardens (HEA 1F), along with several trees, which would be replaced with semi-mature trees. The temporary removal of railings and trees along an approximately 39m section of the southern boundary of Ranelagh Gardens would affect both views to and the sense of enclosure within part of southern end of the garden. Cranes would also be visible rising above the trees to the south of the Royal Hospital Grounds. The magnitude of change to the character of the gardens would be medium. Given the high significance of the asset, construction activity would have a **moderate adverse** effect on character prior to reinstatement and replanting at the end of the construction period.

Royal Hospital Conservation Area

7.5.18 The construction works would detract from the setting of the southern part of the Royal Hospital Conservation Area, and thence from the setting of the conservation area as a whole. Cranes would be visible rising above the trees to the south of the Royal Hospital Grounds and hoardings would interrupt views of the central axis of the conservation area and to the embankment. The repaving in front of the Bull Ring Gate would also alter the fringes of the conservation area. The magnitude of change would be medium. Given the high significance of the asset, construction activity would have a **moderate adverse** effect.

The Royal Hospital

7.5.19 The construction works would detract from the partly obscured views from the central axis of the Royal Hospital building along the formal drive to the Bull Ring Gate. It is also likely that cranes would be visible in views southeast from the upper storeys of the building rising above the trees to the south of the Royal Hospital Grounds. The magnitude of change would be medium. Given the high significance of the asset, construction activity would have a **moderate adverse** effect.

Chilianwalla Memorial Obelisk

7.5.20 The construction works would have a slight effect on the setting of the Chilianwalla Memorial Obelisk when viewed along the formal drive from the northwest, being visible in the distance beyond the memorial. The magnitude of change would be low, as the memorial would still be a focal point in the foreground of these views. Given the high significance of the asset, construction activity would have a **minor adverse** effect.

7.5.21 The separate townscape and visual assessment (Section 11) concludes that the works would have a moderate adverse effect upon the wider area around the obelisk. The difference between the two assessments derives from their different methodologies: one considers the effect of the change to setting upon the heritage value of the listed obelisk and its setting; whereas the other considers the effect upon the townscape character and includes non-heritage factors.)

Bull Ring Gate

7.5.22 The construction works would detract from the setting of the Bull Ring Gate when viewed along the formal drive from the northwest, with construction works being visible directly beyond the gate. The magnitude of change would be medium. Given the high significance of the asset, construction activity would have a **moderate adverse** effect.

Chelsea Bridge

7.5.23 The presence of construction works would detract from the rhythm of the regularly spaced piers and lamp standards along the embankment and the relatively uncluttered nature of the river to the west seen in views from Chelsea Bridge. The magnitude of change to the setting of Chelsea Bridge would therefore be medium. Given the high significance of the asset, construction activity would have a **moderate adverse** effect.

7.5.24 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 setting upon the heritage value of the entire setting of the bridge, of which only a part is affected by the proposals; whereas the other considers the effect upon view towards the site from the bridge, and includes non-heritage factors.

Listed Chelsea Embankment wall

7.5.25 The construction works would interrupt the rhythm of the Embankment Wall, and regularly spaced piers, lamps and trees along the river frontage. However, although the work site would alter the overall nature of the Chelsea Embankment, the site would not be prominently visible from the listed part of the Embankment Wall. The magnitude of change would therefore be medium. Given the high significance of the asset, construction activity would have a **moderate adverse** effect.

Battersea Park

7.5.26 The construction works in the river would interrupt the rhythm of piers and the distinction between the lower 1850s brick wall and 1870s parapet of the Embankment Wall in views from parts of Battersea Park. The cranes and orthogonal projection of the cofferdam from the embankment would also alter views from parts of the park, which make a minor contribution to the setting of the park. The magnitude of change would therefore be low. Given the high significance of the asset, construction activity would have a **minor adverse** effect.

7.5.27 The separate townscape and visual assessment (Section 11) concludes that the works would have a moderate 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 setting upon the heritage value of the park, whereas the other assesses effects on townscape character and includes non-heritage factors.

Sensitivity test for programme delay

7.5.28 For the assessment of historic environment 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. A greater proportion of the Chelsea Barracks development would already be built and occupied with a corresponding reduced level of construction activity, but in terms of the historic environment, the effects would remain unchanged from those assessed. The Battersea Power Station development would lead to no change in effects because of its distance from the site.

7.6 Operational effects assessment

Above-ground heritage assets

Effects on the historic character, appearance and setting of above-ground heritage assets

Thames Conservation Area

7.6.1 The proposed development would affect the historic character and appearance of the Thames Conservation Area. The foreshore structure would alter the linear arrangement of the Embankment Wall, and remove a number of sturgeon lamps. This would detract from the rhythm of piers, lamp standards and trees along the river frontage. However, the effect would be minimised by the proposed design of the foreshore structure, which would continue the visual distinction between the earlier 1850s wall and Bazalgette's later alterations. The extension of the existing forecourt area to the fore of the Bull Ring Gate would also accentuate the monumentality of the gates and formal drive leading to the Chilianwalla Memorial Obelisk and central portico of the Royal Hospital. Overall the changes to the conservation area would be localised, resulting in a low magnitude of change. Given the high significance of the asset, the proposed development would have a **minor adverse** effect on the historic character and appearance of the Thames Conservation Area.

7.6.2 The separate townscape and visual assessment (Section 11) concludes that the works would have a moderate adverse effect upon the conservation area. The difference between the two assessments derives from their different methodologies: this assessment considers the effect of the change to setting upon the heritage value of the entire conservation area; whereas the townscape assessment considers the effect upon the townscape of the part of the conservation area closest to the site itself, and includes non-heritage factors.

Royal Hospital Gardens Grade II Registered Park & Garden (includes Royal Hospital Grounds and Ranelagh Gardens)

7.6.3 The extension of the forecourt area in front of the Bull Ring Gate into the river, created by the permanent foreshore structure, would alter the setting of the Royal Hospital Grounds and Ranelagh Gardens. Similarly the removal of the sturgeon lamps would alter its setting. However, this would be offset by the doubling of the forecourt area adjacent to the Bull Ring Gate, which would increase the monumentality of the setting of the grounds and improve the linkage between the Royal Hospital Grounds and the river, referencing the historic link that existed prior to the mid to late 19th century. The main axis of the Royal Hospital grounds would also be emphasised. There would be minimal change to the setting of Ranelagh Gardens, although its character would alter as a result of the changes on its southern edge. There would be no effect on views from the sunken areas of the Royal Hospital Gardens. Overall the magnitude of change to the Registered Park and Garden would be low. Given the high significance of the asset, the proposed development would have a **minor**

beneficial effect on the historic character and setting of the Royal Hospital Grounds and Ranelagh Gardens.

7.6.4 The separate townscape and visual assessment (Section 11) concludes that the works would have a minor adverse effect upon the registered garden. The difference between the two assessments derives from their different methodologies: one considers the effect of the change to setting upon the heritage value of the entire registered garden, of which only a part is affected by the proposals while some key areas are completely unaffected; whereas the townscape assessment considers the effect upon the townscape of the part of the gardens closest to the site itself, and includes non-heritage factors.

Royal Hospital Conservation Area

7.6.5 The proposed development would affect the setting of the Royal Hospital Conservation Area. The removal of a number of sturgeon lamps would detract from the rhythm of piers, lamp standards and trees along the river frontage. However, the effect would be reduced by the proposed design of the foreshore structure, with the granite parapet still being visible beyond the road in views from the conservation area. The extension of the existing forecourt area to the fore of the Bull Ring Gate would have a beneficial effect, emphasising the monumentality of the main axis of the Royal Hospital and its grounds, running from the portico at the centre of the Royal Hospital's south east frontage to and beyond the Bull Ring. Taking into account that the proposals would only affect a part of the Royal Hospital Conservation Area, on balance the overall change would be negligible. Given the high significance of the asset, the proposed development would have a **minor beneficial** effect on the historic character and setting of the Royal Hospital Conservation Area.

7.6.6 The separate townscape and visual assessment (Section 11) concludes that the works would have a minor adverse effect upon the conservation area. The difference between the two assessments derives from their different methodologies: this assessment considers the effect of the change to setting upon the heritage value of the entire conservation area, of which only a part is affected by the proposals while some key areas are completely unaffected; whereas the townscape assessment considers the effect upon the townscape of the conservation area closest to the site itself, and includes non-heritage factors.

Royal Hospital

7.6.7 The proposed foreshore structure would have a limited effect on views from the Royal Hospital. However, the alignment, form and orientation of the proposed forecourt in front of the Bull Ring Gate would accentuate the monumentality of the main historic axis of the hospital that runs through its Doric portico to the River, thus to an extent reinstating its historic relationship with the river, as demonstrated in an 18th century painting of the river frontage[6]. The reinforcement of the axis would emphasise the building's classical symmetry, and the 'pause' that the proposed structure would bring to the mid 19th century embankment, in front of the gates, would also emphasise the building's classical symmetry, by drawing attention to the original intended view of the building from the river. The kiosks would frame this view, in reference to the pavilions that once framed the original river stairs, located on the river frontage of the central axis. The fact that the 1850s embankment would continue largely to delineate the space between the Royal Hospital and the river, means that the relationship between the 17th century building and the 19th century river frontage, that has been a feature of the townscape since the mid 19th century, would largely be preserved except immediately in front of the Bull Ring Gate. Overall, on balance, there would be a medium beneficial change to the setting of the Grade I listed building. Given the high significance of the asset the proposed development would have a **moderate beneficial** effect on the setting of the Royal Hospital.

7.6.8 The separate townscape and visual assessment (Section 11) concludes that the works would have a minor adverse effect upon the wider area around the Royal Hospital. The difference between the two assessments derives from their different methodologies: this assessment considers the effect of the change to setting upon the heritage value of the listed building and its setting; whereas the townscape assessment considers the effect upon the townscape character and includes non-heritage factors.

Chilianwalla Memorial Obelisk

7.6.9 The proposed development would have a limited effect on views to and from the memorial. In the view through the Bull Ring Gate, the line of the Embankment Wall would remain visible, albeit extended into the river, whilst the removal of the sturgeon lamps would marginally diminish the existing arrangement. The obelisk would, however, still retain its role in the views between the Bull Ring Gate and the Royal Hospital. Overall this would result in a low beneficial magnitude of change. Given the high significance of the asset, the proposed development would have a **minor beneficial** effect on the setting of the Chilianwala Memorial Obelisk.

7.6.10 The separate townscape and visual assessment (Section 11) concludes that the works would have a minor adverse effect upon the wider area around the obelisk. The difference between the two assessments derives from their different methodologies: this assessment considers the effect of the change to setting upon the heritage value of the listed obelisk and its setting; whereas the townscape assessment considers the effect upon the townscape character and includes non-heritage factors.

Bull Ring Gate

7.6.11 The proposed extension of the forecourt area into the river, created by the permanent foreshore structure, would alter the setting of the Bull Ring Gate. The removal of part of the Embankment Wall and sturgeon lamps and their replacement by an altered wall would give rise to a low magnitude adverse change. However the doubling of the forecourt area and improvement to its paved surface would increase the monumentality of the setting of the gate, enhancing and drawing attention to the gate and its axial role in the layout of the Royal Hospital complex, and producing a low beneficial change. Overall the change would be negligible. Given the high significance of the asset, the proposed development would have, on balance, a **minor beneficial** effect on the setting of the Bull Ring Gate.

7.6.12 The separate townscape and visual assessment (Section 11) concludes that the works would have a minor adverse effect upon the wider area around the Bull Ring Gate. The difference between the two assessments derives from their different methodologies: this assessment considers the effect of the change to setting upon the heritage value of the listed gate and its setting; whereas the other considers the effect upon the townscape character which would be more affected by the site, and includes non-heritage factors.

Chelsea Bridge

7.6.13 The proposed development would result in a change in the rhythm of the regularly spaced piers and lamp standards along the linear river frontage of the Embankment Wall as viewed from Chelsea Bridge. The linear nature of the river to the west of the bridge would also be altered, through the introduction of the permanent foreshore structure. This would result in a medium magnitude of change. Given the high significance of the asset, the proposed development would have a **moderate adverse** effect on the setting of Chelsea Bridge.

Chelsea Embankment Wall

7.6.14 The projection of the river wall would break up the alignment and rhythm of the wall, piers, lamps and trees of the embankment in views. However, the alterations would not be particularly visible from the listed part of the embankment, which lies some distance away. This would result in a low magnitude of change. Given the high significance of the asset, the proposed development would have a **minor adverse** effect on the setting of the listed Embankment Wall.

7.6.15 The separate townscape and visual assessment (Section 11) concludes that the works would have a moderate adverse effect upon the character area including the wall. The difference between the two assessments derives from their different methodologies: this assessment considers the effect of the change to setting upon the heritage value of the wall; whereas the townscape assessment considers the effect upon the townscape which includes non-heritage factors.

Battersea Park

7.6.16 The proposed development would be visible in views from the northwest promenade and the north east corner of Battersea Park, and the break in the rhythm of piers and lamp standards would be visible. . However, the horizontal division between the parapet and the brick wall river wall below would remain evident. Given the distance between the park and the proposed development, overall this would constitute a low magnitude of change to the setting of the registered park and garden as a whole. Given the high significance of the asset, the proposed development would have a **minor adverse** effect on the setting of Battersea Park.

Sensitivity test for programme delay

7.6.10 For the assessment of historic environment 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. The Chelsea Barracks development is assumed complete and operational but in terms of the historic environment, the effects would remain unchanged from those assessed. The Battersea Power Station development would lead to no change effects because of its distance from the site.

7.7 Cumulative effects assessment

Construction effects

7.7.1 None of the schemes included in the site development schedule (Vol 13 Appendix N) would have a significant cumulative effect on buried heritage assets during construction due to the distance of these schemes from the site.

7.7.2 Likely significant cumulative effects of the presence of construction works at Chelsea Barracks and Battersea Power Station, together with the Thames Tideway Tunnel project, have been assessed.

7.7.3 With regard to the Chelsea Barracks development, it is heavily screened from almost all heritage assets in the assessment area by the numerous mature trees within Ranelagh Gardens and the buildings east of the Royal Hospital and along Chelsea Bridge Road. The works at Chelsea Barracks would have an adverse effect upon the northern part of Ranelagh Gardens, but this is a large and densely wooded open space and consequently these effects would not reach as far as the southern part of the Gardens, and therefore would not give rise to an elevated effect in combination with the proposed Thames Tideway Tunnel project works.

7.7.4 With regard to the construction works at Battersea Power Station, these would be visible from Chelsea Bridge but they would be a considerable distance (around 470m) away, and as a consequence they would not combine with the Thames Tideway Tunnel project works to create an elevated effect upon the setting of Chelsea Bridge. The other heritage assets considered in this assessment which would be significantly affected by the Thames Tideway Tunnel development are further away from Battersea Power Station, and screened by intervening trees and buildings from the proposed development, and so would not experience elevated, cumulative effects.

Sensitivity test for programme delay

7.7.5 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year, a greater proportion of the Chelsea Barracks development would be built and occupied with a corresponding reduced level of construction activity. In terms of the historic environment, the cumulative effects would remain unchanged i.e. there would still be no elevated effects from the Chelsea Barracks development along with the Thames Tideway Tunnel works at the Chelsea Embankment Foreshore site.

Operational effects

7.7.6 There are no schemes identified which would cause an elevated cumulative effect in Year 1 of operation, for the reasons outlined in para 7.3.25 above.

Sensitivity test for programme delay

7.7.7 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately a year, a greater proportion of the Battersea Power Station development would be built and occupied with a correspondingly reduced level of construction activity. In terms of historic environment, however, the effects would remain unaltered from those assessed above i.e. there would be no cumulative effects.

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 might would 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, 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*), 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 in order to mitigate the impacts upon remains of low asset significance on the landward side of the existing river wall (eg, from service diversions).

b. Targeted archaeological excavation within the temporary and permanent cofferdam following the insertion of the pile walls and prior to infilling.

c. For works taking place below low water on the outside of the cofferdams (such as construction of the campshed), archaeological monitoring and scanning of the excavated material would be undertaken.

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*), 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 cofferdam 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 effect on the southern brick boundary wall of the Grade II registered Ranelagh Gardens (which would be reinstated at the end of the construction period), would be mitigated by a Level 1 standing structure survey and recording, forming a brief visual record (English Heritage, 2006)[7], undertaken according to English Heritage specifications. This would ensure sensitive reinstatement is carried out in line with the original structure of the wall.

7.8.8 The adverse effect arising from the introduction of a new entrance in the boundary railings for utility access would be partly mitigated by a Level 1 standing structure survey and recording.

7.8.9 The adverse effect arising from the physical impact of the proposed works on the unlisted section of the Chelsea Embankment would be mitigated by a standing structure survey and photographic recording before any elements are removed. A Level 2 standing structure survey and recording, forming a descriptive record (English Heritage, 2006)[8], would be undertaken according to English Heritage specifications. Archaeological investigation (see para. 7.8.4 above) would also be necessary during the construction of the interception chamber and culverts on the landward side of the river wall, in order to record any subterranean remains associated with the embankment and Ranelagh Gardens.

7.8.10 The adverse effect of the removal of the late 19th century outfall apron on the foreshore, would be mitigated by a Level 2 standing structure survey and recording, forming a descriptive record (English Heritage, 2006)[9], undertaken according to English Heritage specifications.

7.8.11 All measures embedded in the proposed development and *CoCP* of relevance to the assessment of effects on the character and setting of above-ground heritage assets during construction are summarised in Section 7.2. No further mitigation during construction is possible for significant adverse effects due to the highly visible nature of the construction activities.

7.8.12 Similarly no mitigation is possible for significant adverse operational effects further to that embodied within the proposed design and the design principles.

7.9 Residual effects assessment

Construction effects

7.9.1 With the mitigation described above in place, the residual physical construction effects on above-ground and buried heritage assets within the site would be **negligible**, with the exception of the effect arising from the impact of the new entrance gate in the railings of the Grade II registered Ranelagh Gardens. This would be reduced to a residual **minor adverse effect**. Preservation by record would completely mitigate the effect and the new entrance would permanently change understanding of the heritage asset. All residual effects are presented in Section 7.10.

7.9.2 As no mitigation measures are possible for significant adverse effects (or required for non-significant adverse effects) on the historic character, appearance and setting of above-ground heritage assets beyond those embedded in the proposed development and *CoCP*, the residual construction effects on the setting of heritage assets remain as described in Section 7.5. All residual effects are presented in Section 7.10.

Operational effects

7.9.3 As no mitigation measures are possible for significant adverse effects (or required for non-significant adverse 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

7.10.1 This topic assessment has considered both design options for the new permanent foreshore structure: an inter-tidal habitat and floodable public realm. Given that there would not be any differences in terms of the historic environment, the assessment summary table applies to both options.

Vol 13 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				
High potential for Palaeoenvironmental remains (Low or medium asset significance)	Assets affected by the construction of cofferdams, campshed, scour protection, outfall apron and CSO drop shaft, culverts and chambers. Assets removed by scour around temporary structures. Asset significance reduced to negligible.	Minor adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible
	Assets removed by the construction of the Interception and Overflow Weir Chambers. Asset significance reduced to negligible.	Minor adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible
Uncertain, possibly moderate, potential for prehistoric artefacts (Low asset significance)	Assets affected by the construction of cofferdams, campshed, scour protection, outfall apron and CSO drop shaft, culverts and chambers. Assets removed by scour around temporary structures.	Minor adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
	Asset significance reduced to negligible.			
	Assets removed by the construction of the Interception and Overflow Weir Chambers. Asset significance reduced to negligible.	Minor adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible
Uncertain, possibly moderate, potential for prehistoric or riverside structures (Medium or high asset significance)	Assets affected by the construction of cofferdams, campshed, scour protection, outfall apron and CSO drop shaft, culverts and chambers. Assets removed by scour around temporary structures. Asset significance reduced to negligible.	Major adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible
	Assets removed by the construction of the Interception and Overflow Weir Chambers. Asset significance reduced to negligible.	Major adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible
Low potential for Roman artefacts (Low asset significance)	Assets affected by the construction of cofferdams, campshed, scour protection, outfall apron and CSO drop shaft, culverts and chambers. Assets removed by scour around temporary structures. Asset significance reduced to negligible.	Minor adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
	Assets removed by the construction of the Interception and Overflow Weir Chambers. Asset significance reduced to negligible.	Minor adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible
Low potential to contain early or later medieval fish traps (Medium to high asset significance)	Assets affected by the construction of cofferdams, campshed, scour protection, outfall apron and CSO drop shaft, culverts and chambers. Assets removed by scour around temporary structures. Asset significance reduced to negligible.	Major adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible
	Assets removed by the construction of the Interception and Overflow Weir Chambers. Asset significance reduced to negligible.	Major adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible
High potential for the remains of a Victorian pier, and post-medieval remains on the foreshore, including consolidation deposits, anchor points and timber	Assets affected by the construction of cofferdams, campshed, scour protection, outfall apron and CSO drop shaft, culverts and chambers. Assets removed by scour around temporary structures. Asset significance reduced to negligible.	Minor adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
structures (Low asset significance)				
High potential for buried remains associated with landscaping of the 18th and 19th century Ranelagh Gardens (Medium asset significance)	Assets removed by the construction of the Interception and Overflow Weir Chambers. Asset significance reduced to negligible.	Minor adverse	Preliminary evaluation followed by targeted archaeological investigation (archaeological excavation and or watching brief) where appropriate.	Negligible
Above-ground heritage assets				
Grade II registered Ranelagh Gardens, brick boundary wall and railings (High asset significance)	Localised temporary removal of wall and railings (with subsequent reinstatement). Creation of a permanent entrance gate for services access. Asset significance reduced.	Major adverse (temporary removal of railings) Moderate adverse (new entrance)	Standing Structure recording and photographic survey to EH survey level 1, to form preservation by record.	Negligible (temporary removal of railings) Minor Adverse (new entrance)
Unlisted section of the Chelsea Embankment, including the retaining wall, ornamental lamp standards, trees,	Localised removal of the parapet wall, changes to the form of the embankment, removal of outfall apron and risk of damage to the outfall arch. Low impacts from site set-up. Asset significance reduced.	Moderate adverse	Standing Structure recording and photographic survey to EH survey level 2 to form preservation by record.	Negligible

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
and an arch of an outfall sewer (Medium asset significance)				
Late 19th century outfall apron on foreshore beneath the Ranelagh Sewer Outfall (Medium asset significance)	Removal of structure from foreshore Asset significance reduced to negligible.	Major adverse	Standing Structure recording and photographic survey to EH survey level 2, to form preservation by record.	Negligible
Thames Conservation Area (High asset significance)	The construction works would lead to a medium magnitude of change to the historic character of the conservation area.	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the *CoCP* and environmental design principles.	Moderate adverse
Royal Hospital South Grounds and Ranelagh Gardens Registered Park and Garden (High asset significance)	The construction works would lead to a medium magnitude of change to the historic character and setting of the registered park and garden.	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the *CoCP* and environmental design principles.	Moderate adverse
Royal Hospital Conservation Area (High asset	The construction works would lead to a medium magnitude of change to the historic character and setting of the	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the *CoCP* and	Moderate adverse

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
significance)	conservation area.		environmental design principles.	
Royal Hospital (High asset significance)	The construction works would lead to a medium magnitude of change to the setting of the Royal Hospital.	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the *CoCP* and environmental design principles.	Moderate adverse
Chilianwalla Memorial Obelisk (High asset significance)	The construction works would lead to a low magnitude of change to the setting of the monument.	Minor adverse	No mitigation required further to that embodied within the proposed design and the *CoCP* and environmental design principles.	Minor adverse
Bull Ring Gate (High asset significance)	The construction works would lead to a medium magnitude of change to the setting of the gate.	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the *CoCP* and environmental design principles.	Moderate adverse
Chelsea Bridge (High asset significance)	The construction works would lead to a medium magnitude of change to the setting of the bridge.	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the *CoCP* and environmental design principles.	Moderate adverse
Listed Chelsea Embankment River walls	The construction works would lead to a medium magnitude of change to the setting of the listed embankment walls.	Moderate adverse	No mitigation possible further to that embodied within the proposed design	Moderate adverse

Receptor (Heritage asset)	Effect	Significance of effect	Mitigation	Significance of residual effect
(High asset significance)			and the *CoCP* and environmental design principles.	
Battersea Park (High asset significance)	The construction works would lead to a low magnitude of change to the setting of the park.	Minor adverse	No mitigation required further to that embodied within the proposed design and the *CoCP* and environmental design principles.	Minor adverse

Vol 13 Table 7.10.2 Historic environment – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Thames Conservation Area (High asset significance)	The completed public space above the proposed drop shaft would have a low beneficial effect upon the character of the conservation area, by restoring the lost original emphasis given to the main axis of the Royal Hospital, and creating a calming pause in the linearity of the embankment in front of the Bull Ring Gate, which would highlight the axis and associated views. The loss of several lampstands and alteration to the present line of the river wall would lead to a medium adverse change, as it would affect an appreciation of the original design of the wall and outfall. Overall there would be a low magnitude of adverse change.	Minor adverse	No mitigation required further to that embodied within the proposed design and the design principles.	Minor adverse
Royal Hospital South Grounds and Ranelagh Gardens Registered Park and Garden (High asset significance)	There would be a low magnitude of beneficial change to the setting of the edge of the Park and Garden arising from the increased emphasis given to the main axis in the grounds, and a negligible change to views from within the main sunken part of the gardens. The loss of several lamp standards and alteration to the line of the river wall would cause a low adverse change to the setting of the edge of the Park and Garden. The overall magnitude of effect would be low beneficial.	Minor beneficial	None.	Minor beneficial
Royal Hospital Conservation Area (High asset	The setting of Royal Hospital Conservation Area would be enhanced through the expanded and improved public space offering views into it, and by the added emphasis given to the main axis of the	Minor beneficial	None.	Minor beneficial

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
significance)	Hospital, which together would outweigh the loss of several lamp standards along the embankment and alterations to the line of the river wall. Taking into account that the proposals would affect only a small part of the conservation area, on balance the overall magnitude of change would be negligible.			
The Royal Hospital (High asset significance)	There would be a medium beneficial change to the setting of the Hospital arising from the much improved public space from which to view the building, and the restored emphasis upon the main axis of the site, and the Hospital's original connection to the river. The boundary features would remain intact and the changes to the embankment wall would not give rise to a notable change in its appearance from the Hospital, so that there would be negligible adverse changes. Consequently the overall change would be medium beneficial.	Moderate beneficial	None	Moderate beneficial
Chilianwalla Memorial Obelisk (High asset significance)	There would be a low magnitude beneficial change arising from the increased emphasis given to the axis on which the monument lies, enhancing its setting.	Minor beneficial	None	Minor beneficial
Bull Ring Gate (High asset significance)	There would be a low beneficial change to the setting of the gate from the creation of more coherent public space offering a focus on the gate and the main central axis. This would be countered by a lower level of adverse change resulting from the alteration of the shape of the existing public realm in front of the gate.	Minor beneficial	None	Minor beneficial

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	On balance the overall magnitude of change would be negligible.			
Chelsea Bridge (High asset significance)	The projection into the river of the permanent foreshore structure and loss of several lampstandards would be a medium magnitude of change to the setting of the bridge.	Moderate adverse	No mitigation possible further to that embodied within the proposed design and the design principles.	Moderate adverse
Chelsea Embankment river walls (High asset significance)	The river wall projection and removal of lampstandards would represent a low magnitude adverse change to the setting of the listed river wall, given its location some distance away.	Minor adverse	No mitigation required further to that embodied within the proposed design and the design principles.	Minor adverse
Battersea Park (High asset significance)	The break in the linear river wall on the opposite river bank would represent a low magnitude adverse change to the park as a whole.	Minor adverse	No mitigation required further to that embodied within the proposed design and the design principles.	Minor adverse

References

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

[2] Communities and Local Government. *National Planning Policy Framework* (March 2012)

[3] 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)

[4] Halliday, S. *The Great Stink of London: Sir Joseph Bazalgette and the Cleansing of the Victorian Metropolis* (2009), 162.

[5] Cherry, B. and Pevsner, N. *London North-West. The Buildings of England*. Penguin (1991), 562.

[6] Peter Tillemans, *The Royal Hospital from the South Bank of the River Thames* (c.1708-34), Royal Hospital Chelsea.

[7] English Heritage. *Understanding historic buildings: a guide to good recording practice*. Swindon (2006).

[8] English Heritage. See citation above.

[9] English Heritage. See citation above.

This page is intentionally blank

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 8: Land quality

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 8: Land quality

List of contents

Page number

List of tables

Page number

This page is intentionally blank

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 Chelsea 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. 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.

8.1.4 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.

8.1.5 Two options have been considered for the foreshore: Option A would be an area of intertidal habitat and Option B would be a floodable public realm. Both options would not alter the assessment of likely significant effects on land quality as they would not impact on land quality at the Chelsea Embankment Foreshore site. The options are therefore not presented or reported separately for this topic.

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). 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 13 Chelsea 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

The elements of the proposed development relevant to land quality would consist of the following:

a. dredging and construction of a temporary cofferdam including connection to the existing river wall and construction of a campshed situated within the foreshore and construction of a new section of river wall

b. construction of pits, chambers, ducts and pipes for cables, pipes, utility connections and diversions and drainage

c. construction of an offline combined sewer overflow (CSO) drop shaft, the invert of which would be located at a depth of approximately 46m below ground level (bgl) situated within the Lambeth Group

d. construction of Ranelagh connection tunnel between the CSO drop shaft and the main tunnel west

e. construction of an interception chamber, culvert and valve chamber, CSO overflow structures/overflow weir chamber and connection culvert

f. construction of structures for air management plant and equipment including filter and ventilation columns and associated below ground ducts and chambers.

8.2.2 The above works would involve extensive below ground construction, resulting in the excavation and removal of material, including Made Ground and natural soils below.

8.2.3 An area would also be required within the site for construction logistics, such as materials handling and storage areas, segment storage, site welfare facilities and offices (as shown in the Chelsea Embankment Foreshore site construction plans - see separate volume of figures).

Code of construction practice

8.2.4 The embedded design measures relevant to land quality at the site are set out in Section 9 of the *CoCP* and are summarised below. Reference should be made to the *CoCP (Parts A)* for full details.

8.2.5 There are no *CoCP Part B* measures which are relevant to this land quality assessment.

8.2.6 Land quality issues would be managed in close liaison with the local authority, the Royal Borough of Kensington and Chelsea (RBKC) and the Environment Agency (EA) prior to and during construction.

Pre-construction

8.2.7 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 13 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 site-specific desk study for part of the Chelsea Embankment Foreshore site (see Vol 13 Appendix F.3).

c. drilling of boreholes and assessment of soil and groundwater quality.

8.2.8 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 main works and parkland for other works); 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.

8.2.9 It is however considered that the information used to produce this ES would be reformatted into 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 construction works.

Construction

8.2.10 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 are 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.

8.2.11 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).

8.2.12 Existing topsoil and subsoil within the utility diversion works area would be tested in order to categorise them for waste disposal or for re-use (either on or off-site). Where existing soils are to be replaced on completion of the works they would be analysed to ensure that they meet the standards required for re-use. This action would be recorded in a materials management plan (MMP) and agreed with the RBKC prior to replacement.

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 in Vol 13 Table 8.3.1 below.

Vol 13 Table 8.3.1 Land quality - stakeholder engagement

Organisation	Comment	Response
RBKC (April 2011)	Methodology: No further ground investigation is proposed to that already carried out. However, it is recommended that sediment samples are taken from the foreshore at low tide. Until we have had the opportunity to review the investigations carried out so far, we are not able to state whether we accept that no further investigation works are needed.	The statement applies to the environmental impact assessment (EIA) process only; further investigation of the site will be undertaken as part of the construction process.
RBKC (April 2011)	Para. 14.3.11: Operation potential effects This suggests that the public will have access to a new area of river frontage. It will therefore be necessary to demonstrate that any potential land contaminated issues have been dealt with and are no longer a risk. If this is the case, then the operational phase will need to be considered and should not be scoped out at this stage.	The public have been considered in operational assessment which has been scoped out due to the considerable embedded mitigation measures that are proposed.
RBKC (February 2012)	The land use history of the site and adjacent properties has been identified. Whilst we are not aware of any potential industrial sources being present on the sites themselves, it is common for ambient levels of pollution within the soil to be elevated, for example benzo a pyrene. The presence of contamination therefore cannot be discounted entirely and could present a risk.	This is noted, and is already considered in the overall process – the embedded measures within the *CoCP* include the assessment of soil quality for re-use, disposal and risk assessment where necessary.
RBKC (February 2012)	We are concerned about the locations that have been selected for soil sampling. It seems from Figure 8.4.2 (now Vol 13 Figure F.1.2) that only one further borehole is proposed, which is not adequate. We would welcome a discussion about proposed sampling locations for all sites within the Borough.	The borehole in question is part of the Thames Tideway Tunnel project preliminary ground investigation only. Further assessment and investigation will be undertaken as necessary as part of embedded measures within the *CoCP*.

8.3.2 The RBKC were 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 is presented in Vol 13 Appendix F.1 and Vol 13 Appendix F.2.

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) plus 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 in Vol 10 Appendix N. The baseline is not anticipated to change substantially between the base case year and Site Year 1 of construction (2017). There is one development within the 250m buffer area pertinent to land quality (as shown in Table Vol 13 Table 8.3.2) which is likely to be complete and operational before the commencement of the construction phase and as a result forms part of the construction base case.

8.3.8 The developments within the 250m buffer area which are not considered as part of the construction base case are those developed during and after Site Year 1 of construction, these are included within the cumulative effect assessment and are also identified in Vol 13 Table 8.3.2.

Vol 13 Table 8.3.2 construction base case and cumulative assessment development (2017)

Development	Distance from site	Construction base case	Cumulative impact assessment
Royal Hospital, Royal Hospital Road (change of use of Gordon House to single family dwelling with ancillary accommodation)	220m north west	✓	✗

Development	Distance from site	Construction base case	Cumulative impact assessment
Chelsea Barracks, Chelsea Bridge Road(demolition of existing barracks in connection with redevelopment of the site for mixed use, including residential use and open space	205m north	✗	✓

Symbols ✓ applies ✗ does not apply

8.3.9 Section 8.5 details the likely significant effects arising from the construction at the Chelsea 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 given in Vol 2 Section 3.7. A description of the significance criteria is presented in Vol 2 Section 8.5.

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 assumptions specific to the Chelsea 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 currently available 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 up in this assessment is presented in Vol 2.

8.4.3 A baseline report is presented in Vol 13 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 13 Appendix F, this section should also be read in conjunction with Vol 13 Figure F.1.1, Vol 13 Figure F.1.2 and Vol 13 Figure F.1.3 (see separate volume of figures).

Summary of baseline conditions

Geology

8.4.4 The main tunnel site is underlain by a cover of alluvium/ River Terrace Deposits (approximately 4.0m 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 thickness) (See Vol 13 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 historical land uses. No contamination sources were identified within the site boundaries or in the immediate vicinity of the site.

8.4.7 The majority of the site comprises the current River Thames foreshore. The Thames foreshore sediments up the tidal reaches have been found to contain low levels of polycyclic aromatic hydrocarbons and heavy metals from historic land use activities within the wider River Thames and coliforms from sewage discharges.

8.4.8 The levels of various potential contaminants in the sediments are relatively low in terms of risk to human health 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) (see the sediment sampling report Vol 2 Appendix F.2).

8.4.9 The majority of the excavated materials at the site from the drop shaft are therefore expected to be essentially uncontaminated.

8.4.10 The remainder of the area comprises the highway and a small section of Ranelagh Gardens. It is considered unlikely that widespread contamination would be present at the site, although elevated lead and polyaromatic hydrocarbons (PAHs) can be associated with near surface soils adjacent to highways due to atmospheric deposition from vehicle emissions (although contamination is usually restricted to the very shallow soils only).

8.4.11 Overall, on the basis of the current information, it considered that the site has a low risk of containing contaminated soils or groundwater above general background levels (in particular the majority of the site which is located over the river foreshore).

8.4.12 A stand of Japanese Knotweed has been recorded adjacent to the LLAU.

UXO

8.4.13 A desk based assessment for UXO threat was undertaken for the proposed development 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.

8.4.14 The report advises that no high explosive bomb strikes occurred within the proposed construction areas, however one bomb strike occurred within the buffered site boundary and a further five within 100m of the buffered site boundary.

8.4.15 The proposed construction areas have not been redeveloped since WWII and thus unlikely to have removed buried UXO items. As a result Area A (land based construction area) was given a low/medium risk rating and Area B (foreshore and river) was given a high risk rating).

Summary of receptors

8.4.16 The receptors identified at this site from the baseline survey (see Vol 13 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), workers in the off-site commercial/retail properties and Thames Path users (low sensitivity) and Ranelagh Gardens users (medium sensitivity)

c. built environment: listed structures/buildings ie, Royal Hospital entrance gates, sewer vent and Chelsea Embankment (all high sensitivity) and other non listed structures including river wall, commercial/retail and residential properties (low sensitivity)

Construction base case

8.4.17 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 (base case).

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 8.4.15 may interact with the receptors identified during the construction phase (see para. 8.4.16) 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 or through the spread of Japanese Knotweed rhizome impacted soils excavated as part of construction works

8.5.4 The SPR interactions are summarised in Vol 13 Table 8.5.1. For simplicity the various sources identified have been grouped together into the different phases which they may be found (ie, solid, liquid, and gaseous), as these interact with receptors in a similar manner.

Vol 13 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
Japanese knotweed	N/A	N/A	Spread of rhizomes

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 them 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 comprises advice from a specialist contractor who is experienced at 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 Chelsea Embankment Foreshore, this is likely to include site-specific risk assessments, safe methods of work/tool box talks and emergency response procedure 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 Chelsea Embankment Foreshore.

8.5.15 In addition there are a number of standard measures within the *CoCP* that 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 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/retail land-users and Ranelagh Gardens and Thames Path 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 effect 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/retail land-users and Ranelagh Gardens and Thames Path 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 effect would occur).

Built environment

8.5.21 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 from UXO and Japanese Knotweed to the built environment associated with the construction phase of the proposed development.

UXO

8.5.22 Impacts from existing land quality relate to the accidental detonation of UXO during preliminary surveys or main construction works.

8.5.23 With the embedded design 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 receptor sensitivity, it is considered that the proposed development would result in a **negligible** effect to the commercial/retail and residential buildings and river wall and a **minor adverse** effect on the listed structures/buildings ie, Royal Hospital entrance gates, sewer vent and Chelsea Embankment.

Japanese Knotweed

8.5.25 Impacts from existing land quality relate to the spread of Japanese Knotweed which, if left uncontrolled, can cause damage to structures and services.

8.5.26 With the embedded design measures in place the overall magnitude of the impact to the built environment is assessed to be negligible.

8.5.27 Based on the assessed impact magnitude and receptor sensitivity, it is considered that the proposed development would result in a **negligible** effect to the commercial/retail and residential buildings and river wall and a **minor adverse** effect on the listed structures/buildings ie, Royal Hospital entrance gates, sewer vent and Chelsea Embankment.

8.6 Operational effects assessment

8.6.1 Operational effects have not been assessed for land quality (see para 8.1.4).

8.7 Cumulative effects assessment

Construction effects

8.7.1 Of the projects described in Vol 13 Appendix N, which could potentially give rise to cumulative effects with the proposed development at Chelsea

Embankment Foreshore, one development has been identified (see Vol 13 Table 8.3.2).

8.7.2 No cumulative effects of land quality are expected during the construction of the Thames Tideway Tunnel project, since impacts are constrained to the footprint of the development by the measures incorporated in the *CoCP*.

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 required.

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 13 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 caused by exposure to contaminated soils, liquids, sediment, soil gases / vapours	Negligible	None	Negligible
	Health effects from detonation of UXO	Negligible	None	Negligible
Construction workers – below ground site staff (High)	Health effects caused by exposure to contaminated soils, liquids, sediment, soil gases / vapours	Minor adverse	None	Minor adverse*
	Health effects from detonation of UXO	Minor adverse	None	Minor adverse*
Adjacent land - users – workers in surrounding commercial and retail properties and Thames Path users (Low)	Health effects caused by exposure to wind-blown dusts or vapours	Negligible	None	Negligible
	Health effects from detonation of UXO	Negligible	None	Negligible
Adjacent land - users – Ranelagh Garden users (Medium)	Health effects caused by exposure to wind-blown dusts or vapours	Negligible	None	Negligible
	Health effects from detonation of UXO	Negligible	None	Negligible
Adjacent land - users – residences (High)	Health effects caused by exposure to wind-blown dusts or vapours	Minor adverse	None	Minor adverse*
	Health effects from detonation of UXO	Minor	None	Minor

Receptor (sensitivity)	Effect	Significance of effect	Mitigation	Significance of residual effect
		adverse		adverse*
Built environment – commercial/retail and residential properties and river wall (Low)	Damage to structures from detonation of UXO during construction works	Negligible	None	Negligible
	Damage to structures from spread of Japanese Knotweed.	Negligible	None	Negligible
Built environment – listed structures/buildings ie, Royal Hospital entrance gates, sewer vent and Chelsea Embankment (High)	Damage to listed structures from detonation of UXO.	Minor adverse	None	Minor adverse*
	Damage to structures from spread of Japanese Knotweed.	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).

This page is intentionally blank

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 9: Noise and vibration

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 9: Noise and vibration

List of contents

Page number

List of tables

Page number

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 Chelsea Embankment Foreshore site.

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 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 Vol 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 13 Chelsea 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 when 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 13 Sections 3.3 and 12.2.

Construction activities

9.2.3 Vol 13 Section 3.3 sets out the assumed construction duration and programme for the Chelsea 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 chambers and culvert works

i. landscaping (including construction and fit-out of permanent facility).

9.2.5 Further detail on the plant used in these construction stages is given in Vol 13 Appendix G.2.

9.2.6 Working hours have been subject to consultation with the local authority. As part of the *Code of Construction Practice (CoCP)*[ii] 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 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 approximately four months.

Code of Construction Practice

c. The *CoCP Part A* (Sections 4.3 and 6.4) specifies the use of best practicable means (BPM) to reduce noise and vibration effects.

[ii] 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).

Generic measures include careful selection of construction plant construction methods and programming

d. equipment would be suitably sited so as to minimise noise impact on sensitive receptors

e. use of site enclosures, and temporary stockpiles to provide acoustic screening

f. choice of routes and programming for the transportation of construction materials, excavated material and personnel to and from the site

g. careful programming so that activities which may generate significant noise would be planned with regard to local occupants and sensitive receptors.

h. hoarding would be of a height and extent to achieve appropriate noise attenuation.

9.2.7 There are no site specific measures incorporated into the *CoCP Part B*.

Operation

9.2.8 An underground air treatment chamber would be connected to ventilation columns. Air discharging through the ventilation columns would have the potential to create noise impacts, and these are considered in the assessment.

9.2.9 An electrical and control kiosk would be constructed to contain plant to control penstocks and to monitor the operation of the tunnel.

9.2.10 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

9.2.11 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 Chelsea Embankment Foreshore site, receptors within the Royal Borough (RB) of Kensington and Chelsea have been considered, alongside receptors on the opposite bank of the Thames which lie within London Borough (LB) Wandsworth (see paras. 9.3.17-9.3.18). Receptors to the east of Chelsea Bridge Road lie within the City of Westminster.

9.2.12 The environmental design measures have considered the following noise sources:

a. hydraulic plant for penstock operation (pumps, motors)

b. uninterruptable power supply (UPS) plant.

9.2.13 In considering the noise from the above items, the sound insulation of the housing for the equipment has been taken into consideration.

9.2.14 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 Vol 2 Section 9 Environmental assessment methodology documents the overall engagement which has been undertaken in preparing the ES. 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, and limits for plant noise from the operation of the site were agreed with RB Kensington and Chelsea.

9.3.3 Limits for plant noise from the operation of the site were also agreed with LB of Wandsworth and Westminster City Council.

9.3.4 Additional consultation on the survey methodology was undertaken with regards to the need for continuous monitoring locations. For this site it was agreed that representative data could be obtained by leaving an unattended continuous monitoring kits securely within the Royal Hospital Gardens overnight for a typical weekday and weekend.

9.3.5 Consultation comments relevant to this site for the assessment of noise and vibration are presented Vol 13 Table 9.3.1. There were no other site specific comments from stakeholders in relation to noise and vibration raised at scoping or other consultation stages.

Vol 13 Table 9.3.1 Noise and vibration – Consultation comments

Organisation	Comment	Response
RB of Kensington and Chelsea, scoping response, March 2011	Although the *Scoping Report* considers that noise effects from construction are unlikely to impact on Chelsea Bridge Road, for the sake of clarity the appropriate assessment of noise propagation to this street should be included in the EIA.	Residential properties on Chelsea Bridge Road have been included in the assessment.
RB of Kensington and Chelsea, Phase 2 response, February 2012	Human response to vibration during construction is predicted to be well below that of “Low Probability of Adverse Comment” as per BS 6472:2008 at the worst affected floor of the existing dwellings. The peak vibration velocity is also predicted at well below that such as to cause cosmetic building damage. At these distances vibration effects would be	Baseline vibration data has not been obtained as the vibration assessment is based on absolute criteria, not relative criteria. Hence the assessment of vibration exposure

Organisation	Comment	Response
	anticipated not to be significant. However, the existing baseline vibration magnitudes are not presented, this should be included for comparison, if not here, but in the ES.	would be determined from the predicted magnitude of construction vibration not the change in vibration.
RB of Kensington and Chelsea, Phase 2 response, February 2012	Noise and vibration from plant and equipment in the operational phase will be designed to ensure compliance with RBKC LDF- Noise SPD. Noise and vibration emitted from plant and equipment will be required to comply with RBKC LDF Noise SPD. This will include air noise and fan noise from ventilation stacks.	A design rating level of 10dB below the background noise level has been adopted at this site which is compliant with the RBKC requirements. An assessment of noise associated with the tunnel filling is presented in this chapter.

Baseline

9.3.6 The baseline methodology follows the methodology provided in Vol 2 Section 9. There are no site specific variations for this site.

Construction

9.3.7 The assessment methodology for the construction phase follows that described in Vol 2 Section 9. There are no site specific variations for undertaking the construction assessment of this site.

9.3.8 Section 9.5 details the likely significant effects arising from the construction at the Chelsea 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.

9.3.9 The construction noise and vibration assessment has considered the effects across the whole duration of the construction phase (Years 1 to 4) 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).

9.3.10 Of the schemes outlined in the site development schedule (see Vol 13 Appendix N) the proposals for the Royal Hospital Chelsea are considered relevant to the base case. However the hospital is already considered as a receptor in the base case and as such these proposals are considered where relevant in the assessment of that receptor.

9.3.11 The Chelsea Barracks development is also considered relevant to the construction cumulative assessment as it would be under construction at the same time as the Thames Tideway Tunnel project.

9.3.12 All other schemes in the site development schedule (see Vol 13 Appendix N) are outside of the assessment screening distance of 300m and are therefore not considered in this assessment.

9.3.13 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 Vol 2 Section 9. 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. 9.5.34.

9.3.14 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

9.3.15 As described in Vol 2 Section 9 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

9.3.16 The operational phase assessment methodology follows the methodology provided in Vol 2 Section 9. Site specific variations to this methodology are set out below.

9.3.17 For this site, at residential receptors RB of Kensington and Chelsea requires that 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.

9.3.18 Receptors to the east of Chelsea Bridge Road lie within the City of Westminster, and those on the south side of the River Thames are in LB of Wandsworth. The LB of Wandsworth and Westminster City Council policies for fixed plant are the same as that described above for RB Kensington and Chelsea.

9.3.19 The operational assessment year is taken to be Year 1 of operation.

9.3.20 Section 9.6 details the likely significant effects arising from the operation of the Chelsea 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.

9.3.21 Of the schemes identified in the site development schedule (see Vol 13 Appendix N), the Royal Hospital (Orangery) and Chelsea Barracks residential developments are considered relevant as they would be complete by Year 1 of operation. There are no developments relevant to the operational cumulative assessment at this site because due to their use, none are expected to generate significant noise or vibration levels during their operation.

9.3.22 Based on the traffic flow, speed or composition change criteria specified in Vol 2 Section 9, there are no routes where potential for operational traffic noise effects would occur.

9.3.23 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

9.3.24 Operational effects are considered up to 300m from the site boundary, although the focus is on the closest receptors.

Assumptions and limitations

9.3.25 The generic assumptions and limitations associated with this assessment are presented in Vol 2 Section 9. The site specific assumptions are presented in the following section. There are no site specific limitations.

Assumptions

9.3.26 The working hours assumed for the assessment are as described in para. 9.2.6.

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 full 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 13 Appendix G.1. Vol 13 Table 9.4.1 below shows that the noise levels for the area are heavily influenced by road traffic noise from the Chelsea Embankment.

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 13 Table 9.4.1 below (and shown in plan view in Vol 13 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 13 Table 9.4.2.

9.4.5 The nearest residences to the site are on Chelsea Gardens (in the City of Westminster) to the northeast of the site and Embankment Gardens (in RB Kensington and Chelsea) to the northwest of the site. Other residential dwellings at 1-15 Pavilion Court on Chelsea Bridge Road (City of Westminster), at the Royal Hospital (RB Kensington and Chelsea) and on the south bank of the Thames at Chelsea Bridge Wharf (LB Wandsworth) have also been assessed. The Lister Hospital and Ranelagh Gardens (non-residential receptors) have also been assessed.

9.4.6 Beyond these closest receptors there are other sensitive properties which are screened from the site by intervening buildings, or are located further from the site than the buildings included in the assessment. These properties include Hepworth Court, Hirst Court, the Wellington Buildings and Chelsea Gate and have been considered as secondary receptors to the closest receptors.

Receptor sensitivity

9.4.7 The noise and vibration sensitive receptors have been assessed according to their sensitivity, using the methodology outlined in Vol 2 Section 9.4. The sensitivities of all assessed receptors are presented in Vol 13 Table 9.4.1.

Vol 13 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, dBL_{Aeq}*	Noise survey location
CE1	1-15 Pavilion Court (residential)	High	Westminster City Council	72/71/66	CEF04
CE2	1-104 Chelsea Gardens (residential)	High	Westminster City Council	72/71/66	CEF04

Ref	Receptor addresses	Sensitivity	Local authority	Measured average ambient noise level, day/ evening / night, dBL_{Aeq}*	Noise survey location
CE3	21-23 Embankment Gardens (residential)	High	RB Kensington and Chelsea	80/78/75	CEF03
CE4	13-16 Embankment Gardens (residential)	High	RB Kensington and Chelsea	63/62/58	CEF02 & CEF03
CE5	The Lister Hospital, (hospital)	High	Westminster City Council	72/71/66	CEF04
CE6	Ranelagh Gardens (park)	Medium	RB Kensington and Chelsea	60/-/-	CEF02
CE7	Royal Hospital (residential)	High	RB Kensington and Chelsea	58/54/53	CEF05
CE8	Chelsea Bridge Wharf (residential)	High	LB Wandsworth	72/71/66	CEF04

** Noise level includes correction for façade acoustic reflection unless receptor position is an open outdoor space (eg park)*

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 Chelsea Embankment Foreshore site are as shown in Vol 13 Table 9.5.2. As described in the assessment methodology, this follows the method as defined in Vol 2 Table 9.5.1.

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 13 Table 9.5.2) using the impact criteria described in Vol 2

Section 9.5 (where appropriate) and other factors described in Vol 2 Section 9.

Vol 13 Table 9.4.2 Noise – residential receptors and 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	Impact criterion threshold level*, day, dBL$_{Aeq}$ 10hour/ evening dBL$_{Aeq}$ 1hour/ night, dBL$_{Aeq}$ 1hour
CE1	1-15 Pavilion Court (residential)	70/70/65	C/C**/C**	75/71/66
CE2	1-104 Chelsea Gardens (residential)	70/70/65	C/C**/C**	75/71/66
CE3	21-23 Embankment Gardens (residential)	80/80/75	C**/C**/C**	80/78/75
CE4	13-16 Embankment Gardens (residential)	65/60/60	B/C/C**	70/65/58
CE7	Royal Hospital (residential)	60/55/55	A/B/C	65/60/55
CE8	Chelsea Bridge Wharf (residential)	70/70/65	C/C**/C**	75/71/66

** From method as defined in Volume 2*
***Where the ambient noise level is greater than category C levels the ambient noise level will be used as the significance criterion threshold.*

Construction base case

9.4.11 The construction base case taking into account the schemes described in Section 9.3 would include the scheme within the Royal Hospital grounds (the Orangery redevelopment).

9.4.12 The noise levels, as measured during the baseline noise survey in 2011, are assumed for the base case. 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 and the potential for additional construction noise from nearby developments). The assessment based on data from 2011 therefore presents a worst-case assessment.

9.4.13 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 the first year of construction.

9.4.14 No existing or future major sources of vibration 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

9.4.15 The base case in Year 1 of operation taking into account the schemes described in Section 9.3 would change from the construction phase since the Chelsea Barracks and Royal Hospital scheme (Orangery) developments would be complete and operational and therefore included as receptors in the assessment.

9.4.16 The base case has been estimated from traffic flow expectations for Year 1 of the operational phase as 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 13 Table 9.5.1 and Vol 13 Table 9.5.2. The tables show the range of predicted construction noise levels during the entire period of 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 13 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, Plates G.6 to G.13 in Vol 13 Appendix G.1 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.

9.5.3 The predicted impacts at each representative receptor location are described below, and section 9.10 summarises the assessed significance of effects resulting from all sources of noise and vibration based on the extent of the impacts identified and the particular use of the receptor.

Impacts at residential receptors

9.5.4 The results for residential receptors are shown below.

Vol 13 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 construction noise levels, dBL_{Aeq}	Magnitude		
				Total duration above criterion for <u>all</u> 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
CE1/ 1-15 Pavilion Court (15)	75	42 – 62 (day)	51	0	-13	0
	71	47 – 48 (eve)	48	0	-23	0
	66	47 – 48 (night)	47	0	-18	0
CE2/ 1-104 Chelsea Gardens (104)	75	52 – 66 (day)	64	0	-9	0
	71	53 – 56 (eve)	56	0	-15	0
	66	53 – 56 (night)	53	0	-10	0
CE3/ 21-23 Embankment Gardens (2)	80	53 - 65 (day)	54	0	-15	0
	78	45 – 55 (eve)	55	0	-23	0
	75	45 – 55 (night)	55	0	-20	0
CE4/ 13-16 Embankment Gardens (4)	70	55 - 68 (day)	55	0	-2	0
	65	36 – 47 (eve)	47	0	-18	0
	58	36 – 47 (night)	47	0	-11	0
CE7/ Royal Hospital (50)	65	44 - 62 (day)	44	0	-3	0
	60	36 – 44 (eve)	44	0	-16	0
	55	36 – 44 (night)	44	0	-11	0
CE8/ Chelsea Bridge Wharf (50)	75	51 - 61 (day)	56	0	-14	0
	71	47 – 51 (eve)	51	0	-20	0
	66	47 – 51 (night)	51	0	-15	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*

1-15 Pavilion Court (CE1)

9.5.5 Pavilion Court is a four storey residential development located more than 200m from the main site. The upper floors would have a partial view of the site although the majority would be screened by the site hoarding. The predicted noise levels at these dwellings due to construction activities are shown in Vol 13 Table 9.5.1

9.5.6 The typical daytime noise levels (most frequently occurring monthly level) is 51dBL_{Aeq}. The worst-case noise level of 62dBL_{Aeq} would occur during the site establishment works.

9.5.7 During the evening and night time, the construction of the connection tunnel is expected to cause the worst-case noise level of 48dBL_{Aeq} for both periods.

9.5.8 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor at any time during the day, evening or night. The effect is therefore **not significant.**

9.5.9 To the rear of Pavilion Court lie Hepworth Court and Hirst Court, both of which are further away from the site than Pavilion Court and would benefit from additional screening by these buildings. The impact of noise on these buildings would therefore be lower and no significant effect is identified for these buildings either.

1-104 Chelsea Gardens (CE2)

9.5.10 1-104 Chelsea Gardens is a six storey residential building located on Chelsea Bridge Road approximately 115m from the main site. The upper floors would have a partial view of the site although the majority would be screened by the site hoarding. The predicted noise levels at these dwellings due to construction activities are shown in Vol 13 Table 9.5.1.

9.5.11 The typical daytime noise levels (most frequently occurring monthly level) is 64dBL_{Aeq}. The worst-case noise level of 66dBL_{Aeq} would be due to the site establishment works.

9.5.12 During the evening and night time, the construction of the connection tunnel is expected to cause the worst-case noise level of 56dBL_{Aeq} for both periods.

9.5.13 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor at any time during the day, evening or night. The effect is therefore **not significant.**

9.5.14 To the immediate rear of the residences on Chelsea Gardens lie the Wellington Buildings, and Chelsea Gate. These are further away from the development and would be screened from the construction works by the properties on Chelsea Gardens, and as such a significant is not predicted to these properties.

21-23 Embankment Gardens (CE3)

9.5.15 21-23 Embankment Gardens is a five storey residential building located approximately 100m from the main site. The upper floors would have a partial view of the site although the majority would be screened by the site hoarding. The predicted noise levels at these dwellings due to construction activities are shown in Vol 13 Table 9.5.1.

9.5.16 The typical daytime noise levels (most frequently occurring monthly level) is 54dBL_{Aeq}. The worst-case noise level of 65dBL_{Aeq} would be due to the site establishment works.

9.5.17 During the evening and night time, the construction of the connection tunnel is expected to cause the worst-case noise level of 55dBL_{Aeq} for both periods.

9.5.18 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor at any time during the day, evening or night. The effect is therefore **not significant.**

13-16 Embankment Gardens (CE4)

9.5.19 13-16 Embankment Gardens is a five storey residential building located approximately 150m from the main site. The upper floors would have a partial view of the site although the majority would be screened by the site hoarding. The predicted noise levels at these dwellings due to construction activities are shown in Vol 13 Table 9.5.1.

9.5.20 The typical daytime noise levels (most frequently occurring monthly level) is 55dBL_{Aeq}. The worst-case noise level of 68dBL_{Aeq} would be due to the site establishment works.

9.5.21 During the evening and night time, the construction of the connection tunnel is expected to cause the worst-case noise level of 47dBL_{Aeq} for both periods.

9.5.22 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor at any time during the day, evening or night. The effect is therefore **not significant.**

Royal Hospital (CE7)

9.5.23 The Royal Hospital residential development is a four storey building located approximately 250m from the main site. The upper floors would be screened by the site hoarding. The worst-case predicted noise levels at these dwellings due to construction activities are shown in Vol 13 Table 9.5.1.

9.5.24 The typical daytime noise levels (most frequently occurring monthly level) is 44dBL_{Aeq}. The worst-case noise level of 62dBL_{Aeq} would be due to the site establishment works.

9.5.25 During the evening and night time, the construction of the connection tunnel is expected to cause the worst-case noise levels of 44dBL_{Aeq} for both periods.

9.5.26 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor at any time during the day, evening or night. The effect is therefore **not significant.**

9.5.27 The residential receptor at the Orangery is also part of the Royal Hospital and the building nearest to the worksite is approximately the same distance from the development as the main hospital building. The effect to this receptor is therefore also not significant.

Chelsea Bridge Wharf (CE8)

9.5.28 Chelsea Bridge Wharf residential development is a nine storey residential building located approximately 300m from the main site on the opposite bank of the Thames. The upper floors would have a partial view of the site although the majority would be screened by the site hoarding and existing structures. The predicted noise levels at these dwellings due to construction activities are shown in Vol 13 Table 9.5.1.

9.5.29 The typical daytime noise levels (most frequently occurring monthly level) is 56dBL_{Aeq}. The worst-case noise level of 61dBL_{Aeq} would be due to the site establishment works.

9.5.30 During the evening and night time, the construction of the connection tunnel is expected to cause the worst-case noise levels of 51dBL_{Aeq} for both periods.

9.5.31 The construction noise levels are not estimated to exceed the potential significance criteria for a residential receptor at any time during the day, evening or night. The effect is therefore **not significant.**

Impacts at non-residential receptors

9.5.32 The results for non-residential receptors are shown below.

Vol 13 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 construction noise levels, dBL_{Aeq}	Magnitude	
					Total duration above ambient for all works, months	Worst-case excess above ambient, dBL_{Aeq}
CE5/ The Lister Hospital	High	51 – 67 (day)	72	65	0	-5
		53 – 56 (eve)	71	53	0	-15
		53 -56 (night)	66	53	0	-10

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 construction noise levels, dBL_{Aeq}	Magnitude	
					Total duration above ambient for <u>all</u> works, months	Worst-case excess above ambient, dBL_{Aeq}
CE6/ Ranelagh Gardens	Medium	44 – 65 (day)	60	44	5	+5

[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*

The Lister Hospital (CE5)

9.5.33 The Lister Hospital is located approximately 110m from the main site boundary. The prediction has been made at the upper floor of the hospital, as this part of the building would be expected to be subject to the highest construction noise levels.

9.5.34 The typical daytime noise levels (most frequently occurring monthly level) is 65dBLAeq as shown in Vol 13 Table 9.5.2. The worst-case noise levels of $67dBL_{Aeq}$ during the daytime, and $56dBL_{Aeq}$ during the evening are substantially less than the ambient noise level for the respective periods.

9.5.35 This is therefore assessed as **not significant**.

Ranelagh Gardens (CE6)

9.5.36 Ranelagh Gardens is located on the north side of Chelsea Embankment. The prediction is made at a position close to the centre of the park. The majority of the works would be screened by the site hoarding.

9.5.37 The typical daytime noise levels (most frequently occurring monthly level) is $44dBL_{Aeq}$ as shown in Vol 13 Table 9.5.2. The worst-case noise level of $65dBL_{Aeq}$ would occur during the site setup works. The measured ambient noise levels are currently above guideline noise levels for outdoor public open spaces. An increase of 5dB(A) above ambient noise level is described in BS 5228 (British Standards Institution, 2009)[3] as a significance threshold for public open spaces; in this case the ambient noise level is exceeded by 5dB(A) for only one month. The exceedances above ambient noise level at other periods (ie four months) would be less than 5dB(A) above ambient noise level. The receptor is not considered to be as sensitive as a residential location. Given the level of impact and the nature of use, the effect is assessed as **not significant**.

Road-based construction traffic

9.5.38 The location of the site adjacent to Chelsea Embankment provides direct access to the major road network through London. The construction programme would result in varying traffic generation over a period of three and a half years. During the peak construction period the traffic generation is forecast to average 42 heavy goods vehicles per day (equivalent to 84 movements a day).

9.5.39 The major road links adjacent to and leading to the site are Chelsea Bridge Road, Grosvenor Road, Ebury Bridge Road, Royal Hospital Road, Lower Sloane Street and Pimlico Road. Construction vehicles would not use other local roads such as St. Barnabas Street and Bloomfield Terrace.

9.5.40 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, which is considered to be the minimum change perceptible to the human ear. Additionally, a change in heavy vehicles composition (HGV) of 5% is also considered to cause a change in noise level of approximately 1dB.

9.5.41 The traffic modelling shows that the 18hr Annual Average Weekday Traffic (AAWT) flow on Chelsea Embankment, which is adjacent to the site, is currently slightly below 37,000 vehicles per day (vpd), with average speeds of 26 mph (42 kph) and 15.3 % Heavy Vehicles (HGVs). The total number of HGVs is therefore currently over 5,600 per day.

9.5.42 Chelsea Bridge Road currently has the highest 18hr AAWT flow, with over 38,000 vpd and 7.4% HGVs. The 18hr flows on other roads are varied, with flows ranging from approximately 38,000 vpd to approximately 10,000 vpd. The majority of these roads have a higher percentage of HGVs than Chelsea Bridge Road.

9.5.43 The modelling of construction traffic on these links shows that the highest percentage increase in total flow due to construction HGVs would occur on Chelsea Embankment. The average daily number of construction HGVs on this link during the peak month of construction is 42 and the daily number of worker cars and office/operational light vehicles is 14, with the number of cars and light vehicles consistent across the construction period. This represents a percentage increase in flow of less than 1%.

9.5.44 Additionally, the modelling of the construction traffic on these links shows that the highest increase in HGV proportion would occur on Chelsea Bridge Road and Chelsea Embankment. The average daily number of construction HGVs on these links during the peak month of construction is 42, which represents an increase in HGV proportion of less than 0.1%.

9.5.45 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

9.5.46 The use of river barges for the transport of materials to and from the site could result in noise impacts at nearby receptors.

9.5.47 The movement of these barges would be at appropriate stages in the tide. In between times and during standard working hours, the moored barges would be unloaded or loaded. Noise measurements for such activity have been reported in other studies (Peter Brett Associates)[4]. The engine noise from movement of the barges on the river Thames is limited to 75dB(A) at 25m (Port of London Authority)[5].

9.5.48 The use of tugs is planned during the construction period, operating three times a day with the tide. The former period would comprise one barge with one tug, whilst in the latter period there would be two barges with one tug. Each movement (delivery and removal) would be around 20 minutes, totalling 60 minutes over three periods in one day.

9.5.49 The operation, loading and removal of the river barges which takes place within the site boundary has been considered in the construction noise assessment in paras. 9.5.1-9.5.37.

9.5.50 The operation of the tugs on the river outside of the site boundary have been assessed in relation to the nearest residential receptors, Pavilion Court to the east and Embankment Gardens to the west.

9.5.51 Tugs would operate at a minimum distance of 100m from Pavilion Court. At this distance the predicted noise from this activity during the daytime (7am until 11pm) would be 51dBL_{Aeq} at the receptor. The survey indicates the daytime noise level at this location is 72dBL_{Aeq} (see Vol 13 Appendix G.1 Vol 13 Table G.10) which is greater than the tug noise and therefore the noise from river based construction traffic is considered to be **not significant**.

9.5.52 Tugs would operate at a minimum distance of 70m from Embankment Gardens. At this distance the predicted noise from this activity during the daytime (7am until 11pm) would be 54dB$L_{Aeq,}$at the dwelling. The survey indicates the daytime noise level at this location is 80dBL_{Aeq} (see Vol 13 Appendix G.1, Vol 13 Table G.10) which is greater than the tug noise and therefore the noise from river based construction traffic is considered to be **not significant**.

Vibration

9.5.53 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.

9.5.54 The assessment has been conducted using the methodology defined in Vol 2 Section 9.

9.5.55 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 13 Table 9.5.3.

Vol 13 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
CE1	1-15 Pavilion Court	<0.1	High	Below "low probability of adverse comment" - No impact
CE2	1-104 Chelsea Gardens	<0.1	Medium	Below "low probability of adverse comment" - No impact
CE3	21-23 Embankment Gardens	<0.1	Medium	Below "low probability of adverse comment" - No impact
CE4	13-16 Embankment Gardens	<0.1	Medium	Below "low probability of adverse comment" - No impact
CE5	The Lister Hospital, Chelsea Bridge Rd	<0.1	High	Below "low probability of adverse comment" - No impact
CE6	Ranelagh Gardens	<0.1	Medium	Below "low probability of adverse comment" - No impact
CE7	Royal Hospital	<0.1	High	Below "low probability of adverse comment" - No impact
CE8	Chelsea Bridge Wharf	<0.1	High	Below "low probability of adverse comment" - No impact

**Most affected floor*

9.5.56 The predicted eVDV levels at all receptors fall within or below the 'Low probability of adverse comment' band, as described in Vol 2 Section 9 and therefore significant effects are not anticipated at these locations.

9.5.57 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 Vol 2 Section 9. The results of the assessment of construction vibration are presented in Vol 13 Table 9.5.4.

Vol 13 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*
CE1	1-15 Pavilion Court	<0.5	High	Below threshold of cosmetic damage - No impact
CE2	1-104 Chelsea Gardens	<0.5	Medium	Below threshold of cosmetic damage - No impact
CE3	21-23 Embankment Gardens	<0.5	Medium	Below threshold of cosmetic damage - No impact
CE4	13-16 Embankment Gardens	<0.5	Medium	Below threshold of cosmetic damage - No impact
CE5	The Lister Hospital	<0.5	High	Below threshold of cosmetic damage - No impact
CE6	Ranelagh Gardens	<0.5	Medium	Below threshold of cosmetic damage - No impact
CE7	Royal Hospital	<0.5	Medium	Below threshold of cosmetic damage - No impact
CE8	Chelsea Bridge Wharf	<0.5	High	Below threshold of 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.*

9.5.58 The vibration levels reported here are well below the levels likely to cause cosmetic building damage according to the criteria described in Vol 2 Section 9.

9.5.59 Vibration effects are **not significant** at any receptors.

Sensitivity test for programme delay

9.5.60 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 site development schedule (see Vol 13 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 sources identified for assessment.

Noise from operational plant at above ground structures

9.6.2 A passive ventilation system is to be installed at Chelsea Embankment Foreshore site and therefore there is no requirement to install active ventilation equipment at this location. Plant which has been included in this section is as described in para. 9.2.11. The prediction method and assumptions are described in Vol 2 Section 9.

9.6.3 The appropriate emission limits are shown below in Vol 13 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 13 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 13 Table 9.6.1.

9.6.5 Vol 13 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 13 Table 9.6.1 Noise – operational airborne noise impacts

Ref	Receptor	Lowest baseline noise level	Impact	Value/ sensi-tivity	Magnitude

Ref	Receptor	Lowest baseline noise level	Impact	Value/ sensi-tivity	Magnitude
CE1	1-15 Pavilion Court	49dB$L_{A90, 15 minutes}$	Plant noise emission rating level at receptor less than 39dB$L_{Ar,Tr}$	High	Plant noise level below limit*,– no adverse impact
CE2	1-104 Chelsea Gardens	49dB$L_{A90, 15 minutes}$	Plant noise emission rating level at receptor less than 39dB$L_{Ar,Tr}$	High	Plant noise level below limit*,– no adverse impact
CE3	21-23 Embankment Gardens	46dB$L_{A90, 15 minutes}$	Plant noise emission rating level at receptor less than 36dB$L_{Ar,Tr}$	High	Plant noise level below limit*,– no adverse impact
CE4	13-16 Embankment Gardens	46dB$L_{A90, 15 minutes}$	Plant noise emission rating level at receptor less than 36dB$L_{Ar,Tr}$	High	Plant noise level below limit*,– no adverse impact
CE5	The Lister Hospital	49dB$L_{A90, 15 minutes}$	Plant noise emission rating level at receptor less than 39dB$L_{Ar,Tr}$	High	Plant noise level below limit*,– no adverse impact
CE6	Ranelagh Gardens	60dB$L_{A90, 15 minutes}$	Plant noise emission level at receptor less than 60dB$L_{Aeq.}$	Medium	Plant noise level below ambient daytime level – no adverse impact
CE7	Royal Hospital	48dB$L_{A90, 15 minutes}$	Plant noise emission rating level at receptor less than 38dB$L_{Ar,Tr}$	High	Plant noise level below limit*,– no adverse impact
CE8	Chelsea Bridge Wharf	49dB$L_{A90, 15 minutes}$	Plant noise emission rating level at receptor less than 39dB$L_{Ar,Tr}$	High	Plant noise level below limit*,– no adverse impact

** Limit referred to is that identified for the Local Authority in which the receptor is located (see paras.9.3.17 and 9.3.18).*

9.6.6 The results given above in Vol 13 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 receptor, 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 project, 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 Vol 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.

9.6.8 These events are not typical and only occur during severe rain storms. At Chelsea Embankment, the drop shaft would be enclosed and any noise at the surface would be attenuated by the structure or the air treatment 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 study as described in Vol 2 Section 9 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 Vol 2 Section 9. 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 no 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 project are considered to be not significant. Based on the site development schedule (see Vol 13 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

9.7.1 Of the projects described in Section 9.3, which could potentially give rise to cumulative effects with the proposed development at Chelsea Embankment Foreshore site, the Chelsea Barracks development is considered relevant due to the potential for cumulative effects on noise and vibration for some receptors.

Construction effects

9.7.2 Of the receptors identified in this assessment, it is likely that the Royal Hospital and residences on Chelsea Gardens would be subject to additional noise from the on-going development at Chelsea Barracks, which is scheduled for completion at the same time as the development at Chelsea Embankment Foreshore. These receptors are located adjacent to the Chelsea Barracks site, but over 100m from the Chelsea Embankment Foreshore site, and as such the majority of noise at these receptors would be expected to come from the Chelsea Barracks site. Given that the predicted noise levels from construction at the Chelsea Embankment Foreshore site are all well below the existing ambient noise levels, cumulative noise effects are not anticipated at these receptors.

9.7.3 In the event that the programme for the Thames Tideway Tunnel project is delayed by approximately one year, more of the Chelsea Barracks development may be built 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 There are no schemes considered relevant to the cumulative operational assessment as the developments in the site development schedule (see

Vol 13 Appendix N) are either located outside of the 300m assessment area or 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 are not likely to be any significant adverse effects during the construction phase. As such, no further noise mitigation is required above those measures identified in the *CoCP*.

Operation

9.8.2 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

9.8.3 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 No significant adverse effects were identified in the assessment, and as such no residual effects have been identified. The construction noise effects would remain as presented in Section 9.5.

Operational effects

9.9.2 As no mitigation measures are required, the residual operational effects would remain as presented in Section 9.6.

9.10 Assessment summary

Vol 13 Table 9.10.1 Noise – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Surface construction noise				
CE1 - 1-15 Pavilion Court	Noise	Not significant	None	Not significant
CE2 - 1-104 Chelsea Gardens	Noise	Not significant	None	Not significant
CE3 - 21-23 Embankment Gardens	Noise	Not significant	None	Not significant
CE4 - 13-16 Embankment Gardens	Noise	Not significant	None	Not significant
CE5 - The Lister Hospital	Noise	Not significant	None	Not significant
CE6 - Ranelagh Gardens	Noise	Not significant	None	Not significant
CE7 - Royal Hospital	Noise	Not significant	None	Not significant
CE8 - Chelsea Bridge Wharf	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				
CE1 – 1-15 Pavilion Court	Noise	Not significant	None	Not significant
CE3 - 21-23 Embankment Gardens	Noise	Not significant	None	Not significant

Vol 13 Table 9.10.2 Vibration – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
CE1 - 1-15 Pavilion Court	Vibration	Not significant	None	Not significant
CE2 - 1-104 Chelsea Gardens	Vibration	Not significant	None	Not significant
CE3 - 21-23 Embankment Gardens	Vibration	Not significant	None	Not significant
CE4 - 13-16 Embankment Gardens	Vibration	Not significant	None	Not significant
CE5 - The Lister Hospital	Vibration	Not significant	None	Not significant
CE6 - Ranelagh Gardens	Vibration	Not significant	None	Not significant
CE7 - Royal Hospital	Vibration	Not significant	None	Not significant
CE8 - Chelsea Bridge Wharf	Vibration	Not significant	None	Not significant

Vol 13 Table 9.10.3 Noise – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
CE1 - 1-15 Pavilion Court	Noise	Not significant	None	Not significant
CE2 - 1-104 Chelsea Gardens	Noise	Not significant	None	Not significant
CE3 - 21-23 Embankment Gardens	Noise	Not significant	None	Not significant
CE4 - 13-16 Embankment Gardens	Noise	Not significant	None	Not significant
CE5 - The Lister Hospital	Noise	Not significant	None	Not significant
CE6 - Ranelagh Gardens	Noise	Not significant	None	Not significant
CE7 - Royal Hospital	Noise	Not significant	None	Not significant
CE8 - Chelsea Bridge Wharf	Noise	Not significant	None	Not significant

Vol 13 Table 9.10.4 Vibration – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
CE1 - 1-15 Pavilion Court	Vibration	Not significant	None	Not significant
CE2 - 1-104 Chelsea Gardens	Vibration	Not significant	None	Not significant
CE3 - 21-23 Embankment Gardens	Vibration	Not significant	None	Not significant
CE4 - 13-16 Embankment Gardens	Vibration	Not significant	None	Not significant
CE5 - The Lister Hospital	Vibration	Not significant	None	Not significant
CE6 - Ranelagh Gardens	Vibration	Not significant	None	Not significant
CE7 - Royal Hospital	Vibration	Not significant	None	Not significant
CE8 - Chelsea Bridge Wharf	Vibration	Not significant	None	Not significant

References

[1] Defra, National Policy Statement for Waste Water (2012). http://www.defra.gov.uk/publications/files/pb13709-waste-water-nps.pdf last 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] Peter Brett Associates on behalf of Lafarge Cement UK, Northfleet Works Bulk Aggregates Import Terminal. *Document 2h: Environmental Statement Volume 3 Appendices: Appendix D.3*.

[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: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 10: Socio-economics

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 10: Socio-economics

List of contents

Page number

List of tables

Page number

This page is intentionally blank

10 Socio-economics

10.1 Introduction

10.1.1 This section presents the findings of the likely significant socio-economic effects of the proposed development at Chelsea Embankment Foreshore 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 Ranelagh Gardens and the Royal Hospital Gardens and nearby residents.

10.1.2 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. Two options for the provision of public realm in the operational phase have been considered: Option A involves the incorporation of terraces on the operational structure that provide inter-tidal habitat and Option B involves the incorporation of terraces on the foreshore structure that would provide floodable public realm that incorporates planting. Although Option B would increase the total area of public realm space, the increase is considered to be of a scale that would not change the magnitude of impact on and effect significance for users of the new foreshore structure public realm. The options are therefore not presented or reported separately for this topic.

10.1.3 The likely significant project-wide socio-economic effects, including employment generation, stimulation of the freight-by-water industry, and leisure, recreation and health related effects on users of the River Thames, are described in Volume 3 Project-wide effects assessment.

10.1.4 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.

10.1.5 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 13 Chelsea Embankment Foreshore Figures).

10.1.6 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 A section of the Thames Path National Trail and Public Right of Way (Thames Path) on the south side of Chelsea Embankment would be diverted for the duration of the construction period, though it would be reinstated for public use at weekends. As the Thames Path includes the National Cycle Route 4 (NCR4) at this location, a section of this route would be closed for the duration of the construction period.

10.2.3 A temporary cofferdam would be constructed in the river foreshore. A small area of landscaping space on the southern perimeter of Ranelagh Gardens would be hoarded off for part of the construction period to facilitate additional works on the northern side of Chelsea Embankment.

10.2.4 There would be a reduced number of lanes on the Chelsea Embankment road at this location, though two way traffic would be maintained.

10.2.5 Works at the site are expected to last approximately four years. See Section 3.3 of this volume for further details of the construction working hours.

10.2.6 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).

Direct employment creation on site

10.2.7 Construction is expected to require a maximum workforce of approximately 65 workers at any one time. The number and type of workers is shown in Vol 13 Table 10.2.1.

Vol 13 Table 10.2.1 Socio-economics – construction worker numbers

Contractor		Client
Staff*	**Labour****	**Staff*****
08:00-18:00	**0800 - 1800**	**08:00-18:00**
30	25	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 Client – engineering and support staff managing the project and supervising the Contractor.*

Code of Construction Practice

10.2.8 Measures applicable to all sites are incorporated into the *Code of construction practice (CoCP)*[i] *Part A* to limit significant air quality/ construction dust (see Section 7), noise and vibration (see Section 6), and

[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)

visual impacts (see Section 4) could also reduce socio-economic effects, particularly amenity effects.

10.2.9 The *CoCP Part A* confirms that all land, including highways, footpaths, public open spaces, river embankments / waterways, loading facilities or other land occupied temporarily be made good to the satisfaction of Thames Water[ii] and the local authority where required. This would be in accordance with the Ecology and landscape management plan and the approved landscape design for the site (see Section 4 within the *CoCP Part A*).

10.2.10 The *CoCP Part A* also outlines that the contractor would take reasonable steps to engage with nearby residents, including those who may be detrimentally affected by construction impacts, and ensure that occupiers of nearby properties would be informed in advance of works taking place, including the type and duration of the activity (see Section 3 within the *CoCP Part A*).

10.2.11 Further site specific measures, which could reduce socio-economic effects and particularly amenity effects, are incorporated into the *CoCP Part B*. See the *CoCP* sections in the air quality and odour, noise and vibration, and townscape and visual assessments (Sections 4.2, 9.2 and 11.2 respectively within this volume) within this assessment for detail on the type of measures that would be employed.

10.2.12 Section 5.3 of the *CoCP Part A* and Section 5 of the *CoCP Part B* confirm that:

a. the length and duration of the diversion of the Thames Path would be minimised

b. the diversion of the Thames Path would be adequately signed

c. the riverside footway on Chelsea Embankment (A3212) would be reinstated for public use outside of working hours at weekends.

Operation

10.2.13 The requirement for 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. This would create a small new area of public amenity space at the same level as the existing Thames Path available for passive recreational use by the public.

Environmental design measures

10.2.14 Measures which have been incorporated into the design of the proposed development (described in the design principles) include the:

a. incorporation, on the foreshore structure, of terraces that provide either inter-tidal habitat or floodable public realm which incorporates planting

[ii] 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.

b. replacement of the same number of London Plane Trees that would be removed, along the Embankment or the Bull Ring area

c. retention of a gap in the tree line to facilitate views between the river and Royal Hospital Chelsea

d. relocating the existing pedestrian crossing (refuge) to the east of the Bull Ring gates further east as part of the overall landscaping scheme.

10.3 Assessment methodology

Engagement

10.3.1 Volume 2 documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Specific comments relevant to this site for the assessment of socio-economics are presented in Vol 13 Table 10.3.1.

Vol 13 Table 10.3.1 Socio-economics – stakeholder engagement

Organisation	Comment	Response
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 on recreational facilities has been considered within this socio-economic assessment as appropriate.
RB of Kensington and Chelsea, May 2011	Content of socio-economic policy review – requirement to consider Core Strategy policies and SPDs.	Wherever relevant, Core Strategy policies have been referenced and taken into consideration in the assessment of impacts and effects.
RB of Kensington and Chelsea, May 2011	Possible impact on the Thames Path should be included in scoping.	An assessment of potential amenity effects and the temporary diversion on users of the Thames Path has been undertaken at this site.
RB of Kensington and Chelsea, February 2012	The impact on Ranelagh Gardens, even temporarily, could have an important effect on the ecology of the gardens as well as a loss of open space and amenity for users and a disruption to well known exhibitions and events such as Masterpiece London and the Chelsea Flower Show.	Consideration of the impact of the proposed development at the site on the amenity of users of open space, including users attending events and exhibitions, has been considered. Potential disruption to exhibitions and events relating to transport is covered within Section 12 Transport.
Greater	The impact of the proposed	Safe pedestrian crossing

Organisation	Comment	Response
London Authority (incl. Transport for London), February 2012	diversion of the Thames Path will need assessing and appropriate mitigation put forward, including pedestrian crossings, diversionary signage etc which will need to be discussed further with TfL.	facilities and diversionary signposting, etc, for diverted sections of the Thames Path is provided for within Section 5.3 of the CoCP Part A. Consideration of the effect on users of the Thames Path from its diversion is included in this socio-economic assessment.

Baseline

10.3.2 The baseline methodology follows the methodology described in Volume 2. 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 Table 9.5.1.

10.3.4 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.

10.3.5 Section 10.5 details the likely significant effects arising from the construction at the Chelsea 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 13 Appendix N), the development at Royal Hospital, Royal Hospital Road has been considered relevant to the construction base case. This development, located 220m from the site, would involve a change of use of Gordon House, the Orangery and Creek Lodge to a single family dwelling.

10.3.7 This development is relevant to the amenity effect assessment on nearby residents that has been undertaken as part of this socio-economic assessment. This is because it would be fully complete and operational by the base case, thereby altering the existing baseline by increasing the number of potentially sensitive residential receptors within 250m of the site (ie, the assessment area for amenity effects as set out in Volume 2).

10.3.8 Two other developments noted in Vol 13 Appendix N are for temporary uses (Christmas tree sales at Bull Ring Gate and Art and Antiques Fair or Show in June / July) in the grounds of the Royal Hospital. These two locations have not been considered as sensitive receptors due to their temporary nature and because effects on users of the Royal Hospital Grounds, ie, the location for these uses, is already assessed.

10.3.9 Of the developments listed in the site development schedule (see Vol 13 Appendix N), there is one which is located within the amenity effect assessment area (ie, 250m of the site) and which has been considered in the construction effects cumulative assessment. This is the development at Chelsea Barracks located 205m north of the site. The overall development would be under construction in Site Year 1 and the peak year of construction at the site and therefore it could give rise to cumulative amenity effects with the construction of the Thames Tideway Tunnel project on nearby sensitive receptors.

Operation

10.3.10 The base case is Year 1 of operation. The assessment area is as set out in Vol 2 Table 9.5.1.

10.3.11 The assessment methodology for the operation phase follows that described in Volume 2. There are no site specific variations for undertaking the operation assessment of this site.

10.3.12 Section 10.6 details the likely significant effects arising from the construction at the Chelsea 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.

10.3.13 Of the developments listed in the site development schedule (see Vol 13 Appendix N), there are none which would introduce new receptors into the operational base case; significantly alter circumstances for the receptor covered by the operational assessment; or which would give rise to cumulative effects. This is because the only receptor covered in the operational assessment is users of the new public amenity space and none of the developments would affect the sensitivity of those users.

Assumptions and limitations

10.3.14 The assumptions and limitations associated with this assessment are presented in Volume 2.

Assumptions

10.3.15 There are no assumptions specific to the assessment of this site.

Limitations

10.3.16 There are also 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 surrounding area within 250m of the site on the north side of the River Thames mostly comprises recreational grounds forming part of the Royal Hospital Chelsea and Ranelagh Gardens. There is a limited amount of residential development to the west, north and east of the site beyond the Royal Hospital Gardens, Ranelagh Gardens and Chelsea Bridge Road respectively. These include the residential institutions of Lister Hospital and the Royal Hospital Chelsea (as shown in Vol 13 Figure 2.1.2, see separate volume of figures). Within 1km of the site, recreational grounds, including Battersea Park to the south across the River Thames, and residential development are the predominant land uses although Sloane Square is located approximately 800m to the north of the site, containing commercial, retail and leisure uses.

Community profile

10.4.3 A detailed community profile is outlined in Vol 13 Appendix H.1[iii]. The following points provide a summary of the community profile and provide context for this socio-economic assessment:

a. The resident population was approximately 900 within 250m of the site and approximately 31,150 within 1km of the site at the time of the last census for which data is available[iv].

b. Within 250m of the site, the proportion of under 16 year olds (6.7%) is approximately one third of the Greater London level (20.2%). At a borough-wide level the proportion is somewhat higher (15.6%).

c. Within 250m and 1km of the site, the proportion of over 65 year olds (29.3% and 15.6% respectively) exceeds both the borough (12.6%) and Greater London (12.4%) levels.

d. Within 250m of the site, White residents comprise a higher proportion of the population (86.6%) than the borough average (78.6%) and the Greater London average (71.2%). Black and Minority Ethnic (BME) groups comprise the remaining 13.4% of residents within 250m of the site.

e. Approximately 26.2% of residents within 250m of the site have a long term or limiting illness, approximately double that within 1km, within the RB of Kensington and Chelsea and within Greater London (11.8%, 13.6% and 15.5% respectively). Approximately 4.6% of residents within 250m of the site claim disability living allowance which is slightly more than the RB Kensington and Chelsea level (3.4%) and closely aligned with Greater London levels (4.5%).

f. General health is moderately good in the wider area surrounding the site with low levels of adult obesity (ie, lower being better) but with rates of child obesity ranking amongst the second highest relative to

---

[iii] Information sources are provided in the appendix.

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

Greater London. Levels of physical activity and exercise are also high relative to Greater London.

g. Deaths caused by major illnesses in the local area are low relative to Greater London although heart disease is slightly more prevalent. Both male and female life expectancy are high relative to Greater London.

h. There is no recorded incidence of income or overall deprivation within 250m or 1km of the site (0.0%) and levels of deprivation within 1km of the site are still considerably lower than the borough-wide and Greater London levels.

10.4.4 The community profile suggests that local residents are predominantly White, experience moderately good health and moderately high life expectancy with the exception that there is a high incidence of persons suffering from a long term limiting sickness (most likely attributable to the high proportion of elderly residents that live within the Royal Hospital Chelsea). A relatively high incidence of persons suffer from a disability. There is effectively no deprivation, as measured by the indices analysed, within 250m of the site.

Economic profile

10.4.5 An economic profile (based on 2012 data) is outlined in Volume 13 Appendix H.2. The following points provide a summary of the profile and provide context for this socio-economic assessment:

a. Within approximately 250m of the site there are approximately 800 jobs and 50 businesses.

b. The three largest sectors as measured by employment within approximately 250m are: Human Health and Social Work Activities; Information and Communication; and Education sectors.

c. The three largest sectors as measured by number of businesses at locations / units within approximately 250m are: Human Health and Social Work Activities; Other Service Activities; and Professional, Scientific and Technical Activities.

d. At all geographical levels, most businesses fall within the micro size band (one to nine employees). However, within approximately 250m of the site, there are a higher proportion of large businesses (over 250 employees) than within both the RB of Kensington and Chelsea and Greater London as a whole. This is likely to be attributed to the close proximity of institutions such as the Royal Hospital Chelsea and The Lister Hospital to the site.

e. Businesses within the micro size banding account for the majority within each of the leading sectors within 250m. However, the size band profile of each lead sector varies, with, for example, 100% of Professional, Scientific and Technical Activities businesses are micro sized, compared with 73% in Human Health and Social Work Activities and 67% in Information and Communication.

Receptors

Thames Path

10.4.6 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 runs alongside the northern river embankment, directly adjacent to the River Thames foreshore in the form of a well maintained pathway.

10.4.7 The path is paved and approximately 5m wide. The Chelsea Embankment roadway (A3212), a busy four lane road, lies to the immediate north of the Thames Path. Mature trees line the length of the pedestrian walkway. There are no benches for seating along this section of the path.

10.4.8 The Thames Path provides views directly across the river to Battersea Park. There are also views of Chelsea Bridge, and through that and the adjacent rail bridge to the disused Battersea Power Station.

10.4.9 Policy C04 of the RB of Kensington and Chelsea Adopted Core Strategy sets out its strategic objective regarding public realm and outdoor spaces stating that it aims *'to endow a strong local sense of place by maintaining and extending our excellent public realm to all parts of the Borough.'*[2]

10.4.10 The usage surveys (see Vol 13 Appendix H.3) found the Thames Path to be moderately used, with a peak usage of 156 pedestrian movements per hour during the weekday surveys and 156 pedestrian movements per hour on the weekend surveys. The path was also used, in its capacity as a section of the NCR4, by cyclists. For details of on pavement cyclist numbers see para. 10.4.24. A higher number of joggers were observed to be using the Thames Path compared to the opposite pavement on Chelsea Embankment Road (which is not formally considered to be part of the Thames Path).

10.4.11 Surveys undertaken during the 2012 Royal Horticultural Society (RHS) Chelsea Flower Show in late May also found the Thames Path to be moderately used, with a peak usage of 256 pedestrian movements per hour being recorded during the weekend survey. The opposite pavement on Chelsea Embankment road was well used with a peak of 688 movements per hour being recorded during the weekend. During the survey undertaken when the RHS Chelsea Flower Show was on, a large proportion of users of this pavement were observed to be patrons of the Flower Show exiting via the Bull Ring Gate.

10.4.12 Pedestrian and cycle surveys undertaken as part of Section 12 Transport recorded a peak of approximately 25 pedestrians in each direction (ie, 50 movements in total), during the AM peak hour.

10.4.13 Based on the findings of these surveys, overall the Thames Path route is therefore assessed as being moderately used at this location.

10.4.14 Vol 13 Figure 10.4.1 (see separate volume of figures) shows the location of this receptor.

10.4.15 The main factors affecting the sensitivity of users is the availability of alternatives:

a. As a metropolitan wide recreational asset, users have access to an extensive number of comparable stretches of the Thames Path on both sides of the river across central London, including on the south side of the river through Battersea Park.

b. More locally, considering the section of path that would be affected, there is an accessible alternative route on the north side of the Chelsea Embankment road, although it would divert users a short distance away from the river. Whilst the use of the route does not provide an unencumbered view of the River Thames and opposite bank, users may derive alternative visual amenity from the views the route provides of the open space in Ranelagh Gardens, and of the Royal Hospital and its gardens. This route is therefore considered to be similar in terms of amenity and convenience.

10.4.16 In terms of their sensitivity to potential amenity impacts, pedestrians using the Thames Path are only likely to be near the project site for the time that it takes them to walk past (likely to only be a minute or two for most users). Therefore the duration for which users are likely to experience effects would be limited.

10.4.17 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 impacts that would cause a loss of access to the path or a loss of amenity.

Public amenity space (future) associated with the Thames Path

10.4.18 An area of publicly accessible amenity space would be created in the operational phase as part of the proposed development.

10.4.19 Although not technically defined as public open space, this space would be equivalent in size to a pocket park as categorised by the London Plan's Open Space Hierarchy. It could also be categorised as being part of a linear open space given its position on the Thames Path. Open spaces of pocket park size typically serve a catchment area of less than 400m with linear open spaces serving no fixed catchment area but being accessible to users "*wherever feasible*" (GLA, 2011)[3].

10.4.20 In terms of the value of the new space and the consequent sensitivity of users, the availability (and subsequent adequacy or deficiency) of existing and base case condition alternatives within 400m is a key factor to consider. For instance, there are opportunities for passive recreation in the immediate vicinity of the proposed new amenity space, at Ranelagh Gardens and the Royal Hospital Gardens and on the opposite bank of the River Thames along the promenade of Battersea Park (which itself includes the Thames Path route).

10.4.21 Taking these factors into account, it is considered that users of the future riverside public amenity space would have a low level of sensitivity to the creation of additional public amenity space.

National Cycle Route 4

10.4.22 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 runs within the Thames Path promenade (on the footpath besides Chelsea Embankment). However, the cycle route is not marked or demarcated on the pavement. The NCR4 here forms part of a 2.3km traffic free section of the route for cyclists extending from the junction of Lots Road and Cheyne Walk in the west to the junction of Lupus Street and Grosvenor Road in the east.

10.4.23 Vol 13 Figure 10.4.1 (see separate volume of figures) shows the location of the receptor.

10.4.24 The usage surveys (see Vol 13 Appendix H.3) recorded a peak usage of 24 cyclists per hour on the traffic free NCR4 (ie, the pavement) during a weekday survey and 32 movements per hour on a weekend survey. It should be noted that cyclists used the Chelsea Embankment road much more than the pavement section, with a highest recorded usage of 556 cyclists per hour on a weekday evening; 468 of which were travelling outbound or westward reflecting the fact that the majority appeared to be commuter cyclists. This indicates that the traffic free NCR4 route is used more as a recreational route than a commuter route, and is not preferred to the road by most cyclists at this location.

10.4.25 Surveys undertaken during the 2012 RHS Chelsea Flower Show in late May recorded similar usage patterns of the NCR4 to that recorded in earlier surveys, with the Chelsea Embankment road again experiencing higher usage than the on-pavement section.

10.4.26 Pedestrian and cycle surveys undertaken as part of the *Transport Assessment* (see Section 12 Transport) corroborate the findings of the usage surveys, having also recorded a peak two-way flow of 24 cyclists on the traffic free NCR4, during the AM peak hour survey. With regard to use of the adjacent road at this location, surveys recorded that there is a two way flow of approximately 587 cycles during the AM peak hour.

10.4.27 Factors affecting the sensitivity of users to impacts which would disrupt access to or use of the cycle route are as follows:

a. The NCR4 is traffic free at this location, unlike other large sections of the NCR4 in London, making this section of relatively higher value than other sections of the route.

b. In terms of alternative routes, users are able to cycle within the immediately adjacent Chelsea Embankment (A3212) road without any significant detour, or use other routes such as the Chelsea Bridge Road (A3216) and Royal Hospital Road (B302) to bypass the area altogether. However, the users of the traffic free route would be accustomed to travelling in a safer and more comfortable environment than that of these alternatives and may therefore choose not to use them in the event of disruption.

10.4.28 Taking account of these factors, it is considered that the sensitivity of users of the on-pavement section of the NCR4 to disruption of that route at this location would be medium.

Public open space

10.4.29 There are two distinct open spaces a short distance to the north of the site both located in the grounds of the Royal Hospital Chelsea. These are Ranelagh Gardens and the Royal Hospital Gardens.

10.4.30 With regard to open space, Policy CR5 of RB of Kensington and Chelsea's Core Strategy states that *'the council will protect and enhance outdoor spaces and resist developments which have a negative effect on open land, result in the loss of open space, damages the environment, visual character or amenity of spaces'*[4].

10.4.31 Ranelagh Gardens is located to the north of the Chelsea Embankment. It is approximately 5.3ha in size, and can be categorised as a 'local park' within the GLA Open Space Hierarchy. Open spaces of this size typically serve a catchment area of "less than 400m" (GLA, 2011)[5].

10.4.32 The open space is privately owned and managed by the Royal Hospital Chelsea, however it is identified as 'Public Open Space' in the RB of Kensington and Chelsea's Core Strategy[6]. The space has limited opening hours; generally the gardens are accessible between dawn and dusk, and closed at night, although opening on Sundays is restricted to afternoons only.

10.4.33 Ranelagh Gardens are heavily planted with trees, shrubs and flowers. In particular, a copse of shrubs and mature trees is planted along the southern fenced perimeter of the gardens. Behind this there are secluded lawns. This landscape arrangement forms a barrier between traffic on the Chelsea Embankment road and the park. Users of the gardens experience a secluded environment, in part due to the landscaping and the setting of the series of lawns surrounded by a network of internal paths and structured planting. Traffic noise from Chelsea Embankment becomes increasingly audible towards the southern end of the gardens.

10.4.34 The open space is overlooked on its eastern boundary by the Lister Hospital and Chelsea Gardens residential buildings, both located on the opposite side of Chelsea Bridge Road.

10.4.35 The usage surveys (see Vol 13 Appendix H.3) of Ranelagh Gardens found that the northern lawn of the gardens experienced moderate levels of use, with the areas further south being lightly used or not used. Users recorded were mostly White, older adults (40 to 60 years old), often accompanied by young children (under 12 years old), with users over 60 years old also recorded (some of whom were likely to be residents of the Royal Hospital Chelsea). Walking and passive recreation were the predominant uses recorded.

10.4.36 The Royal Hospital Gardens are a largely open area of lawns, in contrast to Ranelagh Gardens, running down from a smaller and more enclosed area of open space just south of the hospital buildings towards Chelsea Embankment, and are identified as 'Public Open Space' in the RB of

Kensington and Chelsea's Core Strategy. The gardens are planted with an avenue of trees running parallel to the eastern boundary of the adjacent Ranelagh Gardens, and there is some further planting of mature trees along the northern and southern boundaries of the grounds. Various paths run north to south and also east to west. Traffic noise from Chelsea Embankment is increasingly audible at the southern end of the grounds.

10.4.37 The usage surveys (see Vol 13 Appendix H.3) of Royal Hospital Gardens found that, in terms of general recreation, they were mostly lightly used on both the weekdays and weekends. The western part of the space was used for football during autumn and thus user numbers increased during these times. Users were predominantly white adults of varying age and were mostly walkers and dog walkers, with footballers recorded in autumn.

10.4.38 Vol 13 Figure 10.4.1 (see separate volume of figures) shows the location of these receptors.

10.4.39 Ranelagh Gardens and the Royal Hospital Gardens are closed, either wholly or in part, for an established annual / regular pattern of temporary events, exhibitions and private functions. Of these, the most significant is the RHS Chelsea Flower Show. This five day event attracts approximately 150,000 visitors. It results in the closure of the Royal Hospital Gardens and Ranelagh Gardens for a period of two to three months around May and June each year, for the event itself or and for periods before and after the show for set up and demobilisation.

10.4.40 In terms of the sensitivity of the users of the open spaces, the following considerations are relevant.

a. At this location, the southernmost portions of the two open spaces are those most likely to experience impacts given their proximity to the site. These spaces are also affected by existing noise impacts from the adjacent A3212.

b. There are alternative open spaces in the wider area. These include the 83ha Battersea Park which, although on the other side of the river, provides the functions of a 'metropolitan park' within 400m of Ranelagh Gardens across Chelsea Bridge. The availability of this alternative reduces the sensitivity of users to any amenity impacts, as it offers comparable or better facilities close by. There are also areas within the northern extent of Ranelagh Gardens which are distant from the site.

c. The use of the open spaces for events, as explained above, means that at times they will be used by significantly larger numbers than were recorded in the open space surveys.

10.4.41 On the basis of these factors, the sensitivity of users of the open spaces, including attendees and organisers of temporary events, to any reduction in amenity is considered to be medium.

Residential

10.4.42 There are existing and base case residential developments near the proposed construction site as identified in the air quality and odour, noise and vibration and townscape and visual assessments.

10.4.43 Land that is predominantly used for residential development is identified in the land use plan for this site (Vol 13 Figure 2.1.1, see separate volume of figures).

10.4.44 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.

10.4.45 Therefore, as outlined in the methodology for this socio-economic impact assessment (see Volume 2) the sensitivity of nearby residential receptors to amenity impacts would be medium during the day and high during the evening and night.

Summary

10.4.46 A summary of receptors as described in the baseline and their sensitivity is provided in Vol 13 Table 10.4.1.

Vol 13 Table 10.4.1 Socio-economics - receptor values / sensitivities

Receptor	Value / sensitivity and justification
Users of the Thames Path	Low – alternatives to this section of the Thames Path, both in terms of its role as a metropolitan recreational asset and as a local pedestrian route, are available such as the opposite side of the carriageway. Users would be near the site for only a short duration.
Users of the future public amenity space associated with the Thames Path	Low – there are a number of existing public open and amenity spaces, offering similar recreational opportunities within 400m of the site.
Users of the National Cycle Route 4	Medium – an alternative route is available for users within the road however users of the route may be accustomed to travelling traffic free and thus sensitive to temporary loss of the ability to do so at this location.
Users of open space - Ranelagh Gardens and Royal Hospital Gardens	Medium – although comparable alternative open spaces are accessible within the northern extent of Ranelagh Gardens and other sites within 400m, they may not be able to provide alternative open spaces and functionality for all users, given their regular use for large events.
Residents	Medium / High - residents would

Receptor	Value / sensitivity and justification
	have limited opportunity to avoid effects. They would have medium sensitivity to amenity effects overall during the day and high sensitivity to amenity effects overall during the evening and night.

Construction base case

10.4.47 The construction assessment year and area are as set out in para. 10.3.3.

10.4.48 The base case in the peak year of construction taking into account the schemes described in Section 10.3 would differ from the baseline as it would include an additional residential receptor.

10.4.49 Other than the above, it is assumed that the base case socio-economic conditions at the site would remain largely the same as the existing baseline conditions.

Operational base case

10.4.50 The operational assessment year and area are as set out in para. 10.3.10.

10.4.51 As described in para. 10.3.13, 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 diversion of the Thames Path

10.5.1 The proposed construction works would result in the Thames Path being temporarily diverted via the north side pavement of the A3212 Chelsea Embankment at this location.

10.5.2 The magnitude of the impact is influenced by the following factors:

a. The impact would be a medium term impact and temporary, although it would be reinstated for public use outside of working hours at weekends whenever possible, ensuring pedestrians are safeguarded.

b. The diversion would affect a moderate number of, mostly recreational, users. Usage of the Thames Path and of the pavement on the opposite side of the road, including by tourists, can be higher around the time of events (including the RHS Chelsea Flower Show).

c. The proposed diversion would be minor in extent and deviation from the existing route. It would run on the opposite side of the same road, and is approximately 50m longer than the section of the Thames Path that would require temporary closure, the increased length being mainly due to the need to cross Chelsea Embankment back and forth to follow the diversion.

d. Pedestrians may be slightly more at risk when using the diverted route as a result of needing to cross the Chelsea Embankment road twice. Given the intention to use existing crossing points where possible and install adequate signage, the diversion route should not however be disorientating for users or compromise safety and it is unlikely that users would experience significant delay or inconvenience.

10.5.3 Taking account of the above it is assessed that the impact magnitude arising from the diversion of the Thames Path would be medium.

10.5.4 Given the medium magnitude of the impact and the low sensitivity of users the effect of the diversion on users of the Thames Path would be **minor adverse**.

Temporary closure of the National Cycle Route 4

10.5.5 The proposed development would require closure of a traffic-free stretch of the NCR4, which runs on the Thames Path at this location.

10.5.6 The magnitude of the impact is influenced by the following factors:

a. The impact would be a medium term impact and temporary.

b. Based on the usage survey findings the diversion would affect a moderate number of users.

c. Users would be required to use an alternative route. However most would likely simply use the adjacent Chelsea Embankment road around the hoarded area, given its proximity.

d. Usage surveys recorded that typically over 80% of cyclists use the road at this location rather than the, traffic free, NCR4 route, indicating that the NCR4 route is not preferred by cyclists at this location.

e. Cyclists who would normally use the traffic free NCR4 route would be more at risk, in terms of safety, and potentially less comfortable as a result of having to use roads instead of the pavement. The closure could therefore mean that these users choose to avoid cycling in this location altogether.

10.5.7 Taking account of the above, the impact magnitude arising from the diversion of the NCR4 is assessed as low.

10.5.8 Given the low magnitude of the impact and the medium sensitivity of users, the effect of the diversion on users of the NCR4 would be **minor adverse**.

Effect on the amenity of Thames Path users

10.5.9 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:

a. Local air quality and construction dust effects would be **minor adverse**.

b. No noise and vibration receptors were identified as requiring assessment in relation to the Thames Path.

c. At the receptors identified in the visual assessment which are on the north bank or the bridge over the river and located within 250m of the site, visual effects would be **major adverse** at all three (ie, viewpoints 2.2, 2.4 and 2.10).

10.5.10 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 local air quality effects may not be minor adverse over the whole construction period as the assessment is purely based on the peak construction year and these effects may be negligible in other years.

b. The diversion would affect a moderate number of mostly recreational users, and a higher number of users during events.

c. Although a minor adverse effect on local air quality and construction dust has been concluded, the air quality assessment demonstrates that effects generally reduce in severity the further the receptor is from the site. For receptors beyond 20m of the site, the significance of construction dust effects would reduce to negligible.

d. This finding, combined with the linear nature of the Thames Path and the way that it is used, means that users would only be exposed to any impacts for a very short time period, ie, the time it takes to walk, cycle or run past the site (likely to be a few minutes for most users).

e. Exposure to visual effects may occur for a longer period of time, but it is still likely to be relatively brief for most users. The route followed by the Thames Path in this location and the landscaping of the banks on both sides of the river means that recreational users in particular would find their view of the river and Battersea Park interrupted during the works. However, the diversion route would also afford views in other directions that would not be affected. As such, the visual effects would be unlikely to deter most users from using this section of the route. Further, the diversion route would take users closer to the Royal Hospital Gardens affording them pleasant views to the north in place of the river view.

10.5.11 On the basis of the above findings and factors, it is considered that the magnitude of impact would be medium.

10.5.12 Taking account of the medium impact magnitude and the low sensitivity of the receptor, it is considered that the effect on the amenity of Thames Path users would be **minor adverse**.

Effect on the amenity of open space (Ranelagh Gardens and Royal Hospital) users, including visitors and employees of temporary events

10.5.13 Assessments have been undertaken to examine the likelihood of significant air quality, 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 Ranelagh Gardens and Royal Hospital Gardens:

a. Local air quality effects would be **negligible** and construction dust effects would be **minor adverse** for both receptors.

b. Noise and vibration (human response) effects would be **not significant** at Ranelagh Gardens. The Royal Hospital Gardens receptor was not explicitly identified as a receptor.

c. Visual effects would be **moderate adverse** at two viewpoints identified within the assessment (2.1 - view south from the footpath at the eastern edge of the Royal Hospital Gardens and 2.9 - view southeast from the main axis of the Royal Hospital). It would be **major adverse** from viewpoint 2.10 (this viewpoint is located at the entrance to the gardens and is effectively on what would be the Thames Path diversion route during the works. As such, it has been considered in the assessment of the effect on the amenity of Thames Path users).

10.5.14 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.

b. The two open spaces in question have somewhat limited public opening hours, as they are owned and managed by the Royal Hospital Chelsea. They are also periodically closed to allow events such as the RHS Chelsea Flower Show to take place. As well as these closures the gardens, it is very likely that the Flower Show and other events affect the amenity experienced by open space users in the sections of open space that remain open during set-up and demobilization periods as well as when the events are open to the public.

c. The usage surveys found that use of the open spaces for general recreation was heaviest in the northern part of Ranelagh Gardens, the part of the two open spaces that is furthest and most screened by vegetation from the proposed construction site. The surveys also found that users of the gardens included some elderly residents of the Royal Hospital Chelsea, as well as young families.

d. For Ranelagh Gardens, it was concluded that there would not be any significant air quality, construction dust, noise or vibration effects.

Further, a visual effect assessment was not conducted for viewpoints within the gardens. Having consideration to the usage survey findings it is considered unlikely that most users of the open spaces within Ranelagh Gardens would be exposed to any views of the construction site. This is particularly so given the distance of the northern part of Ranelagh Gardens from the site and the landscaping and mature planting.

e. When events such as the RHS Chelsea Flower Show are taking place the arrangement of the displays and exhibitions and the presence of marquees and hoardings, etc, would mean that visitors, event staff and organisers using the two open spaces would have little or no view of the construction works from within the open spaces.

f. On this basis, it is considered that the visual effects noted in the visual assessment would affect a relatively small number of users.

10.5.15 Taking account of the above findings and factors, it is considered that the magnitude of impact on users of the open space would be low.

10.5.16 Given the low impact magnitude and the medium sensitivity of open space users, it is considered that the effect on the amenity of open space users would be **minor adverse**.

Effect on the amenity of residents

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 (see 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 residential receptors:

a. Local air quality effects and construction dust effects would be **negligible** on the receptors identified.

b. Noise and vibration (human response) effects would be **not significant** at any of the residential receptors identified by the assessment. In regard to road-based construction traffic, the noise assessment found that the additional numbers of HGVs would cause negligible change to the traffic noise levels and that the effects would be **not significant**. In relation to river-based construction traffic, the noise assessment found that effects would be **not significant** on the nearest residential receptors.

c. Visual effects would be **minor adverse** at viewpoint 1.2 and **negligible** from viewpoint 1.3.

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 long term period.

b. While it is estimated that there would be a minor adverse visual effect at one viewpoint, 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.

c. None of the above residual effect assessment findings concluded that there would be significant effects during the evening or night.

10.5.19 Taking account of the above findings and factors, it is considered that the magnitude of impact would be negligible.

10.5.20 Given the negligible impact magnitude and medium sensitivity, it is considered that the effect on the amenity of residents would be **negligible**.

10.6 Operational effects assessment

Permanent gain of public amenity space

10.6.1 The extension of the river wall out in to the foreshore would result in the permanent provision of an area of pleasantly landscaped and functional public amenity space measuring approximately 0.1ha 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, landscaped space, suited to passive recreation, along this section of the Thames Path (except on rare occasions during maintenance work). Under Option B, the terraces of the foreshore structure would include a small additional area of floodable public realm incorporating planting.

b. The effect would be long term and permanent.

c. Although new public amenity space on the Thames Path would be likely to benefit the local community, the size and functionality of the space would be limited in an area which already has a high provision within 400m of parks of both local and metropolitan significance. However, as access to Ranelagh Gardens and Royal Hospital Gardens is subject to opening hours and regular closures for use for events and exhibitions, this space would create an alternative for passive recreation, without needing to cross the river, when the spaces are closed.

d. Given medium usage of this section of the Thames Path at most times of day, the new space is likely to benefit a moderate number of users, including local residents and workers, and possibly users from further afield at times when events are taking place at Ranelagh Gardens and the Royal Hospital Gardens.

10.6.3 Taking account of the above factors it is considered that the magnitude of impact would be medium.

10.6.4 Given the medium impact magnitude and the low sensitivity, it is considered that the effect of the permanent gain of public amenity space would be **minor beneficial**.

10.7 Cumulative effects assessment

Construction effects

10.7.1 For the purposes of this cumulative assessment, the assessment year is the peak construction year.

10.7.2 Of the developments described in Section 10.3, a single development, Chelsea Barracks, would be under construction during the peak construction year at Chelsea Embankment Foreshore.

10.7.3 As this development is located approximately 205m to the north and away from the river, it would not be possible for this development to give rise to cumulative effects in respect of the diversion of the existing Thames Path or NCR4.

10.7.4 In respect of the assessments undertaken in Section 10.5, the development is located within assessment area for amenity effects and so it could give rise to cumulative effects on the amenity of potentially sensitive receptors such as residents, public open space, and Thames Path and NCR4 recreational users. The air quality, construction dust, noise, vibration and visual cumulative effect assessments (see Section 4, Section 9 and Section 11 respectively) have concluded that there would not be any elevated effects which would affect the significance of the effect assessment made in each respective assessment of receptors on the same side of the river and within 250m of this site. Therefore, it is considered that the development would not affect the significance of the effects on amenity of sensitive receptors considered in the construction effects assessment.

10.7.5 Therefore, the effects on socio-economics would remain as described in Section 10.5.

Operational effects

10.7.6 As described in para. 10.3.6, there are no other developments that could have the same type of effect as that considered in Section 10.6.

10.7.7 Therefore, the effects on socio-economics would remain as described in Section 10.6.

10.8 Mitigation

Construction effects

10.8.1 The above assessment has concluded that there would not be any major or moderate adverse effects in the construction phase at the site requiring additional mitigation.

Operational effects

10.8.2 The above assessment has concluded that operational effects would be beneficial and therefore mitigation is not required.

10.9 Residual effects assessment

Construction effects

10.9.1 As no additional mitigation measures are proposed, the residual construction effects remain as described in Section 10.5. All residual effects are presented in Section 10.10.

Operational effects

10.9.2 As no mitigation measures are proposed, the residual operational effects remain as described in Section 10.6. All residual effects are presented in Section 10.10.

10.10 Assessment summary

Construction

Vol 13 Table 10.10.1 Socio-economics – summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Users of the Thames Path	Temporary diversion of the Thames Path	Minor adverse	None	Minor adverse
Users of the NCR4	Temporary closure of the NCR4 cycleway	Minor adverse	None	Minor adverse
Users of the Thames Path	Effect on the amenity of the Thames Path users	Minor adverse	None	Minor adverse
Users of open space - Ranelagh Gardens and Royal Hospital Gardens	Effect on the amenity of open space users (Ranelagh Gardens and Royal Hospital Gardens), including visitors and employees of temporary events	Minor adverse	None	Minor adverse
Residents	Effect on the amenity of residents	Negligible	None	Negligible

Operation

10.10.1 This topic assessment has considered both foreshore structure terrace Options A and B and given that there are not anticipated to be any significant differences to the magnitude of impact on and effect significance for users of the foreshore structure public realm, the assessment summary table reflects both options.

Vol 13 Table 10.10.2 Socio-economics – summary of operational assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Users of the public amenity space (future) associated with the Thames Path	Permanent gain of public amenity space	Minor beneficial	None	Minor beneficial

References

[1] Department of Environment, Food and Rural Affairs. 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] RB of Kensington and Chelsea. *Core Strategy for the Royal Borough of Kensington and Chelsea* (2010), p.193

[3] Greater London Authority (GLA). *The London Plan 2011* (2011), p. 234

[4] RB of Kensington and Chelsea. *Core Strategy for the Royal Borough of Kensington and Chelsea* (2010), p.199

[5] GLA. *The London Plan 2011* (2011), p. 234

[6] RB of Kensington and Chelsea. *Core Strategy for the Royal Borough of Kensington and Chelsea* (2010), p.191

This page is intentionally blank

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 11: Townscape and visual

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 11: Townscape and visual

List of contents

Page number

List of plates

Page number

List of tables

Page number

This page is intentionally blank

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 Chelsea Embankment Foreshore. 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 area 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. 11.3.19 for operation).

11.1.4 Each section of the assessment is structured with townscape aspects 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 13 Chelsea 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

b. use of cranes during shaft sinking and secondary lining of the Ranelagh connection tunnel

c. removal of trees along Chelsea Embankment and within Ranelagh Gardens

d. provision of welfare facilities, assumed to be a maximum of three storeys in height

e. installation of 2.4m high hoardings around the boundary of the construction site

f. vehicular construction access to the site off Chelsea Embankment.

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 11)

b. protection of listed structures, including the listed lamp standards along Chelsea Embankment (Section 12)

c. use 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* to reduce townscape and visual impacts include:

a. provision for incorporating suitable art work and viewing windows in public facing sections of the hoarding (Section 4)

b. brickwork, granite stones and railings would be retained for later reinstatement hoarding (Section 12) .

Operation

11.2.5 The particular components of importance to this topic include the:

a. design and materials used for the river wall including the floodable terraces

b. design, layout and materials used in the public realm including the treatment of seating, railings and lighting

---

[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*).

c. design, siting and materials used for the ventilation columns and control kiosks, and the zones within which these above ground structures may be located

d. size, layout and species used for tree planting along Chelsea Embankment, on the foreshore structure and within Ranelagh Gardens.

Environmental design measures

11.2.6 Figures illustrating the proposed development during operation are contained in a separate volume (see separate volume of figures – Section 1). 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 design of the foreshore structure would follow a sweeping curve to minimise its contrast with the surrounding townscape (engineering layout plan)

b. the new river wall and parapet materials would match the stone and brick of the existing wall

c. terraces would be incorporated into the foreshore structure to reduce the bulk of the structure, creating either inter-tidal habitat (Option A) or floodable public realm which incorporates planting (Option B)

d. pre-established planting would be used on the terraces

e. the trees removed along Chelsea Embankment would be replaced with the same number of mature London plane trees along the Embankment or on the Bull Ring

f. the ventilation columns, electrical and control kiosks, and new trees would not be located on the axis of monument walk

g. the carriageway and roundabout between the Bull Ring gates and the Chelsea Embankment, to the north of the site, would be repaved to match the high quality materials used for the new foreshore structure

h. information and interpretative materials would be carefully designed and well integrated with the surrounding townscape

i. no railings would provided on top of the new river wall parapet to preserve clear views to and from the river/Royal Hospital

j. the number of trees removed to undertake the interception works would be replaced with appropriate native species in Ranelagh Gardens

k. the landscape works around the interception chamber would be graded to blend in with existing levels

l. the reinstatement of lamp columns, railings and street lighting would replace those removed during construction

m. use of high quality materials in keeping with the character of the area to clad the electrical kiosks and for the surfacing of the public realm

n. a commitment to a high quality design for the ventilation columns.

11.3 Assessment methodology

Engagement

11.3.1 Volume 2 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 The Royal Borough (RB) of Kensington and Chelsea, and neighbouring authorities (Westminster City Council and London Borough (LB) of Wandsworth) and English Heritage have been consulted on the detailed approach to the townscape and visual assessment, including the number and location of viewpoints. The RB of Kensington and Chelsea (February 2011) requested some changes to the viewpoint locations and some additional locations, which have been incorporated into the visual assessment. The Westminster City Council (March 2011), LB of Wandsworth (May 2011) and English Heritage (May 2011) have confirmed acceptance of 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, particularly with regard the location of the site. 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 two viewpoints from the operational assessment. The RB of Kensington and Chelsea confirmed acceptance of this change, but also requested additional photomontages be prepared from three locations. On the basis that the photomontages prepared from the locations previously agreed are considered sufficient for assessing effects arising from this site, these additional photomontages have not been produced. The LB of Wandsworth (October 2012) have confirmed acceptance of the proposed changes. The Westminster City Council and English Heritage have not commented on the proposed change.

11.3.5 The RB of Kensington and Chelsea have also confirmed (March 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 (see *Design Principles* report in Vol 1 Appendix B).

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 (March 2011, August 2011, and September 2011).

c. Winter photographic surveys of the view from each visual assessment viewpoint (January 2012, and February 2012).

d. Summer photographic survey of the view from visual assessment viewpoints considered in the operational assessment (August 2011).

e. Verifiable photography and verifiable surveying 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 Chelsea 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 Royal Borough of Kensington and Chelsea* (RB of Kensington and Chelsea, 2010)[2] and the neighbouring City of Westminster (City of Westminster, 2011)[3] and LB of Wandsworth (LB of Wandsworth, 2010)[4].

b. *Thames, Royal Hospital and Cheyne Conservation Area Proposals Statements*, produced by the Royal Borough of Kensington and Chelsea (RB of Kensington and Chelsea, no date)[5].

c. Churchill Gardens (City of Westminster, 2005)[6] *Conservation Area Audit*, produced by the City of Westminster.

d. *Battersea Park Conservation Area Appraisal and Management Strategy*, produced by the LB of Wandsworth (LB of Wandsworth, no date)[7].

e. *The Thames Strategy: Kew to Chelsea* (Atkins, June 2002)[8].

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 Chelsea 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 removed by road. This has therefore been used as the assessment year for townscape and visual impacts. The intensity of construction activities would be similar during

Site Year 3 of construction, during the secondary lining of the Ranelagh connection tunnel, 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 Ranelagh connection tunnel

b. all site lighting would have minimal spill into the wider area due to the measures set out in the *CoCP*

c. the surrounding area is lit in the early evening by street lighting and by vehicles along Chelsea Embankment

d. visual receptors have limited sensitivity to additional lighting in the early evening.

11.3.12 The assessment area, defined using the methodology provided in Vol 2 Section 11, is indicated in Vol 13 Figure 11.4.6 for townscape and Vol 13 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 upstream of the site where the visibility of the proposed works would be barely perceptible, downstream of the site where the visibility is in reality obscured by Chelsea Bridge and Grosvenor Bridge, and to the south of the site where visibility is in reality completely obscured by mature trees within Battersea Park. The scale of the visual assessment area has been set by the maximum extents of the construction phase ZTV, except in those locations upstream of the site where the visibility of the proposed works would be barely perceptible, downstream of the site where the visibility is in reality obscured by Chelsea Bridge and Grosvenor Bridge, and to the south of the site where visibility is in reality completely obscured by mature trees within Battersea Park. All visual assessment viewpoints are located within the ZTV.

11.3.13 The construction assessment area for this site intersects with the assessment area for the proposed Thames Tideway Tunnel project sites at Kirtling Street, Heathwall Pumping Station and, to a limited extent, Albert Embankment Foreshore. These sites are therefore included in this assessment.

11.3.14 For the construction base case for the assessment of effects arising from the proposed development at the Chelsea Embankment Foreshore site, it is assumed that the following developments would be complete and occupied by Site Year 2 of construction:

a. Riverlight - a residential led mixed use development. 1km southeast of site.

b. phases 1, 2 and 3 of the Battersea Power Station redevelopment, comprising the residential and mixed use plots to the west of the power station and the power station itself.

c. buildings B4, B5 and B6 of the New Covent Garden Market development, comprising mixed use plots to the south of the development, adjacent to the railway line.

d. the US Embassy development.

e. buildings A02, A05, A09, A10 and A11 of the Embassy Gardens mixed use development surrounding the US Embassy development.

f. Vauxhall Sky Gardens mixed use development.

11.3.15 For the purposes of the cumulative effects assessment, it is assumed that phase 4 and parts of phases 5 and 6 of the Battersea Power Station redevelopment would be under construction during Site Year 2 of construction at the Chelsea Embankment Foreshore site.

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. Any site specific variations are described below.

11.3.18 Five verifiable photomontages have been prepared for this site to assist the assessment of operational effects. These are shown in Vol 18 Figures 11.6.1 to 11.6.5 (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. 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.

11.3.20 The assessment area, defined using the methodology provided in Vol 2 Section 11, is indicated in Vol 13 Figure 11.4.6 for townscape and Vol 13 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 upstream of the site where the visibility of the proposed development would be barely perceptible, downstream of the site where the visibility is in reality obscured by Chelsea Bridge and Grosvenor Bridge, and to the south of the site where visibility is in reality completely obscured by mature trees within Battersea Park. The scale of the visual assessment area has been set by the maximum extents of the operational phase ZTV, except in those locations upstream of the site where the visibility of the proposed development would be barely perceptible, downstream of the site where the visibility is in reality obscured by Chelsea Bridge and Grosvenor Bridge, and to the south of the site where visibility is in reality completely obscured by mature trees within Battersea Park. All visual assessment viewpoints are located within the ZTV.

11.3.21 Section 11.6 details the likely significant effects arising from the operation at Chelsea Embankment Foreshore. There are no other Thames Tideway Tunnel project sites which could give rise to additional effects on the townscape and visual topic within the operational assessment area for this site, therefore no other Thames Tideway Tunnel project sites are considered in this assessment.

11.3.22 In terms of the operational base case for the assessment of effects on Chelsea Embankment Foreshore, no developments within the operational phase assessment areas have been identified that meet the criteria for inclusion in the base case. Therefore, no other developments are considered in the assessment of effects on Chelsea Embankment Foreshore in the operational phase.

11.3.23 As detailed in the site development schedule (Vol 13 Appendix N) no schemes have been identified within the operational phase assessment area which meet the criteria for inclusion in the cumulative assessment. Therefore no assessment of cumulative effects has been undertaken for effects on Chelsea Embankment Foreshore in the operational phase.

11.3.24 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

11.3.25 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 11. Site specific assumptions and limitations are detailed below.

Assumptions

11.3.26 For the purposes of the construction phase assessment, it is assumed that the construction activities and plant, site hoardings, welfare facilities and access points are in the location shown on the Construction phase 2 (shaft construction and tunnelling) 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 Construction phase plans in separate volume of figures – Section 1), with the permanent structures under construction located within the zones shown on Site works parameter plan (see separate volume of figures – Section 1).

11.3.27 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 Site works parameter plan (see separate volume of figures – Section 1).

Limitations

11.3.28 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.

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.

Topography

11.4.3 The assessment area is relatively flat with no notable topographic features within or around the site area.

Land use

11.4.4 To the north of the river, land use is predominantly residential, apart from the Grade II listed Royal Hospital, Chelsea and Ranelagh Gardens.

11.4.5 The land use to the south of the river is dominated by Battersea Park and, along the eastern edge of the open space, a linear band of residential blocks.

11.4.6 The assessment area includes a number of conservation areas, which are shown on Vol 13 Figure 11.4.1 (see separate volume of figures).

Development patterns and scale

11.4.7 Vol 13 Figure 11.4.2 (see separate volume of figures) illustrates the pattern and scale of development and building heights within the assessment area.

11.4.8 Within the assessment area, the pattern of development is heavily influenced by the major open spaces (Royal Hospital Gardens and Battersea Park), and the River Thames.

11.4.9 Residential areas on the north bank are characterised by three to four storey residential terraces on a formal grid layout, with some larger and taller plots throughout the area. Properties generally have small front and rear private gardens and on-street parking.

11.4.10 The linear band of residential properties along Queenstown Road are nine to eleven storeys high, and arranged around internal communal open spaces.

Vegetation patterns and extents

11.4.11 Vol 13 Figure 11.4.3 (separate volume of figures) illustrates the pattern and extent of vegetation, including tree cover, within the assessment area.

11.4.12 The character of vegetation across the assessment area is dominated by widespread mature trees forming avenues along the edges of the Royal Hospital's South Grounds, and Battersea Park and Ranelagh Gardens with scattered dense tree cover. The avenue of mature London plane trees along Chelsea Embankment is a strong feature that characterises this stretch of the river.

11.4.13 Mature trees are also distributed widely among the residential areas on the north bank of the river, including within small public open spaces, private gardens and along streets.

11.4.14 A number of trees within the assessment area are protected by Tree Preservation Orders, and trees within conservation areas on both sides of the river are indirectly protected by virtue of the designation.

Open space distribution and type

11.4.15 Vol 13 Figure 11.4.4 (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.

11.4.16 The character of the area is dominated by a series of large and medium public open spaces, described in more detail in the table below.

Vol 13 Table 11.4.1 Townscape – open space type and distribution

Open space	Distance from site	Character summary
Royal Hospital Gardens	10m (north of river)	Large formal gardens (forming part of the Grade II Royal Hospital, Chelsea and Ranelagh Gardens) providing the setting to the Grade I listed Royal Hospital Chelsea. The gardens are characterised by formal lawns with avenues of mature trees aligned on axis with the Royal Hospital building. The open space provides the venue for the annual Chelsea Flower Show. Designated as Metropolitan Open Land and an Historic Park and Garden. Categorised as a District Park by the Greater London Authority.
Ranelagh Gardens	10m (north of	Medium sized open space adjacent to the Royal Hospital Gardens (forming part of the Grade II

Open space	Distance from site	Character summary
	river)	Royal Hospital, Chelsea and Ranelagh Gardens), characterised by dense tree cover, a network of winding footpaths, ornamental shrub beds and an avenue of mature trees along Chelsea Bridge Road. Designated as Metropolitan Open Land and an Historic Park and Garden. Categorised as a District Park by the Greater London Authority.
Battersea Park	200m (south of river)	Large open space dominated by open amenity grassed areas with numerous mature trees. The park also includes several outdoor sports facilities, including tennis courts, football pitches and running tracks. The Thames Path runs along the riverfront, through the park, along which there are intermittent seating areas and also the Peace Pagoda structure. Designated as Metropolitan Open Land and an Historic Park and Garden. Categorised as a Metropolitan Park by the Greater London Authority.
Chelsea Physic Garden	450m (north of river)	Medium sized open space recorded as one of London's oldest botanical gardens, characterised by scattered mature trees. Designated as Metropolitan Open Land and a Grade I listed Historic Park and Garden. Categorised as a Local Park by the Greater London Authority.
Burtons Court	400m northwest (northwest of river)	Large area of formal lawns surrounded by avenues of mature trees to the north of the Royal Hospital Chelsea. Designated as an Historic Park and Garden. Categorised as a District Park by the Greater London Authority.

Transport routes

11.4.17 Vol 13 Figure 11.4.5 (separate volume of figures) illustrates the transport network within the assessment area, including cycleways, footpaths and Public Rights of Way.

11.4.18 The site is located immediately adjacent to Chelsea Embankment, close to Chelsea Bridge Road (running north) and Queenstown Road (running south), all of which are characterised by high levels of vehicular traffic. The other strategic route in the area is Nine Elms Lane to the south of the Battersea Power Station site. The majority of other streets are fairly narrow and characterised by varying levels of both vehicular and pedestrian traffic.

11.4.19 The Thames Path runs along both the northern and southern banks of the river through the assessment area. The path is much wider and is also dedicated to pedestrians on the southern bank within Battersea Park.

11.4.20 The railway between Clapham Junction and Victoria mainline stations, running north-south across Grosvenor Rail Bridge, forms the boundary of the assessment area to the east of the site.

Site character assessment

11.4.21 The foreshore area is located within Thames Conservation Area whilst the in-highway works to connect to the northern Low Level Sewer No.1 are at the edge of the Royal Hospital Conservation Area. The majority of the site is located on the foreshore of the River Thames, with the remainder located on the southern pavement and one westbound lane of Chelsea Embankment. For a short period of time during construction, an area on the northern side of Chelsea Embankment would also be required: this would comprise the pavement, part of the carriageway and an area within the edge of Ranelagh Gardens. The river wall along Chelsea Embankment, in this location, is partly the historic Grade II listed granite wall, constructed by Sir Joseph Bazalgette, and partly brick built. This length is further characterised by an avenue of mature London plane trees and lamp standards. The section of the site in Ranelagh Gardens comprises semi-mature scattered trees and shrubs, which forms part of a wider belt of vegetation along the southern edge of the gardens. The character of the site is illustrated by Vol 13 Plate 11.4.1 and the components of the site are described in more detail in Vol 13 Table 11.4.2

Vol 13 Plate 11.4.1 The character of the site

Date taken: 29 March 2011. 35mm lens.

Vol 13 Table 11.4.2 Townscape – site components

ID	Component	Description	Condition
01	Grade II listed river wall	Granite clad river wall constructed by Sir Joseph Bazalgette. The wall has regularly spaced stanchions and sits at flood defence level, approximately 1m higher than the pavement level. The Grade II listing is outside the site boundary, at a point west of the Bull Ring Gates where there are steps to the foreshore.	Good condition
02	Brick built river wall	Brick built stretch of river wall in front of Ranelagh Gardens.	Good condition
03	Lamp standards	Ornamental cast iron lamp standards positioned on the regularly spaced stanchions in the river wall.	Good condition
04	Mature trees	A mix of mature and younger London plane trees (including some recently planted saplings), protected by TPOs, lining Chelsea Embankment.	Good condition
05	Thames Path	Yorkstone paved pavement alongside the river wall and Victoria Embankment road.	Good condition
06	Seating	Occasional benches along the Thames Path.	Good condition
07	Ranelagh Gardens railings and brick boundary wall	Black railings above a low brick wall along the southern boundary to Ranelagh Gardens.	Good condition
08	Ranelagh Gardens boundary vegetation	Area of scattered semi-mature trees and shrubs along the southern boundary of Ranelagh Gardens.	Good condition
09	Bull ring roundabout planter	An elevated planter in the roundabout south of the entrance to the Royal Hospital Gardens.	Good condition

11.4.22 A baseline description of Thames Conservation Area as a heritage asset in provided in Section 7.4 of this volume.

11.4.23 The condition of the townscape within the site is generally good, due to the majority of the components being well maintained.

11.4.24 The location of the site alongside Chelsea Embankment, which is characterised by heavy traffic, noticeably limits the level of tranquillity. However, given its location adjacent to a quiet stretch of river and the large open space of Royal Hospital Gardens, the site has a moderate level of tranquillity.

11.4.25 The site is located within a nationally significant historical and cultural stretch of the River Thames, providing the setting to Battersea Park and the Royal Hospital Gardens. As such it is experienced by large numbers of people and the site is therefore nationally valued.

11.4.26 Due to the good condition and national value of the site's character, the site has a high sensitivity to change.

Townscape character assessment

11.4.27 The townscape character areas surrounding the site are identified in Vol 13 Figure 11.4.6 (see separate volume of figures). Townscape character areas 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 – Royal Hospital and Battersea Park Reach TCA

11.4.28 This reach of the River Thames extends from Albert Bridge in the west, to Chelsea Bridge in the east. This reach is characterised by the green frontages of Battersea Park and the Royal Hospital Gardens. Much of this section of the river is designated as the Thames Conservation Area. The character of this area is illustrated by Vol 13 Plate 11.4.2.

Vol 13 Plate 11.4.2 River Thames – Royal Hospital and Battersea Park Reach TCA

Date taken: 25 March 2011. 18mm lens.

11.4.29 The river itself is characterised by a long consistent sweep of river wall with no protrusions beyond the wall. Both banks have a relatively wide area of foreshore at low tide.

11.4.30 A baseline description of Thames Conservation Area as a heritage asset is provided in Section 7.4 of this volume.

11.4.31 The jetties, river walls and bridges are well maintained. The overall townscape condition is good.

11.4.32 Due to the dominance of the two large open spaces, mature tree planting along the river and the relatively light levels of river traffic, this area has a high level of tranquillity.

11.4.33 This reach is a nationally valued stretch of the river, experienced by large numbers of people visiting Battersea Park and the Royal Hospital Gardens.

11.4.34 Due to the good condition and national value of the townscape, this character area has a high sensitivity to change.

River Thames – Nine Elms Reach TCA

11.4.35 This reach of the River Thames extends from Chelsea Bridge in the west, to Vauxhall Bridge in the east. The reach is largely characterised by residential development, set against the Battersea Power Station site, which is undergoing redevelopment. The character of this area is illustrated by Vol 13 Plate 11.4.3.

Vol 13 Plate 11.4.3 River Thames – Nine Elms Reach TCA

Date taken: 2 August 2011. 18mm lens.

11.4.36 The river is characterised by a varying frontage with different river wall characters and numerous piers, jetties and small inlets. Both banks have a relatively wide area of foreshore at low tide.

11.4.37 The river walls and structures are fairly well maintained, although some parts of the frontage at Battersea Power Station are in a poor state of repair. The overall townscape condition is fair.

11.4.38 Despite the residential character along parts of the river frontage, the presence of heavy industries in the immediate area and their associated industrial river transport, means the reach has a moderate level of tranquillity.

11.4.39 The reach is a regionally valued stretch of the river, forming the backdrop to a number of conservation areas on both sides of the river, in addition to Battersea Power Station which is a high profile regeneration project in London.

11.4.40 Because of the fair condition and moderate levels of tranquillity, this character area has a medium sensitivity to change.

Royal Hospital Conservation Area - Grounds TCA

11.4.41 This character area falls within the Royal Hospital Conservation Area, designated by the RB of Kensington and Chelsea and comprises the extensive formal landscape (forming part of the Grade II Royal Hospital Chelsea and Ranelagh Gardens) surrounding the Grade I listed Royal Hospital. The area includes courtyards around the Royal Hospital Chelsea, formal open lawn areas, avenues of mature trees lining paths on axis with the hospital building, together with formally arranged sports pitches in Burtons Court and Duke of York Square to the north of the area. The character of the area is largely enclosed, although the gardens to the south of the Royal Hospital Chelsea have an axial geometry that creates a close relationship with the River Thames. The area is used annually for the Chelsea Flower Show. The area is designated as Metropolitan Open Land and a Grade II Historic Park and Garden. The character of this area is illustrated by Vol 13 Plate 11.4.4.

Vol 13 Plate 11.4.4 Royal Hospital Conservation Area - South and North Grounds TCA

Date taken: 15 August 2011. 18mm lens.

11.4.42 A baseline description of Royal Hospital Conservation Area, the Royal Hospital Grounds & Ranelagh Gardens Grade II Registered Park & Garden and the Grade I listed Royal Hospital as heritage assets is provided in Section 7.4 of this volume.

11.4.43 The buildings and landscape within the area are generally very well maintained. The overall townscape condition is good.

11.4.44 The area has a high level of tranquillity due to the extent of open space, the abundance of mature trees and the relatively quiet levels of use (apart from during events such as the Chelsea Flower Show).

11.4.45 The character area is nationally valued as one of the country's well known formal gardens, providing the setting for the Grade I listed Royal Hospital Chelsea and also the venue for the well attended annual Chelsea Flower Show.

11.4.46 Because of the good condition and national value of the townscape, and high level of tranquillity, this area has a high sensitivity to change.

Ranelagh Gardens TCA

11.4.47 This character area falls within the Royal Hospital Conservation Area, designated by the RB of Kensington and Chelsea. The area comprises Ranelagh Gardens, an open space adjacent to the Royal Hospital Gardens characterised by dense tree cover. The area includes large mature avenues along the boundary with the Royal Hospital Gardens and with Chelsea Bridge Road, which enclose areas with dense tree coverage, large planted shrub beds and occasional open grassed areas. The character of the gardens is enclosed, surrounded by dense boundary vegetation. Parts of the gardens are used annually for the Chelsea Flower Show. The area is designated as Metropolitan Open Land and a Grade II Historic Park and Garden. The character of this area is illustrated by Vol 13 Plate 11.4.5.

Vol 13 Plate 11.4.5 Ranelagh Gardens TCA

Date taken: 5 September 2011. 18mm lens.

11.4.48 A baseline description of Royal Hospital Conservation Area and the Royal Hospital Grounds & Ranelagh Gardens Grade II Registered Park & Garden as heritage assets is provided in Section 7.4 of this volume.

11.4.49 The buildings and landscape within the area are well maintained. The overall townscape condition is good.

11.4.50 The area has a high level of tranquillity due to the extent of open space, the abundance of mature trees and the relatively limited use (apart from during events such as the Chelsea Flower Show).

11.4.51 The character area is regionally valued by virtue of the Metropolitan Open Land designation, and registered Historic Park and Garden listing.

11.4.52 Because of the good condition and regional value of the townscape, and high level of tranquillity, this area has a high sensitivity to change.

Chelsea Residential TCA

11.4.53 This area features a narrow band of newly built and older residential blocks, generally up to eight storeys high, located between the railway from Clapham Junction to London Victoria mainline stations and Chelsea Bridge Road, which forms the eastern boundary of Ranelagh Gardens. The area incorporates the Grade II listed Lister Hospital, and two proposed tower blocks, up to 13 storeys high. The area has been densely developed, and has a limited amount of private or public open space. The character of this area is illustrated by Vol 13 Plate 11.4.6.

Vol 13 Plate 11.4.6 Chelsea Residential TCA

Date taken: 15 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 Despite the presence of the railway line along the eastern boundary of this area, and Chelsea Bridge Road to the west with associated traffic, the townscape has moderate levels of tranquillity because of its residential character, the presence of open spaces, and location adjacent to Ranelagh Gardens.

11.4.56 The townscape of the character area is likely to be locally valued by residents within the area.

11.4.57 Because of the local value attributed to the townscape and moderate levels of tranquillity, this character area has a medium sensitivity to change.

Queenstown Road Residential TCA

11.4.58 This area comprises a band of nine to twelve storey newly built residential blocks located between the railway from Clapham Junction to London Victoria mainline stations, and Queenstown Road which forms the eastern boundary of Battersea Park. The area is located within Battersea Park Conservation Area. The residential blocks are arranged around communal open spaces, and are orientated to maximise views over the river and Battersea Park. The character of this area is illustrated by Vol 13 Plate 11.4.7.

Vol 13 Plate 11.4.7 Queenstown Road Residential TCA

Date taken: 15 August 2011. 18mm lens.

11.4.59 The buildings and public realm within the area are well maintained. The overall townscape condition is good.

11.4.60 Despite the presence of the railway line along the eastern boundary of this area, and the presence of Queenstown Road to the west, the townscape has moderate levels of tranquillity because of its residential character, the presence of open spaces, and the location adjacent to Battersea Park.

11.4.61 The townscape of the character area is valued at the borough level, by virtue of the conservation area designation.

11.4.62 Because of the good condition and borough value of the townscape, this character area has a high sensitivity to change.

Battersea Park Conservation Area TCA

11.4.63 This area comprises Battersea Park, designated as a Conservation Area, Historic Park and Garden, and Metropolitan Open Land. The character of the area is dominated by the mature vegetation and formal arrangement of Battersea Park, which includes tree lined paths, sports facilities, extensive areas of tree and shrub planting and large waterbodies. Because of the presence of dense bands of mature trees, the area is largely enclosed in character, apart from the river frontage, which comprises an open area of public space along the Thames Path. The character of this area is illustrated by Vol 13 Plate 11.4.8.

Vol 13 Plate 11.4.8 Battersea Park Conservation Area TCA

Date taken: 15 August 2011. 18mm lens.

11.4.64 A baseline description of the Grade II* Registered Battersea Park as a heritage asset is provided in Section 7.4 of this volume.

11.4.65 The landscape within the park is well maintained. The overall townscape condition is good.

11.4.66 Despite relatively high levels of traffic on some roads surrounding the open space, the park has a high level of tranquillity due to the density of mature planting, scale of open space and enclosure provided from surrounding development.

11.4.67 The character of this area, dominated by the vegetation and open space of Battersea Park, is regionally valued as a major public open space in London, experienced by large numbers of people. This regional value is strengthened by the park's designation as an Historic Park and Garden and Metropolitan Open Land.

11.4.68 Because of the good condition and regional value of the townscape, and high levels of tranquillity, this area has a high sensitivity to change.

Royal Hospital Residential TCA

11.4.69 This character area falls within the Royal Hospital Conservation Area and also includes a part of Cheyne Conservation Area which is similar in character. The area comprises a mix of residential blocks laid out on a grid pattern around the Royal Hospital Gardens to the east. The character of the area is heavily influenced by the diversity of building scales and architectural styles present, forming clusters of developments that are similar in character. The area has an abundance of large mature trees along streets, in public open spaces and within private and semi-private gardens and courtyards. The area also includes the Grade I listed

Chelsea Physic Garden. The character of this area is illustrated by Vol 13 Plate 11.4.9.

Vol 13 Plate 11.4.9 Royal Hospital Residential TCA

Date taken: 15 August 2011. 18mm lens.

11.4.70 A baseline description of Royal Hospital Conservation Area as a heritage asset is provided in Section 7.4 of this volume.

11.4.71 The buildings and public realm within the area are well maintained. The overall townscape condition is good.

11.4.72 The area has a high level of tranquillity given the residential character, presence of mature trees and open spaces, and limited flows of traffic.

11.4.73 The townscape of the character area is valued at the borough level, by virtue of the conservation area designations.

11.4.74 Because of the good condition and borough value of the townscape, and high level of tranquillity, this area has a high sensitivity to change.

Visual baseline

11.4.75 Vol 13 Figure 11.4.7 (see separate volume of figures) indicates the location of viewpoints referenced below. All residential and recreational receptors have a high 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

11.4.76 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 northwest from residences on Queenstown Road adjacent to Chelsea Bridge

11.4.77 This viewpoint is representative of the typical view from residential properties adjacent to the Thames Path on the southern bank of the River Thames, on Queenstown Road next to Chelsea Bridge.

Vol 13 Plate 11.4.10 Viewpoint 1.1: Winter view

Date taken: 25 January 2012. 18mm lens.

11.4.78 The view (illustrated in Vol 13 Plate 11.4.10) from lower storeys is dominated by Chelsea Bridge in the foreground, with residences on the north bank visible across the river. The view from upper storeys is an open panorama over the river, focused toward the site and Royal Hospital Gardens. Views of the site are unobstructed from upper storeys.

Vol 13 Plate 11.4.11 Viewpoint 1.1: Summer view

Date taken: 19 August 2011. 18mm lens.

11.4.79 In summer, the view towards the site (illustrated in Vol 13 Plate 11.4.11) is largely unchanged, apart from the presence of the dense avenue of mature London plane trees along the northern bank, which form a stronger part of the background of the view during summer.

Viewpoint 1.2: View east from residences in Embankment Gardens

11.4.80 This viewpoint is representative of the typical oblique view from residential properties adjacent to the Thames Path on the northern bank of the River Thames, in Embankment Gardens.

Vol 13 Plate 11.4.12 Viewpoint 1.2: Winter view

Date taken: 5 January 2012. 35mm lens.

11.4.81 The view (illustrated in Vol 13 Plate 11.4.12) is dominated by the avenue of mature London plane trees along Chelsea Embankment, which partially screen views of the river beyond. The oblique view towards the site is a linear view down Chelsea Embankment, framed by the avenue of London plane trees along both sides, which filter views of the site. Chelsea Bridge forms the background of the view.

Vol 13 Plate 11.4.13 Viewpoint 1.2: Summer view

Date taken: 19 August 2011. 35mm lens.

11.4.82 In summer (illustrated in Vol 13 Plate 11.4.13), the avenue of London plane trees along Chelsea Embankment further obscure views towards the site.

Viewpoint 1.3: View southeast from residences on West Road, close to College Court

11.4.83 This viewpoint is representative of the typical view from residential properties adjacent to the Royal Hospital Gardens on West Road, close to College Court.

Vol 13 Plate 11.4.14 Viewpoint 1.3: Winter view

Date taken: 5 January 2012. 35mm lens.

11.4.84 The view (illustrated in Vol 13 Plate 11.4.14) is dominated by the boundary walling to the Royal Hospital Gardens. Through the entrance gates, the open grassland and avenues of mature trees within the gardens are visible. From ground level, the boundary walling obscures views towards the site. From upper storeys, views towards the site are largely obscured by mature trees within the gardens and along Chelsea Embankment.

Recreational

11.4.85 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 south from the footpath at the eastern edge of the Royal Hospital Gardens

11.4.86 This viewpoint is representative of the typical view for recreational users of the Royal Hospital Gardens, located at the footpath along the boundary of the open space with Ranelagh Gardens.

Vol 13 Plate 11.4.15 Viewpoint 2.1: Winter view

Date taken: 5 January 2012. 18mm lens.

11.4.87 The view (illustrated in Vol 13 Plate 11.4.15) is characterised by raised grassed mounds along the southern boundary of the gardens, with scattered semi-mature trees and shrubs along its length, filtering views towards the river and the site. Trees along the frontage of Battersea Park, on the opposite side of the river, form the background to the view.

Vol 13 Plate 11.4.16 Viewpoint 2.1: Summer view

Date taken: 19 August 2011. 18mm lens.

11.4.88 In summer (illustrated in Vol 13 Plate 11.4.16), mature trees along the boundary of the Royal Hospital Garden heavily filter views towards the site.

Viewpoint 2.2: View west from the northern end of Chelsea Bridge

11.4.89 This viewpoint is representative of the typical view for pedestrians crossing Chelsea Bridge, towards the northern end of the bridge.

Vol 13 Plate 11.4.17 Viewpoint 2.2: Winter view

Date taken: 5 January 2012. 35mm lens.

11.4.90 The view (illustrated in Vol 13 Plate 11.4.17) is linear in nature along Chelsea Embankment, up the River Thames, and is characterised by the substantial avenue of mature London plane trees lining the north bank, that visually relates to the green frontage of Battersea Park to the south. The site is highly visible in the foreground of this view. The distinctive World's End Estate high rise development and chimneys of Lots Road Power Station form the background to the view up the river.

Vol 13 Plate 11.4.18 Viewpoint 2.2: Summer view

Date taken: 19 August 2011. 35mm lens.

11.4.91 In summer, the view towards the site (illustrated in Vol 13 Plate 11.4.18) is largely unchanged, although mature vegetation along Chelsea Embankment screens views towards the parts of the site on the edge of Ranelagh Gardens.

11.4.92 A baseline description of the Grade II listed Chelsea Bridge as a heritage asset is provided in Section 7.4 of this volume.

Viewpoint 2.3: View west and south-east from the footpath opposite the King William IV public house

11.4.93 This viewpoint is representative of the typical view for pedestrians along the north side of Grosvenor Road, on the bank of the river, opposite the King William IV public house.

Vol 13 Plate 11.4.19 Viewpoint 2.3: Winter view towards Chelsea Embankment Foreshore (west)

Date taken: 5 January 2012. 18mm lens.

11.4.94 The view (illustrated in Vol 13 Plate 11.4.19) is an open panorama over the river, focused on Grosvenor Bridge in the middle ground of the view. The foreground of the view up the river, towards the site, is characterised by the substantial avenue of mature London plane trees along Chelsea Embankment. Views of the site are therefore largely obstructed by the tree avenue and Grosvenor Bridge.

Vol 13 Plate 11.4.20 Viewpoint 2.3: Winter view towards Kirtling Street and Heathwall Pumping Station (southeast)

Date taken: 15 February 2012. 18mm lens.

11.4.95 This viewpoint is also located within the ZTV of the proposed Thames Tideway Tunnel project sites at Kirtling Street and Heathwall Pumping Station. The view (illustrated in Vol 13 Plate 11.4.20) towards these sites is an open panorama across the River Thames which is dominated by Battersea Power Station on the opposite side of the river (just outside the field of view illustrated). The sites are clearly visible in the background of the view. The foreground of the view is characterised by mature trees along Grosvenor Road.

Viewpoint 2.4: View northwest from towards the southern end of Chelsea Bridge

11.4.96 This viewpoint is representative of the typical view for pedestrians crossing Chelsea Bridge, towards the southern end of the bridge.

Vol 13 Plate 11.4.21 Viewpoint 2.4: Winter view

Date taken: 5 January 2012. 18mm lens.

11.4.97 The view (illustrated in Vol 13 Plate 11.4.21) is linear in nature up the River Thames, and is characterised by the avenue of mature London plane trees along Chelsea Embankment to the north. The site is highly visible in the foreground of the view, set in front of the Royal Hospital Gardens.

Vol 13 Plate 11.4.22 Viewpoint 2.4: Summer view

Date taken: 19 August 2011. 18mm lens.

11.4.98 In summer, the view towards the site (illustrated in Vol 13 Plate 11.4.22) is largely unchanged, although the avenue of mature London plane trees forms a stronger component of the view.

Viewpoint 2.5: View northwest from the Thames Path in Battersea Park, close to Chelsea Bridge

11.4.99 This viewpoint is representative of the typical view for recreational users of the Thames Path within Battersea Park, close to Chelsea Bridge.

Vol 13 Plate 11.4.23 Viewpoint 2.5: Winter view

Date taken: 5 January 2012. 18mm lens.

11.4.100 The view (illustrated in Vol 13 Plate 11.4.23) is an open panorama across the river, characterised by the avenue of mature London plane trees along Chelsea Embankment. The view is focused on Royal Hospital Gardens, in front of which the site would be highly visible.

Vol 13 Plate 11.4.24 Viewpoint 2.5: Summer view

Date taken: 19 August 2011. 18mm lens.

11.4.101 In summer, the view towards the site (illustrated in Vol 13 Plate 11.4.24) is largely unchanged, although the avenue of mature London plane trees forms a stronger component of the view.

Viewpoint 2.6: View northwest from North Carriage Drive, close to Chelsea Bridge

11.4.102 This viewpoint is representative of the typical view for pedestrians on North Carriage Drive within Battersea Park, close to Chelsea Bridge.

Vol 13 Plate 11.4.25 Viewpoint 2.6: Winter view

Date taken: 5 January 2012. 18mm lens.

11.4.103 The view (illustrated in Vol 13 Plate 11.4.25) is an open panorama across the river heavily filtered by vegetation within Battersea Park. The view across the river is focused on Royal Hospital Gardens, in front of which the proposed site would be visible.

Vol 13 Plate 11.4.26 Viewpoint 2.6: Summer view

Date taken: 19 August 2011. 18mm lens.

11.4.104 In summer, mature vegetation along the edge of Battersea Park in the foreground of the view, almost entirely obscures views towards the site (illustrated in Vol 13 Plate 11.4.26).

Viewpoint 2.7: View northeast from the Thames Path in Battersea Park, close to the most easterly car park

11.4.105 This viewpoint is representative of the typical view for recreational users of the Thames Path in Battersea Park from a semi-circular viewing area close to the most easterly car park.

Vol 13 Plate 11.4.27 Viewpoint 2.7: Winter view

Date taken: 5 January 2012. 18mm lens.

11.4.106 The view (illustrated in Vol 13 Plate 11.4.27) is an open panorama across the river with Chelsea Bridge in the background of the view (far right of the image). The view across the river is characterised by the avenue of mature London plane trees along Chelsea Embankment, and the Royal Hospital Gardens, in front of which lies the proposed site. Views of the site are therefore unobstructed from this location.

Vol 13 Plate 11.4.28 Viewpoint 2.7: Summer view

Date taken: 19 August 2011. 18mm lens.

11.4.107 In summer, the view towards the site (illustrated in Vol 13 Plate 11.4.28) is largely unchanged, although the avenue of mature London plane trees along Chelsea Embankment forms a stronger component of the view across the river.

Viewpoint 2.8: View northeast from the Peace Pagoda in Battersea Park

11.4.108 This viewpoint is representative of the view for recreational users at the Peace Pagoda on the river frontage in Battersea Park.

Vol 13 Plate 11.4.29 Viewpoint 2.8: Winter view

Date taken: 5 January 2012. 18mm lens.

11.4.109 The view (illustrated in Vol 13 Plate 11.4.29) is an open panorama across the river with Chelsea Bridge in the background of the view (far right of the image). The view across the river is characterised by the avenue of mature London plane trees along Chelsea Embankment, and the Royal Hospital Gardens, in front of which lies the proposed site. Views of the site are therefore unobstructed from this location.

Vol 13 Plate 11.4.30 Viewpoint 2.8: Summer view

Date taken: 19 August 2011. 18mm lens.

11.4.110 In summer, the view towards the site (illustrated in Vol 13 Plate 11.4.30) is largely unchanged, although the avenue of mature London plane trees along Chelsea Embankment form a stronger component of the view.

Viewpoint 2.9: View southeast from the main axis of the Royal Hospital Chelsea

11.4.111 This viewpoint is representative of the view for recreational users of the Royal Hospital Gardens, located on the main axial footpath (Monument Walk) from the Royal Hospital building that leads to Chelsea Embankment and the River Thames.

Vol 13 Plate 11.4.31 Viewpoint 2.9: Winter view

Date taken: 5 January 2012. 35mm lens.

11.4.112 The view (illustrated in Vol 13 Plate 11.4.31) is open in nature across the gardens, and is framed by the avenues of mature trees to the east and west (beyond the frame of view illustrated). The mature avenue of London plane trees along Chelsea Embankment partially screens views towards the site and the river.

Vol 13 Plate 11.4.32 Viewpoint 2.9: Summer view

Date taken: 19 August 2011. 35mm lens.

11.4.113 In summer, the mature avenue of London plane trees along Chelsea Embankment almost entirely screens views towards the site (illustrated in Vol 13 Plate 11.4.32).

Viewpoint 2.10: View southeast from the entrance to the Royal Hospital Gardens from Chelsea Embankment

11.4.114 This viewpoint is representative of the typical view for pedestrians at the formal entrance to the Royal Hospital Gardens from Chelsea Embankment (the Bullring).

Vol 13 Plate 11.4.33 Viewpoint 2.10: Winter view

Date taken: 5 January 2012. 18mm lens.

11.4.115 The view (illustrated in Vol 13 Plate 11.4.33) is an open panorama across the river, and is partially obstructed by an avenue of mature London plane trees along Chelsea Embankment, in the foreground of the view. The linear view along Chelsea Embankment is also framed by this avenue. The site is located in the foreground of this view, in a gap in the tree avenue and would be highly visible.

Vol 13 Plate 11.4.34 Viewpoint 2.10: Summer view

Date taken: 19 August 2011. 18mm lens.

11.4.116 In summer, the view towards the site (illustrated in Vol 13 Plate 11.4.34) is largely unchanged, although the mature trees along Chelsea Embankment would more heavily screen views towards the portion of the site located on the edge of Ranelagh Gardens.

Construction base case

11.4.117 The base case in Site Year 2 of construction taking into account the schemes described in para. 11.3.14 would change the immediate setting of the River Thames – Nine Elms Reach TCA. By Site Year 2 of construction, the conversion of a number of industrial units and disused plots of land into new residential and mixed use developments would alter the setting of this stretch of the river. However, as there would be no changes to character within the area, the sensitivity would remain medium as described in para. 11.4.35 to para. 11.4.40.

11.4.118 All other receptors would remain as detailed in the baseline.

Operational base case

11.4.119 As described in para. 11.3.22, no developments within the operational phase assessment areas have been identified that meet the criteria for inclusion in the base case. Therefore, all townscape and visual receptors would remain as detailed in the baseline.

11.5 Construction effects assessment

11.5.1 The following section details the likely significant effects arising from construction at Chelsea Embankment Foreshore, taking into account Kirtling Street, Heathwall Pumping Station and Albert Embankment Foreshore (as detailed in Section 11.3).

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)[9] 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 proposed development during construction are contained in a separate volume (Construction phase plans, see separate volume of figures – Section 1).

Site character assessment

11.5.4 Effects on the character of the site would arise from; partial removal of the river wall and lamp standards; removal of existing trees along Chelsea

Embankment; installation of site hoardings and welfare facilities; creation of site access from Chelsea Embankment; 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 13 Table 11.5.1.

Vol 13 Table 11.5.1 Townscape – impacts on existing site components during construction

ID	Component	Impacts
01	Grade II listed river wall	To facilitate access onto the site from Chelsea Embankment, the section of the river wall above pavement level would require removal in places. In addition, the temporary cofferdam forming the site would be joined into the existing structure to ensure flood defences are retained during the works.
02	Brick built river wall	The temporary cofferdam forming the site would be joined into the existing river wall to ensure the flood defences are retained during the works.
03	Lamp standards	For the length of the site boundary, the lamp standards would require removal and careful storage during construction (for reinstatement following the works).
04	Mature trees	Five trees along Chelsea Embankment would require removal during the works, but generally only the smaller trees (including two saplings) would be removed, thus retaining and protecting the larger trees.
05	Thames Path	During construction, the Thames Path would be diverted to the opposite side of Chelsea Embankment. The existing paving would be removed for the duration of construction.
06	Seating	Seats would be removed during construction and reinstated following the works.
07	Ranelagh Gardens railings and brick boundary wall	These would be locally removed during the works.
08	Ranelagh Gardens boundary vegetation	A number of semi-mature shrubs and small trees would be cleared during the utility diversion works.
09	Bull ring roundabout planter	The planter would be removed.

11.5.5 The site has a moderate level of tranquillity at present, which would be substantially altered due to the 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 clearance required to form the construction site, the formation of the cofferdam in the river and the high levels of activity during construction, affecting both character and tranquillity, 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, would result in **major adverse** effects.

11.5.8 The assessment of specific effects on the setting of Thames Conservation Area as a heritage asset is set out in Section 7 of this volume. The historic environment assessment identifies a moderate adverse on the setting of this asset as the conservation area is larger than the area defined as the site. Therefore, the changes within the site affect only a proportion of the conservation area, with part of the setting unaffected.

Townscape character areas assessment

River Thames – Royal Hospital and Battersea Park Reach TCA

11.5.9 The proposed site is adjacent to this reach of the river, introducing high levels of construction activity and a temporary cofferdam within a part of the river currently characterised by a long consistent sweep of river wall with no protrusions beyond the line of the wall. The construction activity would be set in front of the green frontage of the Royal Hospital Gardens and Chelsea Embankment, adversely affecting the strong linear stretch of the river. While the temporary cofferdam and construction site would be relatively small in the context of the overall character area, the intensity of construction activities In the vicinity of Chelsea Bridge would have a marked effect, particular given the openness of the area.

11.5.10 The area has a high level of tranquillity at present, which would be substantially altered because of the introduction of construction activity, including piling and demolition.

11.5.11 Due to the substantial changes to the setting and tranquillity of this area, the magnitude of change is considered to be high.

11.5.12 The high magnitude of change, assessed alongside the high sensitivity of this character area, would result in **major adverse** effects.

11.5.13 The assessment of specific effects on the setting of Thames Conservation Area as a heritage asset is set out in Section 7 of this volume. The historic environment assessment identifies a moderate adverse on the setting of this asset as the conservation area is larger than this TCA. Therefore, the changes within the site affect only a proportion of the conservation area, with part of the setting unaffected.

River Thames – Nine Elms Reach TCA

11.5.14 The proposed Chelsea Embankment Foreshore site is approximately 100m west of this reach of the river, separated by Chelsea and Grosvenor Bridges. Construction activity would take place within the wider setting of this character area, but would be largely screened by the presence of these two bridges. The setting and tranquillity of this character area would therefore only be affected to a limited extent by construction at Chelsea Embankment Foreshore. The magnitude of change caused by works at this site is considered to be low.

11.5.15 However, the proposed Kirtling Street and Heathwall Pumping Station sites are located adjacent to this reach of the river, and the Albert Embankment Foreshore site is located at the northern end of the reach. Together, these sites would introduce high levels of construction activity within this section of the river, affecting both the setting of the area and the existing moderate levels of tranquillity. Construction at all of these sites would be set against an existing industrial context, including industrial barging operations (from the waste transfer station and cement works adjacent to the Kirtling Street site).

11.5.16 Due to the limited changes to setting and tranquillity caused by construction at Chelsea Embankment Foreshore and the more substantial change caused by construction activity at Kirtling Street, Heathwall Pumping Station and Albert Embankment Foreshore, the overall magnitude of change to this character area arising from the Thames Tideway Tunnel project is considered to be medium.

11.5.17 The medium magnitude of change, assessed alongside the medium sensitivity of this character area, would result in **moderate adverse** effects.

Royal Hospital Conservation Area – Grounds TCA

11.5.18 The proposed site is located immediately adjacent to this character area. High levels of construction activity are proposed within a part of the river currently characterised by a long consistent sweep of river wall. The construction activity would be set between this area and the river, and would therefore substantially alter this riverside setting. This change would result from the presence of the temporary cofferdam, construction activity, welfare facilities, site hoardings and cranes, in combination with the removal of vegetation along Chelsea Embankment and on the edge of Ranelagh Gardens. However, the majority of the setting of the character area would remain unaffected, with the Royal Hospital remaining the dominant component. The setting of the northern section of the area would remain unaffected by the works.

11.5.19 The high level of tranquillity in the area would be affected by the presence of construction activity, including piling and demolition, along the riverside edge. However, the effect would be minimised due to construction activity being located on the opposite side of Chelsea Embankment, which is heavily trafficked.

11.5.20 Due to changes to the riverside setting and levels of tranquillity, with the remainder of the area largely unaffected, the magnitude of change is considered to be medium.

11.5.21 The medium magnitude of change, assessed alongside the high sensitivity of this character area, would result in **moderate adverse** effects.

11.5.22 The assessment of specific effects on the setting of Royal Hospital Conservation Area, the Royal Hospital Grounds & Ranelagh Gardens Grade II Registered Park & Garden and the Grade I listed Royal Hospital as heritage assets is set out in Section 7 of this volume.

Ranelagh Gardens TCA

11.5.23 The proposed site is located adjacent to the river frontage of this character area. The character area is highly enclosed by dense boundary vegetation and therefore the river does not form a key part of the setting of the area. The localised setting along the southern boundary of the area would be affected to a limited extent by the proposed utility diversion and Low Level Sewer No 1 interception works, which would include the removal of some existing trees and vegetation, and the presence of site hoardings and construction activity. However, effects arising from this would be minimised through advance planting works (as described in para. 11.2.7d) along the boundary of Ranelagh Gardens, which would screen out both utility diversion and Low Level Sewer No.1 interception works. The majority of the setting to the character area would remain entirely unaffected

11.5.24 The area has a high level of tranquillity at present, which would be altered to a limited extent by the introduction of construction activity (including piling and demolition), on the opposite side of the heavily trafficked Chelsea Embankment road. However, the tranquil setting, created by the dense bands of vegetation around the boundary of the gardens would be almost entirely retained.

11.5.25 Due to the limited changes to a small part of the riverside setting and the limited changes to levels of tranquillity, the magnitude of change is considered to be negligible.

11.5.26 The negligible magnitude of change, assessed alongside the high sensitivity of this character area, would result in a **negligible** effect.

11.5.27 The assessment of specific effects on the setting of Royal Hospital Conservation Area and the Royal Hospital Grounds & Ranelagh Gardens Grade II Registered Park & Garden as heritage assets is set out in Section 7 of this volume. The historic environment assessment identifies a moderate adverse effect on the setting of these assets as they encompass other parts of the townscape which would be affected more substantially than the enclosed character of Ranelagh Gardens TCA.

Chelsea Residential TCA

11.5.28 The proposed site forms part of the wider riverside setting of this character area. Construction activity at the site would be largely obscured by Chelsea Bridge and the dense vegetation throughout Ranelagh Gardens and particularly along the eastern boundary. The riverside setting would be affected to a limited extent by the presence of tall construction plant and cranes. However, the majority of the areas setting would be largely unaffected, including the landward setting to the east and west, and the majority of the riverside setting between Chelsea Bridge and Grosvenor Bridge.

11.5.29 The area has a moderate level of tranquillity at present, which would be largely unaffected by construction activities at the site, set beyond the heavily trafficked Chelsea Bridge Road and Chelsea Embankment.

11.5.30 Due to the limited changes to a small part of the areas setting, the magnitude of change is considered to be negligible.

11.5.31 The negligible magnitude of change, assessed alongside the medium sensitivity of this character area, would result in a **negligible** effect.

Queenstown Road Residential TCA; and Battersea Park Conservation Area TCA

11.5.32 The proposed site forms a direct part of the riverside setting of these character areas, which forms an important part of their character. The presence of the site cofferdam, construction activity and cranes, and the removal of trees along Chelsea Embankment, would affect the riverside setting of both areas. The projection of the temporary cofferdam into the river would adversely affect this stretch of the river, which is currently characterised by a long consistent sweep of river wall. The site would be set in front of the green frontage of the Royal Hospital Gardens and Chelsea Embankment, which would highlight the presence of construction activity and plant. In the vicinity of Chelsea Bridge, this section of the river directly adjacent to these character areas would be heavily characterised by construction activity associated with the site. However, the majority of the immediate setting (dominated by the mature planting of Battersea Park) would remain unaffected.

11.5.33 The moderate to high levels of tranquillity in these character areas at present would be affected to a limited extent by the presence of intense construction activities on the opposite side of the river.

11.5.34 Due to the substantial changes to the riverside setting of these character areas and the limited changes to tranquillity, the magnitude of change is considered to be medium.

11.5.35 The medium magnitude of change, assessed alongside the high sensitivity of these character areas, would result in **moderate adverse** effects.

11.5.36 The assessment of specific effects on the setting of the Grade II* Registered Battersea Park 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 much of the historic character and setting of this area would be largely unaffected.

Royal Hospital Residential

11.5.37 The proposed site forms part of the wider riverside setting of this character area. Whilst the presence of the site cofferdam, construction activity and cranes would affect the wider riverside setting of the character area the majority of the area’s riverside setting and wider landward setting would remain largely unaffected by the proposed development.

11.5.38 The area has a high level of tranquillity at present, which would be largely unaffected by construction activities at the site, set beyond the heavily trafficked Chelsea Embankment.

11.5.39 Due to changes in the wider riverside setting, the magnitude of change is considered to be low.

11.5.40 The low magnitude of change, assessed alongside the high sensitivity of this character area, would result in **minor adverse** effects.

11.5.41 The assessment of specific effects on the setting of Royal Hospital 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 conservation area encompasses other parts of the townscape which would be affected more substantially than the enclosed character of this TCA.

Townscape – sensitivity test for programme delay

11.5.42 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 11.5.41). The Nine Elms Regeneration area (to the west of the proposed development) is subject to ongoing and long term change, and a delay to the Thames Tideway Tunnel project is not likely to change the sensitivity to change of the townscape character areas already presented (paras. 11.4.2 to 11.4.74).

Visual assessment

Residential

11.5.43 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.

Viewpoint 1.1: View northwest from residences on Queenstown Road adjacent to Chelsea Bridge

11.5.44 Views from this location would be affected during construction. From ground level, the site cofferdam, construction activity, welfare facilities and cranes would be visible in the middle ground of the view, partially obscured by Chelsea Bridge. The temporary cofferdam would visibly project into a stretch of river currently characterised by a long consistent sweep of river wall. From upper storeys, views of construction activity would be largely unobstructed. The construction activity would be set in front of the Royal Hospital Gardens, altering the existing character of the green frontage. Therefore, the magnitude of change is considered to be medium.

11.5.45 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate adverse** effects.

Viewpoint 1.2: View east from residences in Embankment Gardens

11.5.46 Views from this location along Chelsea Embankment would encompass the temporary cofferdam, construction activity, welfare facilities, site hoardings and cranes, partially obscured by the avenue of mature London plane trees. However, the majority of the panorama over the river would be unaffected. Therefore, the magnitude of change is considered to be low.

11.5.47 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

Viewpoint 1.3: View southeast from residences on West Road, close to College Court

11.5.48 Views from this location would be affected to a limited extent during construction, by the visibility of cranes beyond the foreground boundary walls and mature trees with the Royal Hospital Grounds. Other construction activity would be screened by intervening structures and planting. Therefore, the magnitude of change is considered to be negligible.

11.5.49 The negligible magnitude of change, assessed alongside the high sensitivity of the receptor, would result in a **negligible** effect.

Recreational

Viewpoint 2.1: View south from the footpath at the eastern edge of the Royal Hospital Gardens

11.5.50 Views from this location would encompass construction activity, welfare facilities, site hoardings and cranes in the middle ground of the view, partially obscured by mature trees along the boundary of the Royal Hospital Gardens and Chelsea Embankment. Views of construction activities at ground level (ie, no higher than approximately 2m) would be obscured by the low mounds along the southern boundary of the gardens. Therefore, the magnitude of change is considered to be medium.

11.5.51 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate adverse** effects.

Viewpoint 2.2: View west from the northern end of Chelsea Bridge

11.5.52 The temporary cofferdam, construction activity, welfare facilities and cranes would be visible in the foreground of the view from this location. The temporary cofferdam would protrude into a stretch of river currently characterised by a long consistent sweep of river wall, therefore forming a prominent feature in the view. Views of Chelsea Embankment and the Royal Hospital Gardens, along with views up the river, would be partially obscured by the site and construction activity. Because of the elevated position of the viewpoint on Chelsea Bridge, views of construction activity within the site would be clearly visible. Therefore, the magnitude of change is considered to be high.

11.5.53 The high magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **major adverse** effects.

11.5.54 The assessment of specific effects on the setting of the Grade II listed Chelsea 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, much of the setting of the bridge would be largely unaffected, as opposed to the substantial change visible from this specific viewpoint.

Viewpoint 2.3: View west and southeast from the footpath opposite the King William IV public house

11.5.55 The background of the view from this location towards Chelsea Embankment Foreshore would be affected to a limited extent during construction by intermittent visibility of the temporary cofferdam, construction activity, welfare facilities and cranes, largely obscured by Grosvenor Bridge, Chelsea Bridge and mature trees along Chelsea Embankment. The foreground of the view would remain unaffected. Therefore, the visibility of works at this site would be limited.

11.5.56 However, the proposed works at Kirtling Street and Heathwall Pumping Station would also be visible from this viewpoint. Panoramic views over the river would be affected by the presence of the jetty at Kirtling Street, the temporary cofferdam at Heathwall Pumping Station, and construction activity and cranes at both sites. However, the construction activities would be set against an existing industrial context including industrial barging operations from the waste transfer station and cement works adjacent to Kirtling Street.

11.5.57 Due to the limited visibility of construction at the Chelsea Embankment Foreshore site and the more substantially visible works at Kirtling Street and Heathwall Pumping Station, the overall magnitude of change to this viewpoint arising from the Thames Tideway Tunnel project is considered to be medium.

11.5.58 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate adverse** effects.

Viewpoint 2.4: View northwest from towards the southern end of Chelsea Bridge; Viewpoint 2.5: View northwest from the Thames Path in Battersea Park, close to Chelsea Bridge; and Viewpoint 2.7: View northeast from the Thames Path in Battersea Park, close to the most easterly car park

11.5.59 The view across the river from these locations would be affected during construction by unobstructed visibility of the temporary cofferdam, construction activity, welfare facilities and cranes. The temporary cofferdam would project into a stretch of river currently characterised by a long consistent sweep of river wall, therefore forming a prominent feature in the views. Views of Chelsea Embankment and the Royal Hospital Gardens, along with views up the river, would be partially obscured by the site and construction activity. Therefore, the magnitude of change is considered to be high.

11.5.60 The high magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **major adverse** effects.

Viewpoint 2.6: View northwest from North Carriage Drive, close to Chelsea Bridge

11.5.61 The view across the river from this location within Battersea Park would be affected by intermittent visibility of the temporary cofferdam, construction activity, welfare facilities and cranes. The temporary cofferdam would project into a stretch of river currently characterised by a long consistent sweep of river wall, therefore forming a prominent feature in the view, although partially obscured by mature trees along the northern boundary of Battersea Park in the foreground of the view. Views of Chelsea Embankment and the Royal Hospital Gardens would be partially screened by the site and construction activity. Therefore, the magnitude of change is considered to be medium.

11.5.62 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate adverse** effects.

Viewpoint 2.8: View northeast from the Peace Pagoda in Battersea Park

11.5.63 The background of the view down the river from this location would be affected during construction by unobstructed visibility of the temporary cofferdam, construction activity, welfare facilities and cranes. The temporary cofferdam would project into a stretch of river currently characterised by a long consistent sweep of river wall, therefore forming a prominent feature in the views. Views of Chelsea Embankment and the Royal Hospital Gardens, in the background of the view, would be partially obscured by the site and construction activity. 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 2.9: View southeast from the main axis of the Royal Hospital

11.5.65 Views from this location would be affected during construction, although the foreground of the view, dominated by the Royal Hospital Garden grounds, would be largely unaltered. Construction activity, welfare facilities, site hoardings and cranes would be visible in the background of the view seen through the mature tree avenue along Chelsea Embankment. The visibility of construction activity in parts of the site would be heightened because of a noticeable gap in the tree avenue on the axis of the footpath. This gap would increase in width because of the removal one tree and pruning of others along Chelsea Embankment as part of the works. The magnitude of change is therefore considered to be medium.

11.5.66 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **moderate adverse** effects.

Viewpoint 2.10: View southeast from the entrance to the Royal Hospital Gardens from Chelsea Embankment

11.5.67 Construction activity, welfare facilities, site hoardings and cranes would be highly visible in the foreground of the view from this location. The mature avenue of London plane trees along Chelsea Embankment would partially obscure views of construction activity, although the requirement to remove one tree and prune others would also be noticeable due to the impact of this on the character of the avenue. Therefore, the magnitude of change is considered to be high.

11.5.68 The high magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **major adverse** effects.

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. 11.5.44 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. 11.4.76 to 11.4.116.

11.6 Operational effects assessment

11.6.1 The following section details the likely significant effects arising during the operational phase at Chelsea Embankment Foreshore.

11.6.2 The effect on tranquillity is a factor that 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 include (see *Design Principles* report in Vol 1 Appendix B) summarised in para. 11.2.6. Where specific measures are of particular relevance to the effect on a receptor, these are described under each townscape character area and viewpoint.

11.6.4 Illustrative plans of the proposed development during operation are contained in a separate volume (see separate volume of figures – Section 1) and design principles describing 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 Chelsea Embankment that would project into the river by approximately 24m. This projection would introduce a new structure into the river beyond the line of the river wall, in a stretch of river currently characterised by a long consistent sweep. However, the smooth curved design and geometry of the foreshore structure and new river wall would be sympathetic to the character of the surrounding area. Terraces built into the structure, incorporating either inter-tidal habitat

(Option A) or floodable public realm incorporating planting (Option B), would reduce the visual bulk of the foreshore structure. The river wall surrounding the foreshore structure would incorporate brick at the lower level and stone at the higher level (including the parapet), visually integrating it into the existing river wall along Chelsea Embankment in this location.

11.6.6 A 4-8m high, well designed ventilation column would be located in the western section of the new foreshore structure, positioned away from the main Royal Hospital axis. The design intent for the ventilation column (which would be the project signature design) is illustrated on the Ventilation columns design intent figure – type B (see separate volume of figures – Section 1). A further narrow 6m high ventilation column serving the interception chamber would be located in the eastern part of the foreshore structure. The 1.5m high electrical and control kiosks would be designed to be integrated into the new river wall parapet away from the main Royal Hospital axis to minimise visual clutter at the site. These would be clad in stone to visually integrate with the design of the river wall.

11.6.7 The current land based area of the construction site would be returned to its original condition at completion, apart from the loss of a small number of London plane trees along Chelsea Embankment (which would all be replaced by newly planted semi-mature London plane trees) and some vegetation within Ranelagh Gardens (which would be replaced by new planting following completion of the interception works), and the removal of a stretch of the Grade II listed river wall. In addition, the part of the site covering the Bull Ring, to the north, would be improved through new high quality paving. The impacts on specific components of the site are described in Vol 13 Table 11.6.1.

Vol 13 Table 11.6.1 Townscape – impacts on baseline components in Year 1 of operation

ID	Component	Impacts
01	Grade II listed river wall	The part of the river wall above the pavement would be reinstated after construction, apart from stretches necessary to allow for pedestrian access, and occasional vehicular access onto the foreshore structure for maintenance.
02	Brick built river wall	This would become obscured behind the new foreshore structure and river wall.
03	Lamp standards	These would be reinstated following the works.
04	Mature trees	The small number of trees removed along Chelsea Embankment would be replaced by the same number of new semi-mature London plane trees.
05	Thames Path	The Thames Path would be reinstated to the riverside location and resurfaced.
06	Seating	These would be reinstated following the works.

ID	Component	Impacts
07	Ranelagh Gardens railings and brick boundary wall	These would be reinstated following the works.
08	Ranelagh Gardens boundary vegetation	Shrubs lost during construction would be reinstated as necessary following completion of the works.
09	Bull ring roundabout planter	The planter would be replaced with new paving as part of the overall landscape design for the site.

11.6.8 Therefore, the magnitude of change is considered to be medium because of the substantial change to the character of the site caused by the introduction of the new foreshore structure and above ground structures, reduced by the design principles which commit to a high quality design in keeping with the character of the area.

11.6.9 The medium magnitude of change, assessed alongside the high sensitivity of this character area, would result in **moderate adverse** effects.

11.6.10 The assessment of specific effects on the setting of Thames Conservation Area as a heritage asset is set out in Section 7 of this volume. The historic environment assessment identifies a minor adverse on the setting of this asset as the conservation area is larger than the area defined as the site. Therefore, the changes within the site affect only a proportion of the conservation area, with part of the setting unaffected.

Townscape character areas assessment

11.6.11 No assessment of townscape effects has been made for the following character areas, as the components of the operational scheme would not substantially alter their setting:

a. River Thames – Nine Elms Reach TCA.

b. Ranelagh Gardens TCA.

c. Chelsea Residential TCA.

d. Royal Hospital Residential TCA.

River Thames – Royal Hospital and Battersea Park Reach TCA

11.6.12 The proposed site is adjacent to this reach of the river, and would result in the creation of a new area of public realm projecting into the river by approximately 24m. This projection would introduce a new structure into the river beyond the line of the river wall, in a stretch of river currently characterised by a long consistent sweep. The smoothly curved design and geometry of the foreshore structure and new river wall would be sympathetic to the character of the surrounding area, and terraces built into the structure would reduce its bulk. The signature design ventilation column and electrical and control kiosks would introduce new built elements into the area, but their design, facade materials and locations would suit the character of the sensitive townscape. The reinstatement of mature London plane trees along Chelsea Embankment would minimise the change to the setting caused by tree removal during construction. However, although the new features would be largely in character with the existing townscape, they would still form prominent elements in the setting of this character area. Therefore, the magnitude of change is considered to be medium.

11.6.13 The medium magnitude of change, assessed alongside the high sensitivity of this character area, would result in **moderate adverse** effects.

11.6.14 The assessment of specific effects on the setting of Thames Conservation Area as a heritage asset is set out in Section 7 of this volume. The historic environment assessment identifies a minor adverse on the setting of this asset as the conservation area is larger than the area defined as the site. Therefore, the changes within the site affect only a proportion of the conservation area, with part of the setting unaffected.

Royal Hospital Conservation Area – Grounds TCA

11.6.15 The proposed development would result in changes to the riverside setting of this area, which forms an important part of its character. The setting would be affected by the above ground structures orientated either side of the Monument Walk axis, which would appear broadly in keeping with the character of the area. The structures would be set beyond the avenue of mature London plane trees along Chelsea Embankment, which is also heavily trafficked. The majority of the setting would remain unaffected, particularly within the northern section of the area (refer to Vol 13 Figure 11.4.6 - see separate volume of figures). Therefore, the magnitude of change is considered to be low.

11.6.16 The low magnitude of change, assessed alongside the high sensitivity of the character area, would result in **minor adverse** effects.

11.6.17 The assessment of specific effects on the setting of Royal Hospital Conservation Area, the Royal Hospital Grounds & Ranelagh Gardens Grade II Registered Park & Garden and the Grade I listed Royal Hospital as heritage assets is set out in Section 7 of this volume. The historic environment assessment identifies a minor to moderate beneficial effect on the setting of these assets due to the reinforcement of the historic axis.

Queenstown Road Residential TCA; and Battersea Park Conservation Area TCA

11.6.18 The proposed development would result in changes to part of the riverside setting of these character areas, due to the presence of the permanent foreshore structure projecting into the river and the above ground structures located on it. The foreshore structure would represent an adverse change to part of the riverside setting of this area in the context of the existing long consistent sweep of the river wall. However, the smoothly curved design and geometry of the foreshore structure and new river wall would be sympathetic to the character of the surrounding area, and terraces built into the structure would reduce its bulk. The signature design ventilation column and electrical and control kiosks would introduce new built elements into the area, but their design, facade materials and locations would suit the character of the sensitive townscape. The reinstatement of mature London plane trees along Chelsea Embankment would minimise the change to the setting caused by tree removal during construction. Therefore, new features would be largely in character with the existing townscape and the magnitude of change is considered to be low.

11.6.19 The low magnitude of change, assessed alongside the high sensitivity of the character area, would result in **minor adverse** effects.

11.6.20 The assessment of specific effects on the setting of the Grade II* Registered Battersea Park as a heritage asset is set out in Section 7 of this volume.

Townscape – sensitivity test for programme delay

11.6.21 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 11.6.20). 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 11.4.74).

Visual assessment

11.6.22 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.

11.6.23 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 1.3: View southeast from residences on West Road, close to College Court.

b. Viewpoint 2.3: View west and southeast from the footpath opposite the King William IV public house.

Residential

Viewpoint 1.1: View northwest from residences on Queenstown Road adjacent to Chelsea Bridge

11.6.24 The permanent foreshore structure and above ground structures would be visible from this viewpoint, partially obscured (from ground level) by Chelsea Bridge. The new area of public realm created by the works would project into the river by approximately 24m, introducing a new structure into the river beyond the line of the river wall, in a stretch of river currently characterised by a long consistent sweep. However, the smoothly curved design and geometry of the foreshore structure and new river wall would be sympathetic to the character of the surrounding area, minimising its visibility, and terraces built into the structure would reduce its bulk. The signature design ventilation column and electrical and control kiosks would introduce new built elements into the view, but their design, facade materials and locations would suit the character of the sensitive townscape. The reinstatement of mature London plane trees along Chelsea Embankment would minimise the change to the view caused by tree removal during construction. These measures, in conjunction with the partial screening provided by Chelsea Bridge, would mean that the proposed development would not form a prominent component of the view from this location. Therefore, the magnitude of change is considered to be low.

11.6.25 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

11.6.26 There would be no change to the assessment during summer.

Viewpoint 1.2: View east from residences in Embankment Gardens

11.6.27 Oblique views from this location would be affected to a limited extent by the visibility of the above ground structures located on the foreshore structure and the replacement tree planting along Chelsea Embankment, partially obscured by the avenue of mature London plane trees and heavy traffic along Chelsea Embankment. The commitment to a high quality design for the project signature ventilation columns and electrical and control kiosks, in keeping with the character of the surrounding townscape, would ensure that these components would not be prominent in the view from this location. The reinstatement of lamp columns along Chelsea Embankment would further minimise the change to the view. The high quality design of the public realm, including improving the townscape around the Bull Ring gates, would be intermittently visible from this location. These changes would improve the view from this location, although the overall character would remain largely unchanged. Therefore, the magnitude of change is considered to be low.

11.6.28 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor beneficial** effects.

11.6.29 During summer, the avenue of mature London plane trees in the foreground of the view would largely screen views of the above ground structures and new public realm. Therefore, the magnitude of change is considered to be negligible, giving rise to a **negligible** effect during summer.

Recreational

Viewpoint 2.1: View south from the footpath at the eastern edge of the Royal Hospital Gardens

11.6.30 Views from this location would be affected to a limited extent by the visibility of the above ground structures. However, the foreground of the view would remain unaffected, and the above ground structures would be partially screened by the avenue of mature London plane trees along Chelsea Embankment, and the low mounding and vegetation along the southern boundary of the Royal Hospital Gardens. Therefore, the magnitude of change is considered to be low.

11.6.31 The low magnitude of change, assessed alongside the high sensitivity of this receptor, would result in **minor adverse** effects.

11.6.32 During summer, the mature trees along the southern edge of the Royal Hospital Gardens would largely obscure views of the proposed development. Therefore, the magnitude of change is considered to be negligible, giving rise to a **negligible** effect during summer.

Viewpoint 2.2: View west from the northern end of Chelsea Bridge

11.6.33 Views from this location would be substantially affected by the design of the river wall, above ground structures and river wall. The view is illustrated in the photomontage shown in Vol 13 Figure 11.6.1 (see separate volume of figures). The new area of public realm, projecting into the river by approximately 24m, would be highly visible in the context of the existing long consistent sweep of the river wall. The new structures would form prominent components of the view along the river. However, the smoothly curved design and geometry of the foreshore structure and new river wall would be sympathetic to the character of the surrounding area, minimising its visibility, and terraces built into the structure would reduce its bulk. The signature design ventilation column and electrical and control kiosks would introduce new built elements into the view, but their design, facade materials and locations would suit the character of the sensitive townscape. The view of the proposed development from this viewpoint is illustrated in Vol 13 Plate 11.6.1 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 13 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 13 Plate 11.6.1 Viewpoint 2.2 – illustrative operational phase photomontage

Date taken: 8 March 2011. 50mm lens.

11.6.34 The reinstatement of mature London plane trees along Chelsea Embankment would minimise the change to the view caused by tree removal during construction. Therefore, the magnitude of change is considered to be medium.

11.6.35 The medium magnitude of change, assessed alongside the high sensitivity of this receptor, would result in **moderate adverse** effects.

11.6.36 There would be no change to the assessment during summer.

11.6.37 The assessment of specific effects on the setting of the Grade II listed Chelsea Bridge as a heritage asset is set out in Section 7 of this volume.

Viewpoint 2.4: View northwest from towards the southern end of Chelsea Bridge; Viewpoint 2.5: View northwest from the Thames Path in Battersea Park, close to Chelsea Bridge; Viewpoint 2.7: View northeast from the Thames Path in Battersea Park, close to the most easterly car park; and Viewpoint 2.8: View northeast from the Peace Pagoda in Battersea Park

11.6.38 Views from these locations would be affected by the design of the above ground structures and river wall. The new area of public realm, projecting into the river by approximately 24m, would be highly visible in the context of the existing long consistent sweep of the river wall. The new structures would form components of the view across the river. The smoothly curved design and geometry of the foreshore structure and new river wall would be sympathetic to the character of the surrounding area, minimising its visibility, and terraces built into the structure would reduce its bulk. The signature design ventilation column and electrical and control kiosks would introduce new built elements into the view, but their design, facade materials and locations would suit the character of the sensitive townscape. The view of the proposed development from viewpoint 2.5 and viewpoint 2.7 are illustrated in Vol 13 Plate 11.6.2 and Vol 13 Plate 11.6.3 below. A larger scale print of the photomontages, including the wider context and annotations, are provided in Vol 13 Figure 11.6.2 and Vol 13 Figure 11.6.3 (see separate volume of figures). The layout of the proposed development illustrated in these photomontages 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 13 Plate 11.6.2 Viewpoint 2.5 – illustrative operational phase photomontage

Date taken: 8 March 2011. 50mm lens

Vol 13 Plate 11.6.3 Viewpoint 2.7 – illustrative operational phase photomontage

Date taken: 8 March 2011. 50mm lens

11.6.39 The reinstatement of mature London plane trees along Chelsea Embankment would minimise the change to the view caused by tree removal during construction. Furthermore, due to the angle of the views, the extent of the protrusion into the river would be less prominent than viewpoint 2.2 from the northern end of Chelsea Bridge (para. 11.6.33). Therefore, the magnitude of change is considered to be low.

11.6.40 The low magnitude of change, assessed alongside the high sensitivity of these receptors, would result in **minor adverse** effects.

11.6.41 There would be no change to the assessment during summer.

Viewpoint 2.6: View northwest from North Carriage Drive, close to Chelsea Bridge

11.6.42 Views from this location would be affected to a limited extent by the design of the above ground structures and river wall around the new foreshore structure. The new area of public realm, projecting into the river by approximately 24m, would be visible set in the context of the existing long consistent sweep of the river with no protrusions beyond the river wall. The smoothly curved design and geometry of the foreshore structure and new river wall would be sympathetic to the character of the surrounding area, minimising its visibility, and terraces built into the structure would reduce its bulk. The signature design ventilation column and electrical and control kiosks would introduce new built elements into the view, but their design, facade materials and locations would suit the character of the sensitive townscape. The reinstatement of mature London plane trees along Chelsea Embankment would minimise the change to the view caused by tree removal during construction. Furthermore, visibility of the proposed development would be partially obscured by vegetation in the foreground of the view on the edge of Battersea Park. Therefore, the magnitude of change is considered to be low.

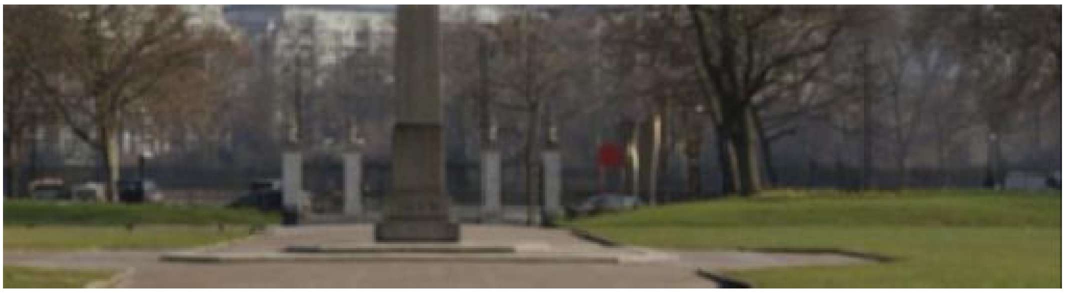
11.6.43 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor adverse** effects.

11.6.44 During summer, planting in the foreground of the view would almost entirely obscure views towards the site. Therefore, the magnitude of change is considered to be negligible, giving rise to a **negligible** effect during summer.

Viewpoint 2.9: View southeast from the main axis of the Royal Hospital

11.6.45 Views from this location would be affected to a limited extent by the visibility of the above ground structures. However, the foreground of the view would remain unaffected, and the above ground structures would be partially screened by the avenue of mature London plane trees along Chelsea Embankment, and the low mounding and vegetation along the southern boundary of the Royal Hospital Gardens. The view of the proposed development from this viewpoint is illustrated in Vol 13 Plate 11.6.4 below. A larger scale print of the photomontage, including the wider context and annotations, is provided in Vol 13 Figure 11.6.4 (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 13 Plate 11.6.4 Viewpoint 2.9 – illustrative operational phase photomontage



Date taken: 8 March 2011. 50mm lens

11.6.46 Due to the low mounding, the vegetation and the intervening trees, the magnitude of change is considered to be low.

11.6.47 The low magnitude of change, assessed alongside the high sensitivity of this receptor, would result in **minor adverse** effects.

11.6.48 During summer, the mature trees along the southern edge of the Royal Hospital Gardens would largely obscure views of the proposed development. Therefore, the magnitude of change is considered to be negligible, giving rise to a **negligible** effect during summer.

Viewpoint 2.10: View southeast from the entrance to the Royal Hospital Gardens from Chelsea Embankment

11.6.49 Views from this location would be affected by the appearance of the new above ground structures located on the foreshore structure. The signature design ventilation columns and electrical and control kiosks would introduce new built elements into the view, but their design, facade materials and locations would suit the character of the sensitive townscape. The improvements to the carriageway and roundabout between the Bull Ring gates and the Chelsea Embankment would be highly visible in the foreground of the view, constituting an improvement to the existing view, which is dominated by asphalt surfacing and traffic. The view of the proposed development from this viewpoint is illustrated in Vol 13 Plate 11.6.5 below. A larger scale print of the photomontages, including the wider context and annotations, are provided in Vol 13 Figure 11.6.5 (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 13 Plate 11.6.5 Viewpoint 2.10 – illustrative operational phase photomontage

Date taken: 8 March 2011. 50mm lens

11.6.50 The reinstatement of mature London plane trees along Chelsea Embankment would minimise the change to the view caused by tree removal during construction. Due to the high quality design of the public realm and, in particular, the improvements to the area around the Bull Ring gates, effects on this view are considered to be beneficial. Due to the overall character of the view not substantially changing, the magnitude of change is considered to be low.

11.6.51 The low magnitude of change, assessed alongside the high sensitivity of the receptor, would result in **minor beneficial** effects.

11.6.52 There would be no change to the assessment during summer.

Visual effects – sensitivity test for programme delay

11.6.53 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. 11.6.23 to 11.6.52). 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. 11.4.76 to 11.4.116.

Operational effects Year 15

11.6.54 Operational effects for all townscape and visual receptors identified would remain unchanged in Year 15 compared to Year 1, due to the limited effect any maturing vegetation (including the newly planted London plane trees) would have on the visibility of the site and 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

Construction effects

11.7.1 As described in Section 11.3, construction of parts of the Battersea Power Station development would be ongoing during Site Year 2 of construction at the Chelsea Embankment Foreshore site.

11.7.2 Cumulatively, construction activity associated with both these sites would elevate effects on River Thames – Nine Elms Reach TCA and Viewpoint 2.3: View west and southeast from the footpath opposite the King William IV public house.

11.7.3 Effects on these receptors, which are considered significant from the Thames Tideway Tunnel project alone (comprising Chelsea Embankment Foreshore, Kirtling Street, Heathwall Pumping Station and Albert Embankment Foreshore in this location) would be elevated and therefore would also be significant when taking into account the Battersea Power Station development.

11.7.4 This assessment would also apply in the event of a programme delay to the Thames Tideway Tunnel project of approximately one year.

Operational effects

11.7.5 As detailed in the site development schedule (Vol 13 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. 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 possible due to the highly sensitive nature of the townscape and highly visible nature of the proposed development.

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

11.10.1 The assessment has considered both Options A and B for the design and use of the floodable terraces and given that there are not anticipated to be any differences, the assessment summary table reflects both options.

Vol 13 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 temporary cofferdam, intensity of construction activity, presence of welfare facilities and site hoardings, and removal of trees, sections of river wall and lamp standards.	Major adverse	No mitigation possible	Major adverse
River Thames – Royal Hospital and Battersea Park Reach TCA	Change to setting due to the presence of construction activity and the temporary cofferdam in a strong linear stretch of river.	Major adverse	No mitigation possible	Major adverse
River Thames – Nine Elms Reach TCA	Change to setting due to construction activity at Kirtling Street and Heathwall Pumping Station, and the background presence of construction activity at Chelsea Embankment Foreshore and Albert Embankment Foreshore.	Moderate adverse	No mitigation possible	Moderate adverse
Royal Hospital Conservation Area – Grounds TCA	Change to riverside setting, which forms a small part of the overall TCA, due to the presence of construction activity and the formation of the temporary cofferdam in a strong linear stretch of river.	Moderate adverse	No mitigation possible	Moderate adverse
Ranelagh Gardens TCA	Slight change to setting due to the presence of cranes and construction activity, partially obscured by boundary planting in Ranelagh Gardens	Negligible	None	Negligible
Chelsea Residential TCA	Slight change to setting due to the presence of the temporary cofferdam and construction activity, partially	Negligible	None	Negligible

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	obscured by Chelsea Bridge and trees in Ranalagh Gardens.			
Queenstown Road Residential TCA	Change to riverside setting due to the presence of the temporary cofferdam and construction activity in a strong linear stretch of river.	Moderate adverse	No mitigation possible	Moderate adverse
Battersea Park Conservation Area TCA	Change to riverside setting due to the presence of the temporary cofferdam and construction activity in a strong linear stretch of river.	Moderate adverse	No mitigation possible	Moderate adverse
Royal Hospital Residential TCA	Change to wider riverside setting due to the presence of the temporary cofferdam and construction activity in a strong linear stretch of river.	Minor adverse	None	Minor adverse

Vol 13 Table 11.10.2 Visual - summary of construction assessment

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Residential				
Viewpoint 1.1: View northwest from residences on Queenstown Road adjacent to Chelsea Bridge	Visibility of the site cofferdam, construction activity and welfare facilities in a strong uncluttered sweep of river, partially obscured by Chelsea Bridge.	Moderate adverse	No mitigation possible	Moderate adverse
Viewpoint 1.2: View east from residences in Embankment Gardens	Oblique visibility of the temporary cofferdam, construction activity, welfare facilities and site hoardings, partially obscured by mature trees along Chelsea	Minor adverse	None	Minor adverse

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
	Embankment.			
Viewpoint 1.3: View southeast from residences on West Road, close to College Court	Limited visibility of cranes.	Negligible	None	Negligible
Recreational				
Viewpoint 2.1: View south from the footpath at the eastern edge of the Royal Hospital Gardens	Visibility of construction activity, welfare facilities and site hoardings, partially obscured by mature trees along Chelsea Embankment and the southern boundary of Ranelagh Gardens.	Moderate adverse	No mitigation possible	Moderate adverse
Viewpoint 2.2: View west from the northern end of Chelsea Bridge	Foreground visibility of the temporary cofferdam, construction activity and welfare facilities in a strong uncluttered sweep of river.	Major adverse	No mitigation possible	Major adverse
Viewpoint 2.3: View west from the footpath opposite the King William IV public house	Visibility of construction at Kirtling Street and Heathwall Pumping Station. Background visibility of construction activity and the site cofferdam at Chelsea Embankment Foreshore.	Moderate adverse	No mitigation possible	Moderate adverse
Viewpoint 2.4: View northwest from towards the southern end of Chelsea Bridge	Visibility of the temporary cofferdam, construction activity and welfare facilities in a strong linear stretch of river.	Major adverse	No mitigation possible	Major adverse
Viewpoint 2.5: View northwest from the Thames Path in Battersea Park, close to Chelsea Bridge	Visibility of the temporary cofferdam, construction activity and welfare facilities in a strong linear stretch of river.	Major adverse	No mitigation possible	Major adverse
Viewpoint 2.6: View northwest from	Visibility of the temporary cofferdam,	Moderate	No	Moderate

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
North Carriage Drive, close to Chelsea Bridge	construction activity and welfare facilities in a strong linear stretch of river, partially obscured by mature trees within Battersea Park.	adverse	mitigation possible	adverse
Viewpoint 2.7: View northeast from the Thames Path in Battersea Park, close to the most easterly car park	Visibility of the temporary cofferdam, construction activity and welfare facilities in a strong linear stretch of river, substantially altering the character of the view.	Major adverse	No mitigation possible	Major adverse
Viewpoint 2.8: View northeast from the Peace Pagoda in Battersea Park	Wider visibility of the temporary cofferdam, construction activity and welfare facilities in a strong uncluttered sweep of river, altering the character of the view.	Moderate adverse	No mitigation possible	Moderate adverse
Viewpoint 2.9: View southeast from the main axis of the Royal Hospital	Visibility of construction activity, welfare facilities and site hoardings in the background of the view, partially obscured by mature trees along Chelsea Embankment.	Moderate adverse	No mitigation possible	Moderate adverse
Viewpoint 2.10: View southeast from the entrance to the Royal Hospital Gardens from Chelsea Embankment	Foreground visibility of construction activity, welfare facilities, site hoardings and trees to be removed, partially obscured by mature trees along Chelsea Embankment.	Major adverse	No mitigation possible	Major adverse

Vol 13 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 creation of a new foreshore structure creating a new area of public realm with views of the River Thames including above ground structures projecting into an uncluttered stretch of river.	Moderate adverse	No mitigation possible	Moderate adverse
River Thames – Royal Hospital and Battersea Park Reach TCA	Change to setting due to the creation of a new foreshore structure and above ground structures projecting into an uncluttered stretch of river.	Moderate adverse	No mitigation possible	Moderate adverse
Royal Hospital Conservation Area – Grounds TCA	Slight change to riverside setting due to the introduction of above ground structures between this character area and the river, partially obscured by the avenue of mature trees along Chelsea Embankment.	Minor adverse	None	Minor adverse
Queenstown Road Residential TCA	Change to part of the riverside setting due to the creation of a new foreshore structure and above ground structures projecting into an uncluttered stretch of river.	Minor adverse	None	Minor adverse
Battersea Park Conservation Area TCA	Change to part of the riverside setting due to the creation of a new foreshore structure and above ground structures projecting into an uncluttered stretch of river.	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 13 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 northwest from residences on Queenstown Road adjacent to Chelsea Bridge	Wider visibility of the new foreshore structure and above ground structures, projecting into an uncluttered stretch of the river.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Minor adverse	Summer – None	Summer – Minor adverse
Viewpoint 1.2: View east from residences in Embankment Gardens	Oblique visibility of the above ground structures and new area of high quality public realm, partially obscured by the avenue of trees along Chelsea Embankment.	Winter – Minor beneficial	Winter – None	Winter – Minor beneficial
		Summer – Negligible	Summer – None	Summer – Negligible
Recreational				
Viewpoint 2.1: View south from the footpath at the eastern edge of the Royal Hospital Gardens	Visibility of the above ground structures partially obscured by the avenue of trees along Chelsea Embankment.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Negligible	Summer – None	Summer – Negligible
Viewpoint 2.2: View west from the northern end of Chelsea Bridge	Foreground visibility of the foreshore structure and above ground structures projecting into the river, currently	Winter – Moderate adverse	Winter – No mitigation possible	Winter – Moderate adverse

[iv] Operational effects have been assessed to be the same in both Year 1 and Year 15 of operation
[v] Viewpoints not assessed during operation (refer to para. 11.6.23) are not included in the summary table

Receptor[v]	Effect	Significance of effect	Mitigation	Significance of residual effect
	characterised by a long consistent sweep.	Summer – Moderate adverse	Summer – No mitigation possible	Summer – Moderate adverse
Viewpoint 2.4: View northwest from towards the southern end of Chelsea Bridge	Visibility of the foreshore structure and above ground structures projecting into the river, currently characterised by a long consistent sweep) and above ground structures into the previous undeveloped river channel, although less prominent than in Viewpoint 2.2.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Minor adverse	Summer – None	Summer – Minor adverse
Viewpoint 2.5: View northwest from the Thames Path in Battersea Park, close to Chelsea Bridge	Visibility of the foreshore structure and above ground structures projecting into the river, currently characterised by a long consistent sweep) and above ground structures into the previous undeveloped river channel, although less prominent than in Viewpoint 2.2.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Minor adverse	Summer – None	Summer – Minor adverse
Viewpoint 2.6: View northwest from North Carriage Drive, close to Chelsea Bridge	Visibility of the foreshore structure and above ground structures projecting into the river, currently characterised by a long consistent sweep) and above ground structures into the previous undeveloped river channel, partially obscured by planting within Battersea Park.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Negligible	Summer – None	Summer – Negligible
Viewpoint 2.7: View northeast from the Thames Path in	Visibility of the foreshore structure and above ground structures projecting into the	Winter – Minor adverse	Winter – None	Winter – Minor adverse

Receptor[v]	Effect	Significance of effect	Mitigation	Significance of residual effect
Battersea Park, close to the most easterly car park	river, currently characterised by a long consistent sweep) and above ground structures into the previous undeveloped river channel, although less prominent than in Viewpoint 2.2.	Summer – Minor adverse	Summer – None	Summer – Minor adverse
Viewpoint 2.8: View northeast from the Peace Pagoda in Battersea Park	Visibility of the foreshore structure and above ground structures projecting into the river, currently characterised by a long consistent sweep) and above ground structures into the previous undeveloped river channel, although less prominent than in Viewpoint 2.2.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Minor adverse	Summer – None	Summer – Minor adverse
Viewpoint 2.9: View southeast from the main axis of the Royal Hospital	Visibility of the above ground structures partially obscured by the avenue of trees along Chelsea Embankment.	Winter – Minor adverse	Winter – None	Winter – Minor adverse
		Summer – Negligible	Summer – None	Summer – Negligible
Viewpoint 2.10: View southeast from the entrance to the Royal Hospital Gardens from Chelsea Embankment	Foreground visibility of the above ground structures and the improved townscape around the Bull Ring gates	Winter – Minor beneficial	Winter – None	Winter – Minor beneficial
		Summer – Minor beneficial	Summer – None	Summer – Minor beneficial

References

[1] Department of Environment, Food and Rural Affairs. *National Policy Statement for Waste Water* (2012). Available at: http://www.defra.gov.uk/publications/files/pb13709-waste-water-nps.pdf. Last accessed November 2012.

[2] Royal Borough of Kensington and Chelsea. *LDF Core Strategy* (December 2010).

[3] City of Westminster. *LDF Core Strategy* (January 2011).

[4] London Borough of Wandsworth. *LDF Core Strategy* (October 2010).

[5] Royal Borough of Kensington and Chelsea. *Conservation Area Proposal Statements* (no date).

[6] City of Westminster. *Churchill Gardens Conservation Area Audit* (April 2005).

[7] London Borough of Wandsworth. *Conservation Area Appraisal and Management Strategies* (no date).

[8] Atkins. *The Thames Strategy: Kew to Chelsea* (June 2002).

[9] 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: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 12: Transport

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 12: Transport

List of contents

Page number

List of plates

Page number

List of tables

Page number

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 Chelsea 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 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 nearby residential properties and users of adjacent recreational spaces.

12.1.4 The operation of the Chelsea 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 Chelsea Embankment Foreshore site. The *Transport Assessment* accompanies the application for development consent (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 13 Chelsea 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 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 would be located on the foreshore of the River Thames. In order to provide working areas, the site would occupy part of the River Thames foreshore, sections of the eastbound and westbound carriageways and sections of the north and south side footways of Chelsea Embankment (A3212), and a small section of Ranelagh Gardens. Vehicle access to and from the site would take place from the westbound and eastbound carriageway of Chelsea Embankment (A3212).

12.2.3 During construction it is anticipated that the elements listed under para. 12.1.2 above may be affected as a result of the additional construction traffic associated with Chelsea Embankment Foreshore and other construction sites with construction routes along Chelsea Embankment and vehicle and pedestrian diversions along Chelsea Embankment.

12.2.4 Details of the peak year of construction, anticipated lorry and barge movements and the activities which would generate these movements are provided in Vol 13 Table 12.2.1.

Vol 13 Table 12.2.1 Transport – construction details

Description	Assumption
Assumed peak period of construction lorry movements	Site Year 3 of construction
Assumed average peak daily construction lorry vehicle movements (in peak month of Site Year 3 of construction)	84 movements per day (42 vehicle trips)
Assumed peak period of construction barge movements	Site Year 1 of construction
Assumed average peak daily construction barge movements (in peak month of Site Year 1 of construction)	6 movements per day (3 barge trips)
Types of lorry requiring access (comprising rigid-bodied, flatbed and articulated vehicles)	Excavated material lorries Plant and equipment deliveries Imported fill lorries Ready mix concrete lorries

Description	Assumption
	Office/general delivery lorries Rebar lorries Temporary construction material lorries including Pipe/track/oils/greases lorries Shaft precast concrete lining 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.

12.2.5 During construction cofferdam fill (both import and export) and shaft and ‘other’ excavated material (export) 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.

12.2.6 Vehicle movements would take place during the standard day shift of ten and a half hours on weekdays (08:00 to 18:30) and five and a half hours on Saturdays (08:00 to 13:30). In exceptional circumstances 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 Royal Borough (RB) of Kensington and Chelsea.

Construction traffic routing

12.2.7 The access plan and highway layout during construction (utility diversion phase, phase 1-2 and phase 3) (see separate volume of figures – Section 1) presents the highway layout during construction.

12.2.8 The Chelsea Embankment Foreshore site is located on the Transport for London Road Network (TLRN) on Chelsea Embankment (A3212) approximately 150m west of the junction with Chelsea Bridge Road (A3216), Grosvenor Road (A3212) and Chelsea Bridge (A3216).

12.2.9 The construction routing for all phases at Chelsea Embankment Foreshore would use the TLRN.

12.2.10 Vehicle access would be arranged on a ‘left-turn in / left-turn out’ basis from Chelsea Embankment (A3211). All vehicles would approach the site via the junction of Chelsea Embankment (A3211), Chelsea Bridge Road (A3216), Grosvenor Road (A3212) and Chelsea Bridge (A3216) and travel westbound along Chelsea Embankment (A3212) to the site.

12.2.11 Vehicles leaving the site would travel westbound along Chelsea Embankment (A3212) towards West Cromwell Road (A4) and Battersea.

12.2.12 Vol 13 Figure 12.2.1 (see separate volume of figures) shows the construction traffic routes for access to/from Chelsea Embankment Foreshore. Construction routes have been discussed with both Transport for London (TfL) and the Local Highway Authority (LHA), RB of Kensington and Chelsea (RBKC) for the purposes of the assessment.

Construction workers

12.2.13 The construction site is expected to require a maximum workforce of approximately 65 workers at any one time. The number and type of workers is shown in Vol 13 Table 12.2.2.

Vol 13 Table 12.2.2 Transport – maximum estimated construction worker numbers

Contractor		Client
Staff*	**Labour****	**Staff*****
08:00-18:00	**08:00-18:00**	**08:00-18:00**
30	25	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 Client – engineering and support staff managing the project and supervising the Contractor.*

12.2.14 At the Chelsea Embankment Foreshore 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 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 13 Table 12.5.1.

Code of Construction Practice

12.2.15 Measures incorporated into the *Code of Construction Practice* (*CoCP*)[i] *Part A* (Section 5) to reduce transport effects 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

[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).

12.2.16 In addition to the general measures within the *CoCP Part A*, the following measures have been incorporated into the *CoCP Part B* (Section 5) relating to the Chelsea Embankment Foreshore site:

a. all vehicles would access/egress site from the westbound lane, using a left turn in and left turn out arrangement

b. the site areas would be designed to maintain two-way traffic flow on Chelsea Embankment (A3212). If required, a suitable central safety barrier would be installed between alternate direction lanes

c. minimum lane width of 3.25m to be retained

d. the existing traffic island directly to the northeast of Bull Ring Gate would be removed

e. management arrangements during events in the adjacent area to be confirmed in consultation with the Local Highway Authority, TfL and other stakeholders

f. access through the Bull Ring entrance for set-up and take-down of the Chelsea Flower Show and Masterpiece events and for VIP access would be maintained during these events. Emergency access from Chelsea Embankment (A3212) would be maintained during the events

g. the diversion of the Thames Path would be adequately signed and a temporary signalised pedestrian crossing would be provided between the foreshore site and the worksite in the eastbound carriageway of Chelsea Embankment (A3212)

h. the riverside footway on Chelsea Embankment (A3212) would be reinstated for public use outside of working hours at weekends

i. arrangements to allow buses to turn right from A3212 into the bus stop in the Bull Ring area would be maintained, except during landscaping works in this area, unless agreed otherwise

j. the bus stop in the Bull Ring area would be suspended temporarily only during landscaping works in the area.

12.2.17 The effective implementation of the *CoCP Part A* and *Part B* measures is assumed within the assessment.

12.2.18 Based on current travel planning guidance including TfL's Travel planning for new development in London (TfL, 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 (TfL, 2011)[3]*;* this accompanies the application. The *Draft Project Framework Travel Plan* addresses project-wide travel planning 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 Chelsea Embankment Foreshore site

b. a mode split established for the Chelsea 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

12.2.19 At the end of construction at the Chelsea Embankment Foreshore site the existing kerb line of the Bull Ring would be realigned to provide a site access point for the maintenance vehicles during the operational phase.

Operation

12.2.20 During operation, maintenance vehicles would enter the site from Chelsea Embankment (A3212). 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 cranes and associated support vehicles to be brought to the site. The cranes would facilitate lowering and recovery of tunnel inspection vehicles and to provide duty/standby access for personnel. The Thames Path may need to be temporarily diverted during the ten-yearly inspections.

12.3 Assessment methodology

Engagement

12.3.1 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 traffic and transport are presented in Vol 13 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 impact assessment (EIA). 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 13 Table 12.3.1 Transport – stakeholder engagement

Organisation	Comment	Response
RB of Kensington and Chelsea, Transport Assessment workshop,	The pedestrian diversion routes and site access pedestrian traffic will significantly increase the number of pedestrians crossing	The assessment considers the impact of increased pedestrian flows and the additional temporary crossing (see

Organisation	Comment	Response
November 2012	Chelsea Embankment on both temporary and existing crossings. These increased pedestrian flows on road crossings have the potential to impact on vehicular traffic flows.	Section 12.5).
Transport for London, Transport Assessment workshop, November 2012	Information on construction traffic associated with other Thames Tideway Tunnel project sites should be provided.	The OmniTrans outputs identify lorry traffic which would be associated with the Chelsea Embankment Foreshore site, and with other Thames Tideway Tunnel project sites, that would use routes in the vicinity of the Chelsea Embankment Foreshore site.
RB of Kensington and Chelsea, Section 48 consultation, October 2012 Phase two consultation, February 2012	The riverside footway should be able to remain open as often as possible, especially at weekends.	While the riverside footway along Chelsea Embankment would be closed temporarily during construction works, it would be opened for public use at weekends with appropriate pedestrian safeguards. It would be reinstated in full at the end of the construction works.
RB of Kensington and Chelsea, Section 48 consultation, October 2012	Disappointingly, *Transport Assessments* for sites within the RB have not yet been published. An opportunity to review the TAs in advance of the submission of the application would be valuable.	A draft version of the *Transport Assessment* was provided in October/November 2012 and comments were received from RB of Kensington and Chelsea.
Transport for London, Section 48 consultation, October 2012	Works at a number of proposed sites (eg. Blackfriars, Victoria Embankment, Chelsea	Strategic and local highway modelling has been carried out to identify the likely effects

Organisation	Comment	Response
	Embankment, Deptford Church Street) will significantly impact on highway capacity for extended periods of time. This would have significant impacts on journey times and reliability for users of the network, including bus services. TfL is very concerned that every effort is made to look at ways to minimise the need for any works that require the loss of any lane capacity. If works must take place then they should be for as short a period as possible and appropriate mitigation measures put in place.	on the highway network and any mitigation necessary (see Vol 3 for project-wide assessment and Section 12.5 of this volume for site-specific effects).
RB of Kensington and Chelsea, Phase two consultation, February 2012 Consultation workshop, September 2011	Road transport will invariably be cheaper but causes much greater impacts on the local environment and the environment more generally. Economic considerations should not influence the choice of logistics strategy.	The National Policy Statement for Waste Water (Defra, 2012)[4] section 4.13 refers to cost-effective. Therefore it is considered appropriate to consider the cost as one of the factors in the decision of the transport strategy. Use of river transport is however proposed at the Chelsea Embankment Foreshore site.
RB of Kensington and Chelsea, Phase two consultation, February 2012 Consultation workshop, September 2011	Requests reference to the Thames Path in 'operational' stage and opportunities to infill missing riverside sections where feasible.	The riverside southern footway along Chelsea Embankment would be reinstated after the temporary diversion during construction works.
RB of Kensington	The detail of potential	Traffic management

Organisation	Comment	Response
and Chelsea, Phase two consultation, February 2012 Consultation workshop, September 2011	traffic management on Chelsea Embankment requires further detailed surveys and analysis.	requirements for this site are considered as part of the assessment.
RB of Kensington and Chelsea, Phase two consultation, February 2012 Consultation workshop, September 2011	The new public space adjacent to Bull Ring Gate should be designed in a manner that discourages parking.	The design would not provide any more parking space than is currently available.
RB of Kensington and Chelsea, Phase two consultation, February 2012 Consultation workshop, September 2011	The impact of construction traffic on designated access routes and other affected streets should be assessed.	The assessment considers the impact of construction traffic on the local highway network (see Section 12.5).
Transport for London, Phase two consultation, February 2012 Consultation workshop, September 2011	Relocation of the pedestrian crossing opposite Chelsea Gardens.	The signalised pedestrian crossing would not be relocated during construction works.
Transport for London, Phase two consultation, February 2012 Consultation workshop, September 2011	Operation of the SRN / TLRN in the vicinity of Chelsea Embankment.	Highway network operation has been considered at both strategic and local levels within the assessment (see Vol 3 for project-wide assessment and Section 12.5 of this volume for site-specific effects).
Transport for London,	Operation of bus at the ‘Bull Ring’ needs to be considered as	The traffic management proposals make provision to keep the

Organisation	Comment	Response
Phase two consultation, February 2012 Consultation workshop, September 2011	construction may affect timetabled operation and /or right turn movement.	Bull Ring and the right turn in operation at all times. It is only during landscaping works that the bus stop in the Bull Ring area would be temporarily removed and bus route 360 would be diverted temporarily.
Transport for London, Phase two consultation, February 2012 Consultation workshop, September 2011	Need to consider any effects on the cycle superhighway at the adjacent junction with Chelsea Bridge Road.	Effects on Cycle Superhighways have been taken into consideration within the assessment (see Section 12.5).
RB of Kensington and Chelsea, Phase two consultation, February 2012 Borough meeting, April 2011	Consider Chelsea Barracks and Battersea Power Station development proposals as part of the baseline assessment.	The assessment includes consideration of these new developments as part of the base case (see para. 12.3.7).
RB of Kensington and Chelsea, phase two consultation, February 2012	The provision of parking within Royal Hospital Gardens is unlikely to be acceptable.	No parking is proposed within Royal Hospital Gardens.
RB of Kensington and Chelsea, phase two consultation, February 2012	There is a concern at the number of lorry visits to construction sites. It is difficult to understand how such a significant number of lorry movements can work in practice. Thames Water needs to do much more work with boroughs on minimising local disruption and agreeing site access routes	The assessment covers both project-wide (Vol 3) and site-specific transport issues (Vols 4-27). The assessment for the Chelsea Embankment Foreshore site covers measures to minimise local disruption and the site access routes have been discussed with RB of Kensington and Chelsea.
RB of Kensington	The TA should explain	The vehicular accesses

Organisation	Comment	Response
and Chelsea, phase two consultation, February 2012	how vehicular access to the secondary site would be achieved and explain how the chosen arrangement would minimise disruption to traffic.	to the Chelsea Embankment Foreshore site are explained in Section 12.2 and traffic management requirements are considered as part of the assessment.
RB of Kensington and Chelsea, phase two consultation, February 2012	A signalised pedestrian crossing should be constructed on Chelsea Embankment between the primary and secondary sites.	A temporary signalised pedestrian crossing would be provided between the main site and the worksite in the eastbound carriageway of Chelsea Embankment.
RB of Kensington and Chelsea, phase two consultation, February 2012	The number of lorry movements per day should be confirmed.	The number of lorry movements per day is set out in Section 12.2 and forms the basis of the assessment.
RB of Kensington and Chelsea, phase two consultation, February 2012	The TA should provide sufficient information to quantify times when any queuing around junctions may occur and to consider the potential impact of reducing the lane widths on traffic flows. Traffic flows for other Thames Water sites and committed developments should be included.	The assessment takes account of construction traffic associated with the Chelsea Embankment Foreshore site and other Thames Tideway Tunnel project sites that may pass through the area around Chelsea Embankment Foreshore and also takes account of committed developments in the surrounding area. The assessment considers the effect of the temporary reduced lane widths in Chelsea Embankment including the effects on queuing around the junctions (see Section 12.5).
RB of Kensington and Chelsea, phase two consultation,	No staff car parking should be provided to satisfy policy CT1(e). A	There would be no parking for construction workers on site. A *Draft*

Organisation	Comment	Response
February 2012	staff travel plan should be submitted with the planning application.	*Project Framework Travel Plan* has been prepared which includes objectives to minimise the number of workers travelling by car and sets out requirements for the site-specific *Travel Plans* to be prepared by the contractor with measures identified to achieve these objectives
Transport for London, phase two consultation, February 2012	Any impacts on Chelsea Embankment (A3212) need to be understood through suitable traffic modelling.	Traffic modelling has been undertaken to understand the impact on the local highway network (see Section 12.5).
Transport for London, phase two consultation, February 2012	Existing capacity on Chelsea Embankment (A3212) should be maintained at all times. Any lane or parking suspensions should be kept to a minimum.	During construction a 3.3m wide lane would be created on the nearside of the westbound lane of Chelsea Embankment (A3212) to accommodate construction vehicles arriving at and departing from the site. However, one lane in each direction would remain open to general traffic at all times with a minimum lane width of 3.25m and typically a width of 4.3m in each direction.
Transport for London, phase two consultation, February 2012	The impact of Blackfriars Bridge Foreshore, Chelsea Embankment Foreshore and Victoria Embankment Foreshore should be assessed together.	The effects of the project on individual sites are presented in the relevant site-specific *Environmental Statement* volumes (Vols 13, 17, and 18). An assessment of the

Organisation	Comment	Response
		interaction between the Blackfriars Bridge Foreshore and Victoria Embankment Foreshore sites is presented in the project-wide assessment volume (Vol 3). Chelsea Embankment Foreshore has not been included in that combined assessment as it is some distance from the other two sites.
Transport for London, phase two consultation, February 2012	Confirmation is needed if both sites either side of Chelsea Embankment will be operational during Phase 1 of construction.	During phase 1 of construction, construction work would only be undertaken at the main site at Chelsea Embankment Foreshore.
Transport for London, phase two consultation, February 2012	Safety implications as a result of lane narrowing need to be considered.	Traffic management requirements for this site have been considered as part of the assessment to ensure the road safety. Minimum lane widths of 3.25m in each direction would be maintained at all times.
Transport for London, phase two consultation, February 2012	Impacts of closing the Thames Path should be considered. Mitigation measures should be discussed with TfL.	This has been taken into consideration within the design of the project and the assessment.
Transport for London, phase two consultation, February 2012	Highway layout changes as part of the permanent scheme should be discussed with TfL.	The proposals have been discussed with TfL and RB of Kensington and Chelsea and have been refined in response to comments provided.
RB of Kensington and Chelsea, consultation	The justification for a single carriageway is required.	The carriageway width would be reduced but in all phases the

Organisation	Comment	Response
workshop, October 2011 September 2011		remaining width would safely accommodate vehicle traffic running in both directions.
RB of Kensington and Chelsea, consultation workshop, October 2011 September 2011	The need for gas mains diversion will affect the duration of works in road.	Utility diversions are incorporated within the assessment of transport effects.
RB of Kensington and Chelsea, consultation workshop, September 2011	Cycling that was previously allowed on the foreshore footway will be diverted along Chelsea Embankment (A3212).	This has been taken into consideration within the assessment.

Baseline

12.3.3 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

12.3.4 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.

12.3.5 The effect of all other Thames Tideway Tunnel project sites on the area surrounding Chelsea 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 13 Appendix N), five developments identified within 1km of the Chelsea Embankment Foreshore site would be operational during Site Year 3 of construction. These developments have therefore been included in the construction base case. They comprise:

a. a change of use of Gordon House, the Orangery and Creek Lodge on Royal Hospital Road

b. a site licence for Christmas tree sales at the Bull Ring Gate for 28 days in any one year

c. the Masterpiece London Art and Antiques Fair event in the South Grounds of the Royal Hospital

d. redevelopment of Riverlight to provide a residential-led mixed-use development (on the south bank of the River Thames)

e. Northern Line Extension – extension of London Underground Northern Line (Charing Cross branch) to Battersea via new station at Nine Elms (on the south bank of the River Thames).

12.3.7 Development at Battersea Power Station (phases 1, 2 and 3) on the south bank of the River Thames would be complete and operational by Site Year 3 of construction; however, phase 4 and part of phases 5 and 6 of this development would still be under construction in Site Year 3 of construction. Development at Chelsea Barracks would also be under construction in Site Year 3 of construction. This means that the transport assessment should consider cumulative effects in relation to those developments under construction at the same time as construction works at the Chelsea Embankment Foreshore site.

12.3.8 The TfL Highway Assignment Models (HAM) which have been used in the transport assessment have been developed using GLA employment and population forecasts, which are based on the employment and housing projections set out in the *London Plan 2011*(GLA, 2011)[5]. As a result the assessment inherently takes into account a level of future growth and development across London.

12.3.9 This means that the trips associated with the other developments described above within 1km of the Chelsea Embankment Foreshore site which could alter the operation of the transport networks in the future are already taken into consideration within the traffic modelling.

Construction assessment area

12.3.10 The assessment area for the Chelsea Embankment Foreshore site includes the site access directly from Chelsea Embankment (A3212), which is a part of the TLRN. The junction of Chelsea Bridge Road (A3216) / Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge (A3216) approximately 150m to the east of the site has also been assessed.

12.3.11 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 of the site and rail services within 960m of the site have also been assessed[ii].

Construction assessment year

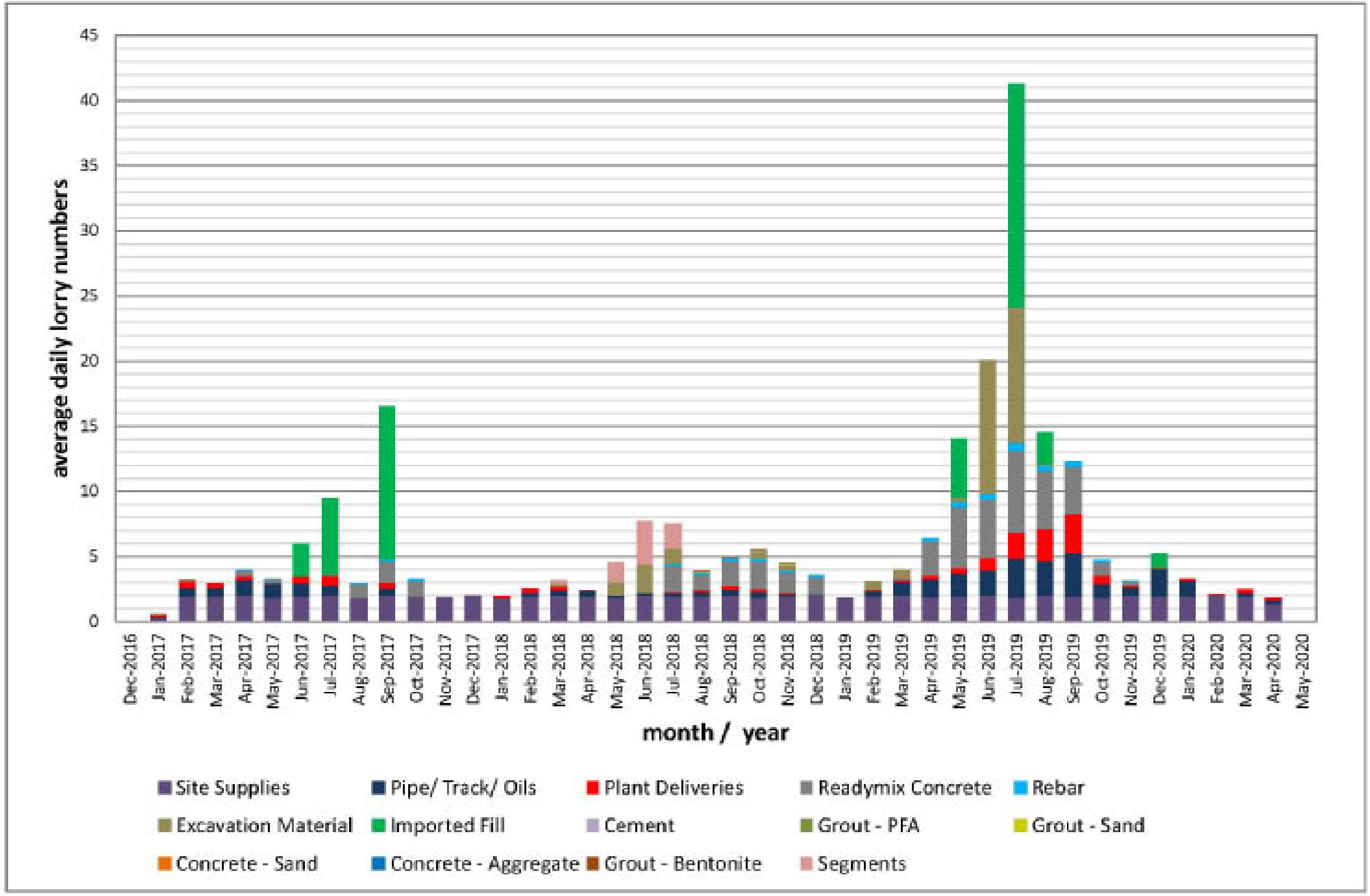
12.3.12 Site-specific peak construction assessment years have been identified. The histograms in Vol 13 Plate 12.3.1 and Vol 13 Plate 12.3.2 show that the peak site-specific activity at the Chelsea Embankment Foreshore site would occur in Site Year 3 of construction for road transport and Site Year 1 for river transport.

12.3.13 The assessment of construction effects also considers the extent to which the assessment findings would be likely to be materially different should

[ii] Distances derived from the Public Transport Accessibility Level (PTAL) methodology described in Volume 2.

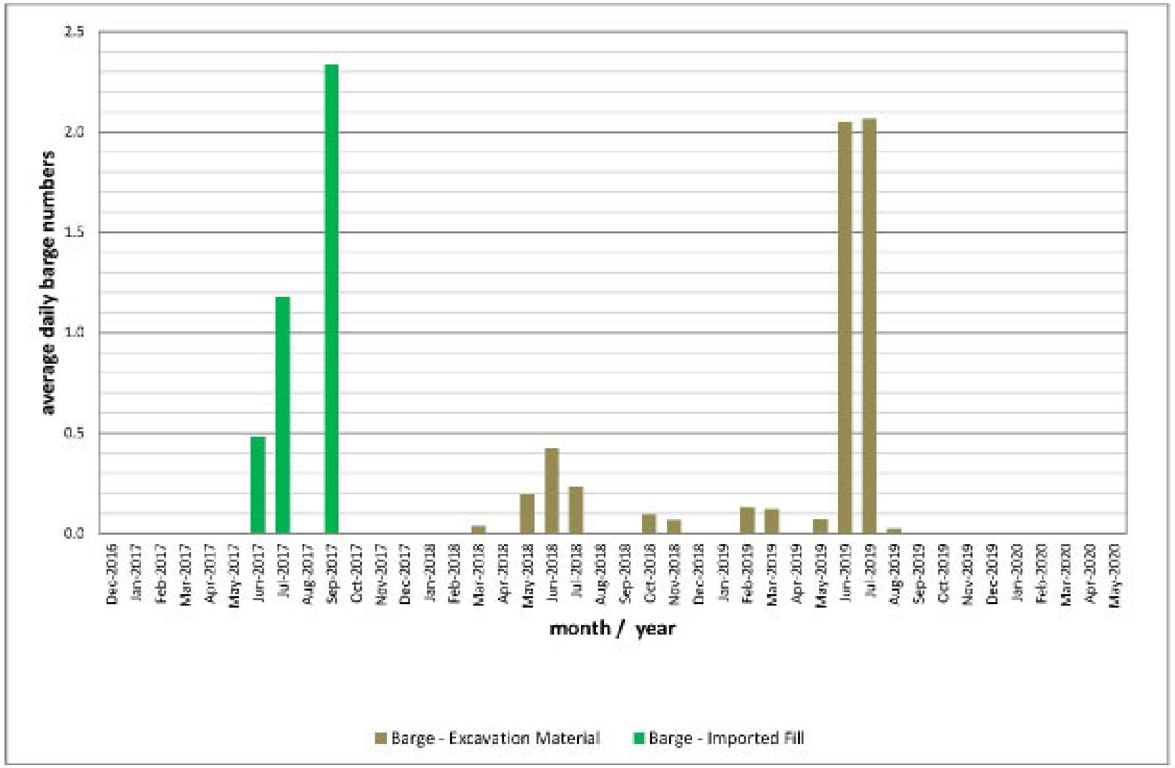
the programme for the Thames Tideway Tunnel project be delayed by approximately one year.

Vol 13 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 13 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

12.3.14 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.

12.3.15 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 elements listed at para. 12.1.2. The only elements considered are the effects on highway layout and operation.

12.3.16 These elements are considered qualitatively (as described in Vol 2) 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 RB of Kensington and Chelsea and TfL.

12.3.17 Also, given the level of transport activity associated with the Thames Tideway Tunnel project during the operational phase, as outlined in para. 12.2.20, only the localised transport effects around the Chelsea Embankment Foreshore site are assessed. Other Thames Tideway Tunnel project sites would not affect the area around the site in the operational phase and therefore it is not necessary to consider them in the assessment.

12.3.18 With regard to other developments in the vicinity of the site (as detailed in Vol 13 Appendix N), all seven developments described in paras. 12.3.6-12.3.7 would be operational within 1km of the Chelsea Embankment Foreshore site 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 and operation (see para. 12.6.2).

12.3.19 Ongoing construction of phases 5 (part) and 7 of Battersea Power Station in Year 1 of operation suggests that there may be cumulative effects to assess. However, as that development is on the opposite side of the river and activity associated with maintenance at the Chelsea Embankment Foreshore site would be extremely low and infrequent, and would only present effects on highway layout and operation in the area immediately surrounding the site, it is considered that a cumulative assessment for the operational phase is not necessary.

Operational assessment area

12.3.20 The assessment area for the operational assessment remains the same as for the construction assessment as set out in paras. 12.3.10 and 12.3.11.

Operational assessment year

12.3.21 As outlined in Vol 2 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.

12.3.22 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

12.3.23 The general assumptions and limitations associated with this assessment are presented in Vol 2.

Assumptions

12.3.24 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.

12.3.25 There would be deliveries of fuel for construction plant at this site and a number of construction products may be classified as hazardous. For the Chelsea Embankment Foreshore site, it is assumed that there would be one hazardous load per fortnight generated by the site.

12.3.26 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

12.3.27 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 13 Figure 12.4.1 (see separate volume of figures), road access to the site would be directly off Chelsea Embankment (A3212) which forms part of the TLRN.

Pedestrian routes

12.4.3 The existing pedestrian network and facilities in the vicinity of the site are shown in Vol 13 Figure 12.4.2 (see separate volume of figures). Chelsea Embankment (A3212) provides a continuous east-west link for pedestrians along the north bank of the River Thames. Chelsea Embankment (A3212) starts at Battersea Bridge to the west, and then follows the course of the north bank, past Albert Bridge to Chelsea Bridge, and then continuing eastwards as Grosvenor Road (A3212).

12.4.4 The footways along either side of Chelsea Embankment (A3212) are between 2.2m and 4m wide. There is some provision for resting provided along the northern footway of Chelsea Embankment (A3212).

12.4.5 Signalised pedestrian crossings are provided at the junction of Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge (A3216) / Chelsea Bridge Road (A3216). All arms have staggered pedestrian crossing facilities with tactile paving and dropped kerbs.

12.4.6 Additional pedestrian crossing facilities are provided 340m walking distance west of the junction of Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge (A3216) / Chelsea Bridge Road (A3216) to the west of Bull Ring.

12.4.7 Signalised pedestrian crossings are provided at the junction of Chelsea Bridge Road (A3216) / Royal Hospital Road (B302) / Pimlico Road (A3214) which is located a further 550m walking distance northwest of the Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge (A3216) / and Chelsea Bridge Road (A3216) junction.

12.4.8 The Thames Path runs along the riverside footway of Chelsea Embankment (A3212), adjacent to the river.

Cycle facilities and routes

12.4.9 The existing cycle network and facilities in the vicinity of the site are shown in Vol 13 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 (traffic free through the central section) which routes through central London along Cheyne Walk (A3220), Chelsea Embankment (A3212), Grosvenor Road (A3212) and Lupus Street.

12.4.11 Advanced stop lines are provided on the east and south arms of the junction of Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge Road (A3216) / Chelsea Bridge (A3216).

12.4.12 Cycle lanes are provided along Chelsea Bridge Road (A3216) in both directions between the junction of Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge Road (A3216) / Chelsea Bridge (A3216) and the junction of Chelsea Bridge Road (A3216) / Pimlico Road (A3214) / Royal Hospital Road (B302) / Lower Sloane Street (A3216).

12.4.13 Cycle Superhighway (CS) route 8, which opened in summer 2011, routes from Westminster to Wandsworth, passing along Chelsea Bridge (A3216) and to the east along Grosvenor Road (A3212). The closest point of approach to the site is at Chelsea Bridge, approximately 200m walking distance to the east.

12.4.14 The closest cycle hire docking station is located on Grosvenor Road (A3212). The docking station is located 200m walking distance to the east of the site, to the east of the junction of Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge Road (A3216) / Chelsea Bridge (A3216). This cycle docking station accommodates 15 bicycles.

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, 2011)[6] 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 3, rated as 'moderate' (with 1 being the lowest accessibility and 6b being the highest accessibility).

12.4.17 Vol 13 Figure 12.4.3 (see separate volume of figures) shows the public transport network around the Chelsea Embankment Foreshore site.

Bus routes

12.4.18 As shown in Vol 13 Figure 12.4.3 (see separate volume of figures), a total of five daytime bus routes and two night bus routes operate within 640m of the site.

12.4.19 These bus routes operate from the following bus stops:

a. Bull Ring Gate bus stop on Chelsea Embankment (A3212) turning loop (northbound only), 150m walking distance west of the site.

b. Lister Hospital bus stop on Chelsea Bridge Road (A3216) (northbound and southbound), 240m walking distance northeast of the site

c. Grosvenor Road bus stop on Grosvenor Road (A3212) (eastbound and westbound), 610m walking distance east of the site

12.4.20 These routes would also serve other stops further from the site as shown on Vol 10 Figure 12.4.3 (see separate volume of figures).

12.4.21 On average there are a total of 103 daytime bus services per hour in the AM peak and 92 bus services per hour in the PM peak within a 640m walking distance of the site.

12.4.22 There are approximately 12 night-time bus services per hour Monday – Friday between 00:00 – 06:00 and on Saturdays between 00:00 – 06:00 within 640m walking distance of the site.

London Underground

12.4.23 Sloane Square underground station, which is served by the Circle and District lines, is located approximately 1.1km to the north of the site, as shown on Vol 13 Figure 12.4.3 (see separate volume of figures).

12.4.24 Circle Line trains from this station travel clockwise to Edgware Road and anti-clockwise to Hammersmith. District Line trains travel west to Earls Court, Ealing Broadway and Richmond, south to Wimbledon, and east to Upminster. Passengers wishing to travel west to Ealing Broadway and Richmond for interchange with National Rail services must change trains at Earls Court.

12.4.25 In the AM and PM peak hours, the frequency of the Circle Line trains is approximately every ten minutes providing six services per hour in each direction and the frequency of the District Line trains is every two to three minutes providing approximately 21-22 services per hour in each direction.

12.4.26 On average there are 55 underground services in total during each of the AM and PM peak hours from Sloane Square Underground station.

National Rail

12.4.27 The closest National Rail stations to the site are Battersea Park and Queenstown Road, on the south side of the River Thames. Battersea Park and Queenstown Road are approximately 1.1km and 1.4km or 14 and 18 minutes walk respectively to the south of the site.

12.4.28 Battersea Park is served by Southern services and provides northbound services to London Bridge / Victoria and southbound services to Caterham / Sutton.

12.4.29 In each of the AM and PM peak hours there are approximately 21 services (14 northbound and seven southbound) calling at Battersea Park. In the PM peak hour there are approximately 21 services (15 northbound and 6 southbound).

12.4.30 Queenstown Road provides access to South West Trains services and provides northbound services to London Waterloo and southbound services to Weybridge via Hounslow.

12.4.31 In the AM and PM peak hours there are approximately 16 services. In the AM peak hour there are 12 eastbound and four westbound services and in the PM peak hour there are 14 eastbound and two westbound services.

River passenger services

12.4.32 The nearest passenger pier to the site is Cadogan Pier, approximately 1km walking distance to the west of the site. The pier is served by Thames Executive Charters travelling between Blackfriars Millennium Pier in the east and Putney Pier in the west. The pier is served Monday to Friday and the morning service calls at Putney, Wandsworth, Chelsea Harbour, Cadogan Pier, Embankment Pier and Blackfriars.

12.4.33 These river services are shown on Vol 13 Figure 12.4.3 (see separate volume of figures).

12.4.34 During the AM weekday peak hour, no westbound services run via this pier. In the PM weekday peak, there is one service per hour in the westbound direction. There is one eastbound service from the pier in the AM peak hour, at 08:25 but no eastbound service in the PM peak hour in the eastbound direction.

12.4.35 Services do not run outside the peak hours or at weekends.

River navigation and access

12.4.36 No cargo handling piers are in the immediate vicinity of the Chelsea Embankment Foreshore site. An analysis has been made of the typical volume of river vessel traffic passing the Chelsea 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 hour is between 14:00 and 15:00, Monday to Friday. During this hour approximately 15 vessels are estimated to pass the site. This figure is not constant however 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 10 to 12 days when the tide is at its highest[7].

Parking

12.4.37 Vol 13 Figure 12.4.4 (see separate volume of figures) shows the locations of the existing car parks, car club spaces and coach parking within the vicinity of the site.

Existing on-street car and motorcycle parking

12.4.38 On-street parking bays are provided in the Bull Ring adjacent to Chelsea Embankment, Cheyne Walk, Dilke Street, Embankment Gardens, Paradise Walk, Swan Walk and Tite Street. Parking bays provided in the Bull Ring are for residents only.

12.4.39 In total there are approximately 233 residents parking bays on the roads in the vicinity of the site.

12.4.40 On Chelsea Embankment (A3212), Cheyne Walk, Dilke Street and Embankment Gardens, there are a total of 17 pay and display parking bays.

12.4.41 Motorcycle parking bays are located on Cheyne Walk, Embankment Gardens, Swan Walk, and Tite Street accommodating up to 25 motorcycles in total.

Existing off-street/private car parking

12.4.42 The nearest off-street car park to the site is on Queenstown Road to the south, on the south side of the River Thames at a walking distance of approximately 600m. The car park is operated by Parking Partners (Management Services) Ltd and provides private parking for residents and a number of local businesses.

Coach parking

12.4.43 There is no provision for coach parking in the immediate area. The nearest coach parking locations are at Victoria Coach Station which is approximately 1.3km walking distance to the northeast of the site.

Car clubs

12.4.44 The closest car club parking space to the site is operated by City Car Club and is approximately 250m walking distance away from the site on Grosvenor Waterside, Gatliff Road where two car spaces are provided.

Servicing and deliveries

12.4.45 A loading / blue badge holder parking bay is located along Chelsea Embankment (A3212) to the east of the junction with Royal Hospital Road (B302) approximately 700m walking distance west of the site.

Taxis

12.4.46 The nearest taxi rank to the site is located on Lower Sloane Street (Sloane Club) approximately 940m walking distance to the north of the site with one taxi space provided.

Highway network and operation

12.4.47 The site is located on Chelsea Embankment (A3212) as shown in Vol 13 Figure 12.4.1 (see separate volume of figures). Chelsea Embankment

(A3212) forms part of the TLRN and is an 11.8m wide single carriageway. A 30mph speed limit applies and the road is suitable for HGVs and long vehicles. The road links to Grosvenor Road (A3212) in the east and Cheyne Walk (A3220) and Cremorne Road (A3220) in the west, all of which form part of the TLRN.

12.4.48 The highway at the signalised junction of Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge Road (A3216) / Chelsea Bridge (A3216), Chelsea Embankment (A3212) flows into three lanes on the approach to and two lanes on the exit from the junction. To the east of the junction, Grosvenor Road (A3212) has two lanes eastbound and westbound.

12.4.49 Chelsea Bridge (A3216) to the south of the junction is part of the Strategic Road Network (SRN) and leads to Queenstown Road (A3216), Battersea Park Road (A3205) and Nine Elms Lane (A3205) to the south. Battersea Park Road (A3205) and Nine Elms Lane (A3205) form part of the TLRN and Queenstown Road (A3216) is part of the SRN. Chelsea Bridge (A3216) has two lanes northbound and a single lane southbound.

12.4.50 Chelsea Bridge Road (A3216) to the north of the junction has two lanes in a southbound direction and two lanes in the northbound direction. Chelsea Embankment (A3212) runs to the west to meet West Cromwell Road (A4) which is part of the TLRN.

12.4.51 The Bull Ring is accessed directly from Chelsea Embankment (A3212) and provides a turnaround facility for bus service 360 as well as on-street car parking for resident permit holders.

Data from third party sources

Description of data

12.4.52 The following data have been sourced from TfL:

a. five year accident data on roads within the vicinity of the site

b. Automatic Traffic Counts (ATCs)

c. TRANSYT 12 / TranEd model of Chelsea Embankment and associated junction movement data.

Accident analysis

12.4.53 A total of 18 serious accidents and 69 slight accidents occurred in the Chelsea Embankment Foreshore assessment area over the five years for which accident data was obtained and analysed. There were no fatal accidents.

12.4.54 Of the total accidents, 16 accidents occurred along Chelsea Embankment (A3212) and associated junctions within the vicinity of the site. Of these, five accidents were classified as serious and the remaining 11 accidents were classified as slight.

12.4.55 Of the total accidents, ten of the accidents which occurred in the assessment area involved goods vehicles, all of which were Light Goods Vehicles (LGVs). Of these accidents, six led to slight accidents and the remaining four accidents led to serious accidents.

12.4.56 In total, seven pedestrians were involved in the accidents, of these one was recorded as serious and the remaining six as slight.

12.4.57 Of the total accidents, 24 accidents involved cyclists of which six were classified as serious and 18 as slight.

12.4.58 Of the five years of accident data analysed none of the accidents happened as a result of the road geometry.

Traffic flow data analysis

12.4.59 ATC data for Chelsea Embankment (A3212) were obtained from TfL and were analysed to identify the traffic flows along this road in February 2011. The weekday vehicle flows for a 12-hour period (07:00-19:00) show that the AM peak hour for Chelsea Embankment (A3212) is the busiest hour with a two-way flow of approximately 2,450 vehicles per hour.

12.4.60 In addition, junction movement data and a TRANSYT model for Chelsea Embankment (A3212) were obtained from TfL. Data have been analysed to validate the traffic surveys undertaken in 2011 for the project.

12.4.61 Traffic data from the TRANSYT model indicate that there is a total traffic flow of 4,148 and 3,938 vehicles in the AM and PM peak hours respectively using the junction of Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge (A3216) / Chelsea Bridge Road (A3216).

Survey data

Description of surveys

12.4.62 Baseline survey data were collected in May, July, and September 2011 to establish the existing transport movements and usage of parking in the area. Vol 13 Figure 12.4.5 (see separate volume of figures) shows the survey locations in the vicinity of the site.

12.4.63 As part of the surveys in May and July 2011, manual and automated traffic surveys were undertaken to establish specific traffic, pedestrian and cycle movements including turning volumes, queue lengths and traffic signal timings. Parking surveys were undertaken to establish the usage of resident and pay and display parking in addition to loading bays and motorcycle bays. Further surveys were conducted in August 2011 to establish the summer usage of Thames Path.

Results of the surveys

12.4.64 The surveys inform the baseline situation in the area surrounding the site.

Pedestrians and cyclists

12.4.65 Pedestrian flows around the site during the AM and PM peak hours indicate that there is a balanced flow of pedestrians during the AM peak hour along the footway directly outside the site of approximately 25 pedestrians in each direction. During the PM peak hour the directional flow is heavier with approximately 28 eastbound pedestrians and 17 westbound pedestrians on the footway passing the site although the overall total remains similar to the AM peak hour.

12.4.66 The cyclists flow along Thames Path directly outside the site is low with a maximum two-way flow of 24 cyclists in the AM peak hour and 22 cyclists in the PM peak hour. There is a two-way flow of approximately 587 cycles along Chelsea Embankment (A3212) during the AM peak hour, and 357 cycles during the PM peak hour.

Traffic flows

12.4.67 ATC data collected as part of the surveys have been analysed to identify the existing traffic flows along Chelsea Embankment (A3212). Weekday flows are used as this is when the greatest impacts from the project are likely to be experienced. The weekday vehicle and HGV flows for a 12-hour period (07:00-19:00) show that the AM peak hour for Chelsea Embankment (A3212) is the busiest hour with a maximum two-way flow of approximately 630 vehicles every 15 minutes (350 vehicles in the eastbound direction and 280 vehicles in the westbound).

12.4.68 The junction surveys undertaken have been validated against the TfL junction data and TRANSYT model. The traffic flows for the busiest period within the area are indicated in Vol 13 Figure 12.4.6 and Vol 13 Figure 12.4.7 (see separate volume of figures). These figures take into consideration the TfL data collected.

12.4.69 Traffic surveys indicate that there is a total traffic flow of 3,866 and 3,806 vehicles in the AM and PM peak hours respectively using the junction of Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge (A3216) / Chelsea Bridge Road (A3216) with a predominant traffic flow from Chelsea Embankment (A3212) to Grosvenor Road (A3212) in the AM peak hour and from Grosvenor Road (A3212) to Chelsea Embankment (A312) in the PM peak hour. This is slightly lower, but of a similar order of magnitude, to that indicated in the TRANSYT model for this junction obtained from TfL.

Parking

12.4.70 The results of the surveys indicate that usage of the loading bay along Chelsea Embankment is infrequent. Resident and motorcycle parking spaces within the area covered by surveys are up to 80% utilised although there is spare capacity available on both weekdays and at weekends.

12.4.71 Surveys were also undertaken to establish the availability of pay and display parking in the vicinity of the site to understand existing occupancy and capacity. Results indicate there is car parking capacity in the vicinity of the Chelsea Embankment Foreshore site overnight but these spaces are heavily used during the weekdays.

Local highway modelling

12.4.72 To establish the existing capacity on the local highway network, a scope was discussed with TfL and the RB of Kensington and Chelsea to model the junction of Chelsea Embankment (A3212) with Grosvenor Road (A3212), Chelsea Bridge (A3216) and Chelsea Bridge Road (A3216) using a TfL TRANSYT model. The baseline model accounts for the current traffic and transport conditions within the vicinity of the site and followed the methodology outlined in Vol 2.

12.4.73 The weekday AM and PM baseline model queues for Chelsea Embankment (A3212) were compared against observed queue lengths for the peak periods (from junction surveys) to validate the TRANSYT model and ensure reasonable representation of existing conditions.

12.4.74 Vol 13 Table 12.4.1 shows the modelling outputs for the baseline case. The overall junction performance shows that the junction is operating above theoretical capacity in the weekday AM and PM peak hours.

Vol 13 Table 12.4.1 Transport – baseline TRANSYT model outputs

Approach	Movement	Weekday							
		AM peak hour (08:00-09:00)				PM peak hour (17:00-18:00)			
		Flow (PCU)	DoS	MMQ (PCU)	Delay (seconds per PCU)	Flow (PCU)	DoS	MMQ (PCUs)	Delay (seconds per PCU)
Chelsea Embankment (A3212)	Ahead	589	74%	12	27	552	61%	11	24
	Ahead left	348	46%	6	20	308	36%	6	20
	Right	222	101%	15	171	292	97%	16	127
Grosvenor Road (A3212)	Ahead	460	93%	18	81	515	95%	23	85
	Ahead left	428	90%	16	75	502	97%	24	96
Chelsea Bridge Road (A3216)	Ahead	339	37%	4	11	430	89%	18	70
	Ahead left	170	22%	2	11	253	56%	7	43
Chelsea Bridge (A3216)	Ahead left	797	102%	43	120	642	89%	23	54
	Ahead right	510	67%	13	31	314	45%	8	31
		PRC		Total delay (PCU hours)		PRC		Total delay (PCU hours)	
Overall average delay per PCU		-13%		510		-8%		520	

Note: 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.

12.4.75 In the AM peak hour, the results show that the Chelsea Embankment (A3212) eastbound right turning movement and Chelsea Bridge (A3216) northbound ahead/left movements are operating over capacity in the baseline situation with queues of 15 and 43 vehicle lengths respectively. The Grosvenor Road (A3212) arm of the junction is operating just below the theoretical capacity with maximum queues of 18 vehicle lengths.

12.4.76 In the PM peak hour the right turn on Chelsea Embankment (A3212) and both lanes of the Grosvenor Road (A3212) approach are operating just below theoretical capacity with maximum queues of 23-24 vehicle lengths.

12.4.77 In the AM and PM peak hours delays are most significant on Chelsea Embankment (A3212) eastbound right turn movement with an average of 171 and 127 seconds of delay per PCU in the AM and PM peak hours respectively.

Transport receptors and sensitivity

12.4.78 The receptors and their sensitivities in the vicinity of the Chelsea Embankment Foreshore site are summarised in Vol 13 Table 12.4.2. The transport receptor sensitivity is defined as high, medium or low using the criteria detailed in Vol 2.

12.4.79 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.

12.4.80 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 13 Table 12.4.2 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	Construction	High sensitivity to diversions and footway closures, resulting in

[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
Thames Path and Chelsea Embankment (A3212)		increases to journey times.
Private vehicle users (including taxis) in the area using the local highways or on-street parking.	Construction Operation	Medium sensitivity to increases in HGV traffic resulting in journey time delays and to changes in parking activity.
Emergency vehicles travelling on Chelsea Embankment (A3212)	Construction Operation	High sensitivity to journey time delays due to time constraints on journey purposes.
Marine emergency services	Construction	High sensitivity to changes in vessel movements / moorings
Service vehicles using loading bay on Chelsea Embankment (A3212)	Construction	Low sensitivity due to distance from the site.
Bus users (passengers) travelling through Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge Road (A3216) / Chelsea Bridge (A3216) junction.	Construction Operation	Medium sensitivity to journey time delays as a result of increases to traffic flows.
River vessel operators including river passenger services.	Construction	Medium sensitivity to increases in passage of construction barges
Leisure users of the River Thames	Construction	High sensitivity to passage of construction barges
Public transport users using rail or river services within the area	Construction	Low sensitivity to distance from the site and low numbers of

Receptors (relating to all identified transport effects)	Phase at which receptor is sensitive to identified impacts	Value/sensitivity and justification
		construction workers
Residents of Embankment Gardens, 100m to the northwest of the site. Residents of Chelsea Gardens, 115m northeast of the site.	Construction	High sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays.
Users of recreational spaces at Royal Hospital Chelsea (South Grounds), including for events such as the Chelsea Flower Show, 12m north of the hoarding boundary	Construction	Low sensitivity to changes to footways and highway operations given temporary nature of events; vulnerable pedestrian groups are likely to be present (children, mobility impaired users).

Construction base case

12.4.81 As described in Section 12.3 above, the construction assessment year for transport effects in relation to this site is Site Year 3 of construction in relation to construction road traffic and Site Year 1 in relation to construction river traffic.

12.4.82 There is a TfL proposal to change the pedestrian network in the vicinity of the site by Site Year 3 of construction which involves replacing the signalised pedestrian crossing along Chelsea Embankment (A3212) by the Bull Ring (approximately 10m west of the site) with a zebra crossing. There are no proposals to change the cycle facilities by Site Year 3 of construction and the network will operate as described in the baseline situation.

12.4.83 In terms of the public transport network, it is expected that as a result of the TfL *London Underground Upgrade Plan* (TfL, 2011)[8], compared to the current baseline, London Underground capacity is anticipated to increase by approximately 24% on the District Line. The *TfL Upgrade Plan* envisages a combined increase in capacity on the Circle and Hammersmith and City Line of 65% although it is clear that a significant proportion of this increase is attributed to the revised service patterns implemented in 2009, which will already be reflected in the baseline data. It is envisaged that London Underground and National Rail patronage will increase by Site Year 3 of construction.

12.4.84 Due to the traffic growth in the construction base case compared to the baseline situation (see para. 12.4.90), bus journey times along Chelsea Embankment (A3212), Chelsea Bridge Road (A3216), Grosvenor Road (A3212), Chelsea Bridge (A3216) and within the wider area would be affected. The effect on journey times in the base case is detailed under the highway operation and network assessment (paras. 12.5.46 and 12.5.48), and would result in an additional road network delay of a maximum of approximately one minute 35 seconds on the Chelsea Bridge (A3216) ahead and left movements at the junction of Chelsea Embankment (A3212) / Chelsea Bridge Road (A3216) / Grosvenor Road (A3212) / Chelsea Bridge (A3216) in the AM peak hour and eight minutes and 11 seconds in the PM peak hour on Chelsea Embankment (A3212) right turn movement at the same junction.

12.4.85 In order to ensure that the busiest base case scenario is used in the assessment, the capacity for National Rail and London Underground has been assumed to remain the same as capacity in the baseline situation. This ensures a robust assessment as outlined in Vol 2.

12.4.86 It is expected that river services between Putney and Blackfriars may increase from baseline conditions as a result of planned service changes which were being tendered at the time of writing.

12.4.87 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 Chelsea Embankment Foreshore site in Site Year 3 of construction without the Thames Tideway Tunnel project. The construction base case traffic flows (derived from the survey data) providing input to the TRANSYT model are shown on Vol 13 Figure 12.4.6 and Vol 13 Figure 12.4.7 (see separate volume of figures).

12.4.88 The key findings from the construction base case model for Chelsea Embankment Foreshore indicate that the junction would operate above capacity in both peak hours. The base case assessment assumes that traffic signal optimisation would be undertaken by TfL to maximise capacity at the junction.

12.4.89 There would be a change in queue lengths at the junction of Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge Road (A3216) / Chelsea Bridge (A3216). In the AM peak hour this would be most noticeable on the Chelsea Bridge (A3216) approach and in the PM peak hour would occur on the Chelsea Embankment (A3212), Chelsea Bridge Road (A3216) and Chelsea Bridge (A3216) approaches.

12.4.90 In addition it is anticipated that there will be an increase in average delay to vehicles in the construction base case compared to the baseline conditions. The increases in each peak hour reflect the fact that the junction would operate further above capacity than in the baseline situation.

12.4.91 The construction base case takes into account traffic growth and new developments within the local area by Site Year 3 of construction including the developments detailed in para. 12.3.6. Developments within 250m of the site are considered to present potential receptors to transport effects, as described in Vol 2. The change of use at Gordon House, the site licence for Christmas tree sales for Bull Ring Gate, and the Masterpiece London Art and Antiques Fair are within 250m of the site and would be operational by Site Year 3 of construction therefore representing additional receptors as detailed in Vol 13 Table 12.4.3 below.

12.4.92 It should be noted that the Masterpiece London Art and Antiques Fair and selling of Christmas trees are temporary events and therefore receptors associated with these events would be of a temporary nature.

Vol 13 Table 12.4.3 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
Residents of Gordon House / the Orangery / Creek Lodge - Royal Hospital, Royal Hospital Road	Construction	High sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays.
Exhibitors and visitors at Masterpiece London Art and Antiques Fair, South Grounds	Construction	Low sensitivity to changes to footways and highway operations given temporary nature of event.
Operators / visitors at temporary Christmas tree outlet, Bull Ring Gate, South Grounds	Construction	Low sensitivity to increases in HGV traffic and changes to pedestrian environment resulting in journey time delays, given temporary nature of operation.

Operational base case

12.4.93 The operational assessment year for transport is Year 1 of operation.

12.4.94 As explained in para. 12.1.4, the elements of the transport network considered in the operational assessment are highway layout and operation. For the purposes of the operational base case, it is anticipated that the highway layout will be as indicated in the construction base case.

12.4.95 The operational base case, Year 1 of operation, takes into account the developments described in Vol 13 Appendix N (site development schedule) as described in para. 12.3.18 to 12.3.19. In addition to the receptors identified in the construction base case (see Vol 13 Table

12.4.2), the Chelsea Barracks development would be complete and operational by Year 1 of operation (within 250m of the Chelsea Embankment Foreshore site). However, given the limited effects which are anticipated in the operational phase and the distance between the developments and the Chelsea Embankment Foreshore site, these developments do not present additional relevant transport receptors requiring 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 Chelsea Embankment Foreshore site (Site Year 3 of construction for construction road traffic and Site Year 1 of construction for construction river traffic).

12.5.2 The anticipated mode split of worker trips (covering all types of construction worker described in Vol 13 Table 12.2.2) for Chelsea Embankment Foreshore is detailed in Vol 13 Table 12.5.1 and has been generated based on 2001 Census data[iv] for journeys to workplaces within the vicinity of the Chelsea Embankment Foreshore site. 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 in Vol 13 Table 12.5.1 to reflect increased levels of non-car use by workers at this site. This forms the basis of the assessment.

Vol 13 Table 12.5.1 Transport – mode split

Mode	Percentage of trips to site	Equivalent number of worker trips (based on 65 worker trips)	
		AM peak hour (07:00-08:00)	PM peak hour (18:00-19:00)
Bus	11%	7	7
National Rail	38%	25	25
Underground	35%	23	23
Car driver	<1%*	0	0
Car passenger	<1%*	0	0
Cycle	3%	2	2
Walk	10%	7	7

[iv] Based on 2001 Census as this type of data had not been released from the 2011 Census at the time of assessment.

Mode	Percentage of trips to site	Equivalent number of worker trips (based on 65 worker trips)	
		AM peak hour (07:00-08:00)	PM peak hour (18:00-19:00)
River	1%	1	1
Other (taxi/motorcycle)	2%	1	1
Total	100%	65	65

** Assumed to be zero for the purposes of the assessment.*

Pedestrian routes

12.5.4 The construction phases – phase 1-4 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 Chelsea Embankment (A3212) and would require closure and diversion during all phases of construction as a result of the construction works. The Thames Path would be diverted to the north side of Chelsea Embankment (A3212) for the duration of the construction period. However, the riverside footway would be opened for public use outside of working hours at weekends with appropriate measures to protect pedestrians.

12.5.6 When the Thames Path is closed, pedestrians would be diverted to the northern footway, using an existing signalised pedestrian crossing to the west of the Bull Ring. During phases 1, 2 and 4 of construction (when the northern footway is open), pedestrians would be diverted back to the southern footway using the existing signalised crossing at the junction of Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge Road (A3216) / Chelsea Bridge (A3216). During phase 3 of construction (when the northern footway is closed), pedestrians would be diverted back to the southern footway using a temporary signalised pedestrian crossing to the east of the main construction site.

12.5.7 To assess a busiest case scenario, it has been anticipated that all worker trips would finish their journeys by foot. As a result the 65 worker trips generated by the site have been added to the construction base case pedestrian flows during the AM and PM peak hours.

12.5.8 Taking into consideration the pedestrian diversions and increase in worker trips, the greatest effect would be on the northern footway along Chelsea Embankment (A3212) which pedestrians would need to use as an alternative to the riverside footway during the diversion.

12.5.9 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).

12.5.10 It is anticipated that the pedestrian diversions around the Chelsea Embankment Foreshore site would result in a worst case journey time increase of approximately two minutes 40 seconds, due to the additional crossings and extension of the journey by 40m, based on a walking speed of 1.3m/sec. This results in a medium adverse impact on pedestrian delay for those walking along the southern side of Chelsea Embankment (A3212). Other pedestrian movements in the area would experience a negligible impact.

12.5.11 With regards to pedestrian amenity and accidents and safety, the closure of the southern Chelsea Embankment (A3212) footway would result in pedestrians having to make an additional two road crossings. The impact magnitude for pedestrian amenity and accidents and safety would therefore be classified as high adverse using the criteria set out in Vol 2.

Cycle facilities and routes

12.5.12 The relevant impact criteria to determining the magnitude of impacts for cycle facilities and routes are cycle delay and accidents and safety (as set out in Vol 2).

12.5.13 Cyclists using the highway would experience an additional delay to cycle time as a result of the construction works at the Chelsea Embankment Foreshore site. This would include those cyclists using the NCN Route 4 along Chelsea Embankment (A3212) on the Thames Path which would be diverted to the highway. The effect on journey times is identified in the highway operation and network assessments (paras. 12.5.36 to 12.5.48) and would be an increase of a maximum of 16 seconds per PCU in the AM peak hour and 14 seconds per PCU in the PM peak hour compared with that in the construction base case. This represents a negligible impact.

12.5.14 With regards to accidents and safety during construction, the operation and layout of the road network would change. In phases 1-3 of construction, the available carriageway width on Chelsea Embankment (A3212) between the ambulance gate to the Royal Hospital Chelsea Grounds, Ranelagh Gardens and the Bull Ring would be reduced both in the eastbound and westbound lanes by 1.6m. However, lane widths of 4.3m, where HGVs can safely overtake cyclists, would be retained for traffic in each direction.

12.5.15 Additionally, while cyclists would not be required to make any additional road crossings as a result of the diversions and lane adjustments along Chelsea Embankment (A3212), there would be an increase in construction traffic flow of between four and 20 two-way HGV movements per hour. Overall this represents a low adverse impact on accidents and safety.

Bus routes and patronage

12.5.16 Bus service 360 runs past the site and uses the turnaround facility at Bull Ring Gate. This service would be able to continue in operation during the construction period except when landscaping works are being carried out to the Bull Ring. The ‘loop’ section of this bus service between Grosvenor Road (A3212) and the Bull Ring would be temporarily suspended during the landscaping works and buses would turn directly between Grosvenor Road (A3212) and Chelsea Bridge Road (A3216). Such arrangements are already used by the bus operator during major events at the Royal Hospital.

12.5.17 Additional construction vehicles serving the site and the traffic management arrangements along Chelsea Embankment (A3212) may also affect some bus routes and bus journey times along Chelsea Embankment (A3212), Chelsea Bridge (A3216), Chelsea Bridge Road (A3216), Grosvenor Road (A3212) and within the wider area.

12.5.18 The effect on journey times is detailed under the highway operation and network assessment (paras. 12.5.36 to 12.5.48) and would be an increase of a maximum of 16 seconds per PCU in the AM peak hour and 14 seconds per PCU in the PM peak hour compared with that in the construction base case at the junction of Chelsea Bridge Road (A3216), Grosvenor Road (A3212), Chelsea Bridge (A3216) and Chelsea Embankment (A3212). This represents a negligible impact.

12.5.19 It is expected that approximately seven 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 103 buses and 92 buses within a 640m walking distance during the AM and PM peak hours respectively).

12.5.20 Given the distance of London Underground and National Rail stations from the site, if workers using rail services were to finish their journeys to the site by bus, this would increase bus patronage by approximately 55 journeys in each peak hour compared to the base case. However, this would still represent less than one worker trip per bus in both the AM and PM peak hours.

12.5.21 Based on the impact criteria outlined in Vol 2, the additional worker trips made by bus in peak hours would have a negligible impact on bus patronage.

London Underground and National Rail and patronage

12.5.22 No underground or rail stations are directly adjacent to the site and therefore none would be directly affected by the site construction. It is anticipated that approximately 48 construction workers and labourers would use London Underground or National Rail services to access the site which would result in 23 additional person trips on London Underground and 25 additional person trips on National Rail services in each of the AM and PM peak hours.

12.5.23 On both London Underground and National Rail services these additional trips equate to less than one additional trip per train, given the level of service available at local stations in the base case.

12.5.24 Based on the quantitative assessment of patronage and the impact criteria on rail patronage in Vol 2, this would result in a negligible impact on London Underground and National Rail patronage.

River passenger services and patronage

12.5.25 During construction, no river passenger services would be directly affected. It is anticipated that 1% of construction workers and labourers would use the river services to access the construction site, which would result in a maximum of one construction worker per boat service. In accordance with the impact criteria in Vol 2, this would result in a negligible impact on river passenger services due to the low number of additional passenger trips.

River navigation and access

12.5.26 This section addresses the effects on river navigation and access in the vicinity of the Chelsea 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.

12.5.27 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 1 of construction and would be an average of six barge movements a day. Barges would be hauled by tugs which may haul two barges at a time where possible. The number of transit movements required on the river may therefore be lower than the number of individual barge movements.

12.5.28 Due to the low number of barges arriving at the site and based on the impact criteria outlined in Vol 2, it is anticipated that the impact on river navigation in the vicinity of the site as a result of the barge movements at Chelsea Embankment Foreshore would be negligible.

12.5.29 It is noted that a separate *Navigational Issues and Preliminary Risk Assessment* has been undertaken for the temporary construction works and barges to be used at the Chelsea Embankment Foreshore site. This is reported separately outside of the *Environmental Statement* and *Transport Assessment* and accompanies the application.

Parking

12.5.30 Chelsea Embankment (A3212) does not have any on-street car parking available due to TLRN restrictions in the immediate vicinity of the site. There would be no change to on-street parking (resident and pay and display) or private parking in the vicinity of the area as a result of the construction works.

12.5.31 There are ten resident parking bays in the Bull Ring area but there would be no change to these except for a short period of restriction when landscaping works are taking place to the Bull Ring.

12.5.32 With regard to determining the magnitude of impacts, the relevant criteria with respect to the assessment of parking is vehicle parking and loading changes (as set out in Vol 2).

12.5.33 Parking for five essential maintenance vehicles would be provided on site. However, there would be no on-site parking for workers, parking on surrounding streets is restricted and site-specific *Travel Plan* measures would discourage workers from travelling by car to and from the site.

There would therefore be no impact on local parking from construction workers.

12.5.34 As there would be no impact on local parking from construction workers and no change to parking bay provision for the majority of the construction period, the impact on parking would be negligible.

12.5.35 There would be no change to the loading bay on Chelsea Embankment (A3212) to the east of the junction with Royal Hospital Road (B302). This represents a negligible impact.

Highway network and operation

12.5.36 The highway layout during construction (utility diversion phase, phase 1-2 and phase 3) plans (see separate volume of figures – Section 1) shows that the site is on the southern side of Chelsea Embankment (A3212) and would be accessed from the westbound lane. The highway layout during construction vehicle swept path analysis plans (see Chelsea Embankment Foreshore *Transport Assessment* Figures) demonstrates that the construction vehicles would be able to safely enter and leave the site.

12.5.37 During construction phases 1 to 3, an intermittent lane closure (a 3.3m wide lane) would be required on the nearside of the westbound lane of Chelsea Embankment (A3212) to accommodate construction vehicles arriving at and departing from the site. The construction lane would reduce both the eastbound and westbound lanes of general traffic by 1.6m to 4.3m in each direction. One lane per direction would remain open throughout construction.

12.5.38 There would be a gated access for the left-turn in / left turn out movement for construction traffic travelling westbound along Chelsea Embankment (A3212). Construction lorry movements would be limited to the day shift only (08:00 to 18:30 Monday to Friday, 08:00 to 13:30 Saturday). In exceptional circumstances 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 RB of Kensington and Chelsea.

12.5.39 Vol 13 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 this site. The assessment has been 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 Plan*s which are required as part of the *CoCP part A* (Section 5).

Vol 13 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%*	84	0	8	8	0
Other construction vehicle movements**	36	4	4	4	4
Worker vehicle movements***	nominal	0	0	0	0
Total	**120**	**4**	**12**	**12**	**4**

** The assessment has been 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, 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 driving. In practical terms, this would be close to zero.*

12.5.40 An average peak flow of 120 vehicle movements a day is expected during the months of greatest activity during Site Year 3 of construction at this site. At other times in the construction period, vehicle flows would be lower than this average peak figure.

12.5.41 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).

12.5.42 It is anticipated that along Chelsea Embankment (A3212) there would be an additional eight HGV movements per hour as a result of the construction at Chelsea Embankment Foreshore. It is anticipated that there would be no construction traffic from other Thames Tideway Tunnel project sites using this road during Site Year 3 of construction at Chelsea Embankment Foreshore. This and the retention of lane widths of at least 3.25m and typically 4.3m would result in a low adverse impact on accidents and safety. However given that the site access would be directly onto the TLRN, this elevates the accident and safety impact in relation to the highway network to medium adverse.

12.5.43 It is assessed that potentially there would be one hazardous load per fortnight. This equates to a low adverse impact in relation to the number of hazardous loads anticipated to be generated by the site.

12.5.44 The local TRANSYT model has been used to apply the construction traffic demands and local geometrical changes to the construction base case to determine the changes in the highway network and operation due to the project (ie, comparison of base and development cases). The development case traffic flows (providing input to the TRANSYT model) are shown on Vol 13 Figure 12.4.6 and Vol 13 Figure 12.4.7 (see separate volume of figures).

12.5.45 A summary of the construction assessment results for the weekday AM and PM peak is presented in Vol 13 Table 12.5.3 and Vol 13 Table 12.5.4.

12.5.46 The assessment indicates that the junction would already be operating above capacity in the construction base case.

12.5.47 In the construction development case the road network delay during the AM and PM peak hours as a result of the additional construction traffic would be a maximum of 16 seconds per PCU in the AM peak hour on the Chelsea Bridge (A3216) northbound ahead and left movements and a maximum of 14 seconds per vehicle during the PM peak hour on Chelsea Embankment (A3212) eastbound right turn movement and Chelsea Bridge (A3216) northbound ahead and left turn compared with that in the construction base case. A number of movements at this junction would be unaffected.

12.5.48 Overall this would result in a negligible impact, based on the impact criteria identified in Vol 2.

Vol 13 Table 12.5.3 Transport – construction TRANSYT model outputs (AM peak hour)

Approach	Arm	Flow (PCU)	Weekday								
			AM peak hour (08:00-09:00)								
			DoS			MMQ (PCU)			Delay (seconds per PCU)		
			Base case	Devt case	Change	Base case	Devt case	Change	Base case	Devt case	Change
Chelsea Embankment (A3212)	Ahead	629	79%	79%	0%	17	17	0	37	37	0
	Ahead left	372	49%	49%	0%	8	8	0	26	26	0
	Right	238	108%	108%	0%	21	21	0	254	254	0
Grosvenor Road (A3212)	Ahead	492	99%	99%	0%	24	24	0	118	118	0
	Ahead left	462	97%	97%	0%	21	21	0	102	106	+4
Chelsea Bridge Road (A3216)	Ahead	363	39%	39%	0%	4	4	0	11	11	0
	Ahead left	181	23%	23%	0%	2	2	0	11	11	0
Chelsea Bridge (A3216)	Ahead left	861	109%	111%	+2%	67	72	+5	215	231	+16
	Ahead right	546	72%	72%	0%	14	14	0	33	33	0
			PRC						Total delay (PCU hours)		
Overall average delay per PCU			-21%	-23%	-2%				703	718	+15

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. 12.3.24.

Vol 13 Table 12.5.4 Transport – construction TRANSYT model outputs (PM peak hour)

Approach	Arm	Flow (PCU)	Weekday								
			PM peak hour (17:00-18:00)								
			DoS			MMQ (PCU)			Delay (seconds per PCU)		
			Base case	Devt case	Change	Base case	Devt case	Change	Base case	Devt case	Change
Chelsea Embankment (A3212)	Ahead	607	68%	68%	0%	14	14	0	27	27	0
	Ahead / left	337	39%	39%	0%	6	6	0	21	21	0
	Right	321	142%	142%	0%	60	61	+1	618	632	+14
Grosvenor Road (A3212)	Ahead	557	92%	92%	0%	20	20	0	58	57	-1
	Ahead / left	543	93%	94%	+1%	20	21	+1	63	65	+2
Chelsea Bridge Road (A3216)	Ahead	473	115%	115%	0%	48	48	0	304	300	-4
	Ahead / left	278	72%	72%	0%	8	8	0	45	45	0
Chelsea Bridge (A3216)	Ahead / left	715	101%	103%	+2%	36	40	+4	114	128	+14
	Ahead / right	345	51%	51%	0%	8	8	0	30	30	0
			PRC						Total delay (PCU hours)		
Overall average delay per PCU			-58%	-58%	0%				1106	1125	+19

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. 12.3.24.

Significance of effects

12.5.49 The significance of the effects has been determined based on the transport impacts described above, considered in the context of the sensitivity of the receptors identified in Vol 13 Table 12.4.2 and Vol 13 Table 12.4.3.

12.5.50 Vol 13 Table 12.5.5 sets out the effects on each receptor in the vicinity of the site.

Vol 13 Table 12.5.5 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 Chelsea Embankment (A3212)	Major adverse effect on pedestrians Minor adverse effect on cyclists	**Pedestrians:** • High sensitivity • Medium adverse impact on pedestrian delay • High adverse impact on pedestrian amenity and accidents and safety • Due to impacts of high and medium adverse magnitude, equates to major adverse effect **Cyclists:** • High sensitivity • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Due to impacts of negligible and low adverse magnitude, equates to minor adverse effect
Private vehicle users (including taxis) in the area using the local highways or on-street parking	Minor adverse effect on highway users Negligible effect on parking users	**Highway users:** • Medium sensitivity • Negligible impact on road network delay • Medium adverse impact on accidents and safety • Low adverse impact from hazardous loads • Due to negligible, low and medium adverse impact magnitudes, and the sensitivity of the receptor, this equates to a minor adverse effect

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
		Parking users: • Medium sensitivity • Negligible impact on on-street parking • Due to negligible impact, this equates to negligible effect
Emergency vehicles travelling on Chelsea Embankment (A3212).	Minor adverse effect	• High sensitivity • Negligible impact on road network delay • Medium adverse impact on accidents and safety • Low adverse impact from hazardous loads • Due to negligible, low and medium adverse impact magnitudes, and the sensitivity of the receptor, this equates to a minor adverse effect
Marine emergency services	Negligible effect	• High sensitivity • Negligible impact from barge movements • Due to negligible impact, equates to negligible effect
Service vehicles using loading bay on Chelsea Embankment (A3212)	Negligible effect	• Low sensitivity • Negligible impact on loading bay • Due to negligible impact, equates to negligible effect
Bus users (passengers) travelling through Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge Road (A3216) / Chelsea Bridge (A3216) junction.	Negligible effect	• Medium sensitivity • Negligible impact on road network delay and patronage • Due to negligible impacts, equates to negligible effect
River vessel operators	Negligible effect	• Medium sensitivity

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
including river passenger services		• Negligible impact from barge movements • Due to negligible impact, equates to negligible effect
Leisure users of the River Thames	Negligible effect	• High sensitivity • Negligible impact from barge movements • Due to negligible impact, equates to negligible effect
Public transport users using rail or river services within the area	Negligible effect	• Low sensitivity • Negligible impact on patronage • Due to negligible impact, equates to negligible effect
Residents of Embankment Gardens Residents of Chelsea Gardens Residents of Gordon House / the Orangery / Creek Lodge	Major adverse effect on pedestrians Minor adverse effect on cyclists Minor adverse effect on highway users Negligible effect on parking users	**Pedestrians:** • High sensitivity • Medium adverse impact on pedestrian delay • High adverse impact on pedestrian amenity and accidents and safety • Due to impacts of high and medium adverse magnitude, equates to major adverse effect **Cyclists:** • High sensitivity • Negligible impact on cycle delay. • Low adverse impact on accidents and safety. • Due to impacts of negligible and low adverse magnitude, equates to minor adverse effect **Highway users:** • High sensitivity • Negligible impact on road network delay • Medium adverse impact on accidents and safety • Low adverse impact from hazardous

Receptors (relating to all identified transport effects)	Significance of effect	Justification (receptor sensitivity and impacts)
		loads • Due to negligible, low and medium adverse impact magnitudes, and the sensitivity of the receptor, this equates to a minor adverse effect **Parking users:** • Medium sensitivity • Negligible impact on on-street parking • Due to negligible impact, this equates to negligible effect
Users of recreational spaces at Royal Hospital Chelsea (South Grounds) including the Chelsea Flower Show and London Art and Antiques Fair	Minor adverse effect on pedestrians Minor adverse effect on cyclists Minor adverse effect on highway users Negligible effect on parking users	**Pedestrians and cyclists:** • Low sensitivity • Given low sensitivity of this receptor and temporary nature of events, equates to a minor adverse effect on pedestrians and cyclists. **Highway and parking users:** • Low sensitivity • Given low sensitivity of this receptor and temporary nature of events, equates to a minor adverse effect on highway users and negligible effect on parking users.
Operators / visitors at temporary Christmas tree outlet, Bull Ring Gate, South Grounds	Minor adverse effect on pedestrians Minor adverse effect on cyclists Minor adverse effect on highway users Negligible effect on parking users	**Pedestrians and cyclists:** • Low sensitivity • Given low sensitivity of this receptor and temporary nature of use, equates to a minor adverse effect on pedestrians and cyclists **Highway and parking users:** • Low sensitivity • Given low sensitivity of this receptor and temporary nature of use, equates to a minor adverse effect on highway users and negligible effect on parking users.

Sensitivity test for programme delay

12.5.51 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.

12.5.52 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 or cycle route diversions, where required, 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 Chelsea 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 13 Appendix N), it is possible that as a result of a one year delay, some developments which have been assumed to be under construction in this assessment (Chelsea Barracks and Battersea Power Station) would be partially complete and occupied. However, it is not expected that new receptors would experience any different effects to those receptors which have been assessed above; rather it would be a case of the potential for some additional receptors to experience the same effects that have already been identified.

12.6 Operational effects assessment

12.6.1 This section summarises the findings of the assessment undertaken for the Year 1 of operation at the Chelsea 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 instances when 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 highway network as outlined in Section 12.2. This assessment approach has been discussed with RB of Kensington and Chelsea and TfL.

12.6.4 The operational assessment has taken into consideration those elements that would be affected, which comprise the short-term impacts on the highway layout and operation when maintenance visits are made to the site.

Highway layout and operation

12.6.5 During the operational phase, the site would be accessed via Chelsea Embankment (A3212) from the westbound carriageway. The permanent highway layout plan (see separate volume of figures – Section 1) shows the highway layout during the operational phase.

12.6.6 For routine three or six monthly inspections vehicular access would be required for light commercial vehicles, typically a transit van. On occasion there may be a need for flatbed vehicles to access the site.

12.6.7 During ten-yearly inspections, space to locate two large cranes within the site area would be required and the Thames Path may need to be temporarily diverted. The cranes would facilitate lowering and recovery of tunnel inspection vehicles and to provide duty/standby access for personnel. To assess the effect of these on the highway layout, swept paths have been undertaken for the largest vehicles including 11.36m mobile cranes, a 10m rigid vehicle and a 10.7m articulated vehicle. The permanent highway layout vehicle swept path analysis plan (see Chelsea Embankment Foreshore *Transport Assessment* Figures) demonstrates that the maintenance vehicles would be able to safely enter and leave the site.

12.6.8 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.

12.6.9 In accordance with the criteria outlined in Vol 2, during the routine inspections of the operational site, there would therefore be a negligible impact on road network delay.

12.6.10 Taking into consideration the various sensitivities of the receptors affected during the operational phase (private vehicle users, emergency vehicles and bus users on routes in the immediate area), this would result in a **negligible** effect on highway layout and operation.

Sensitivity test for programme delay

12.6.11 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 described in para. 12.3.6, there are no specific cumulative effects to assess as the TfL Highway Assignment Models (HAM) have been developed using GLA employment and population forecasts, which are based on the employment and housing projections set out in the *London Plan 2011* (GLA, 2011)[9]. 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 13 Appendix N), all other developments within 1km of the site would be complete and operational by Year 1 of operation with the exception of later phases of development at Battersea Power Station on the opposite side of the River Thames. However, there is no need for a cumulative assessment on transport and the effects would remain as described in Section 12.5 above. 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 *CoCP* and *Draft Project Framework Travel Plan*, would minimise the effects resulting from construction works at the Chelsea Embankment Foreshore site. This includes the commitment in the *CoCP Part B* (Section 5) for this site to open the riverside footway to public use during weekends. This has been taken into account in the assessment of construction effects which are reported in Section 12.5.

12.8.3 These are the most appropriate measures for this site and it is not possible to mitigate all significant effects.

Operation

12.8.4 No mitigation is required during the operational phase.

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 13 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 Chelsea Embankment (A3212).	• Loss of footway • Pedestrian diversion routes • Increased journey time for pedestrians and cyclists • Movement of large construction vehicles	Major adverse effect on pedestrians. Minor adverse effect on cyclists	None	Major adverse effect on pedestrians. Minor adverse effect on cyclists.
Private vehicle users (including taxis) in the area using the local highways or on-street parking.	• Movement of large construction vehicles • Highway layout changes including highway capacity modifications • Delay to journey time • No effect on on-street parking	Minor adverse effect on highways users Negligible effect on parking users	None	Minor adverse effect on highway users Negligible effect on parking users
Emergency vehicles travelling on Chelsea Embankment (A3212).	• Movement of large construction vehicles • Highway layout changes including highway capacity modifications • Delay to journey time	Minor adverse effect	None	Minor adverse effect
Marine emergency services	• Additional barge movements in the vicinity of the Chelsea Embankment Foreshore site	Negligible effect	None	Negligible effect
Service vehicles using loading bay on Chelsea Embankment (A3212)	• No effect on loading bay	Negligible effect	None	Negligible effect
Bus users (passengers) travelling through	• Movement of large construction vehicles • Highway layout changes including highway	Negligible effect	None	Negligible effect

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge Road (A3216) / Chelsea Bridge (A3216) junction.	capacity modifications • Delay to journey time			
River vessel operators including river passenger services	• Additional barge movements in the vicinity of the Chelsea Embankment Foreshore site	Negligible effect	None	Negligible effect
Leisure users of the River Thames	• Additional barge movements in the vicinity of the Chelsea Embankment Foreshore site	Negligible effect	None	Negligible effect
Public transport users using rail or river services within the area	• Some additional patronage from construction workers	Negligible effect	None	Negligible effect
Residents of Embankment Gardens Residents of Chelsea Gardens Residents of Gordon House / the Orangery / Creek Lodge	• Loss of footway • Pedestrian diversion routes • Movement of large construction vehicles • Highway layout changes including junction modifications. • Delay to journey time	Major adverse effect on pedestrians Minor adverse effect on cyclists Minor adverse effect on highway users Negligible effect on parking users	None	Major adverse effect on pedestrians Minor adverse effect on cyclists Minor adverse effect on highway users Negligible effect on parking users
Users of recreational spaces at Royal Hospital Chelsea (South	• Loss of footway • Pedestrian diversion routes	Minor adverse effect on pedestrians	None	Minor adverse effect on pedestrians an Minor adverse effect

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Grounds) including the Chelsea Flower Show and London Art and Antiques Fair Operators / visitors at temporary Christmas tree outlet, Bull Ring Gate, South grounds	• Movement of large construction vehicles • Highway layout changes including junction modifications • Delay to journey time	Minor adverse effect on cyclists Minor adverse effect on highway users Negligible effect on parking users		on cyclists Minor adverse effect on highway users Negligible effect on parking users

Vol 13 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.	Negligible effect	None	Negligible effect
Emergency vehicles travelling on Chelsea Embankment (A3212).	• Occasional maintenance trips resulting in some temporary, short-term road network delay.	Negligible effect	None	Negligible effect
Bus users (passengers) travelling along Chelsea Embankment (A3212) / Grosvenor Road (A3212) / Chelsea Bridge Road (A3216) / Chelsea Bridge (A3216) junction.	• Occasional delay to bus users when large maintenance vehicles accessing site	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,* 2011.

[3] Transport for London, *Assessment Tool for Travel Plan Building Testing and Evaluation (ATTrBuTE)*, 2011. Available at: http://www.attrbute.org.uk/

[4] Defra. 2012, See citation above.

[5] Greater London Authority, *London Plan*, 2011.

[6] Transport for London, *Transport Assessment Best Practice Guidance,* 2010.

[7] 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.

[8] Transport for London, *London Underground Upgrade Plan,* 2011. Available at: http://www.tfl.gov.uk/assets/downloads/corporate/our-upgrade-plan-london-underground-february-2011.pdf

[9] Greater London Authority, 2011. See citation above.

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 13: Water resources - groundwater

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

Hard copy available in

Box **27** Folder **A**
January 2013

Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 13: Water resources – groundwater

List of contents

Page number

List of tables

Page number

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 Chelsea Embankment Foreshore site.

13.1.2 The proposed development has the potential to affect groundwater due to:

a. use of grout/ground treatment to control ingress of water

b. creation of pathways for pollution

c. obstruction to groundwater flows

d. seepage into and out of the CSO drop shaft during operations.

13.1.3 This groundwater assessment at this site should be read in conjunction with the supporting Volume 13 Appendix K (K.1 – K.9) and the land quality assessment (see section 8 of this volume).

13.1.4 The site is underlain by thick layer of London Clay Formation, which is relatively impermeable. Construction would extend down a short distance into the low permeability Lambeth Group. No dewatering of the upper aquifer would be required at the Chelsea Embankment Foreshore site and instead the groundwater in the River Terrace Deposits (upper aquifer) would be cut off using a jacked caissoni and secant or sheet piles[ii]. Depressurisation[iii] of the top of the Lambeth Group would be required to avoid minor seepages and inflows of groundwater during the construction of shaft and base slab. There would be no effects on the lower aquifer because of the separation distance between the base of the shaft and the lower aquifer and therefore this aquifer has been 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).

---

[i] Caisson –a watertight chamber, open at the bottom from which the water is kept out by air pressure and in which construction work may be carried out under water.

[ii] Secant or sheet piles – alternate piles in-filled with concrete to form a water-tight retaining wall.

[iii] Depressurisation – a term used to describe dewatering or lowering of hydraulic pressures in a confined aquifer.

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 13 Chelsea Embankment Foreshore Figures).

13.1.8 Two options have been considered for the foreshore: Option A would be an area of intertidal habitat and Option B would be a floodable public realm. Both options would not alter the assessment of likely significant effects on ground water as they would not impact on groundwater resources at the Chelsea Embankment Foreshore site. The options are therefore not presented or reported separately for this topic.

13.2 Proposed development relevant to groundwater

13.2.1 The proposed development is described in Section 3 Proposed development of this volume. The elements of the proposed development relevant to groundwater are set out below.

Construction

13.2.2 The elements of construction at the Chelsea Embankment Foreshore site, relevant to groundwater, would include:

a. A combined sewer overflow (CSO) drop shaft approximately 12m internal diameter (ID) and approximately 46m deep to invert (based on 59.96mATD[iv] from an assumed ground level of 105.4mATD).

b. A permanent structure in the foreshore encompassing the CSO drop shaft and interception structures, and surrounded by a new river wall.

c. An interception chamber on the Ranelagh CSO outfall and a connection culvert and valve chamber to divert the flows to the CSO drop shaft.

d. An overflow chamber on the northern Low Level Sewer No. 1 and a connection culvert and valve chamber to divert flows to the CSO drop shaft.

e. A short connection tunnel, connecting the CSO drop shaft to the main tunnel.

13.2.3 The proposed methods of construction for these elements of the Chelsea Embankment Foreshore site are summarised in Vol 13 Table 13.2.1 below. Approximate duration of construction and depths are also contained in this table.

[iv] 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.

Vol 13 Table 13.2.1 Groundwater – methods of construction

Design element	Method of construction	Construction periods (years)*	Construction depth**
CSO drop shaft	Jacked caisson as far as possible into London Clay Formation.	<1	Deep
	Underpinning techniques for lower portion of CSO drop shaft, with depressurisation in Lambeth Group.		
Interception chambers and connection culverts	Secant or sheet piles	>1	Shallow
Connection tunnel (from the CSO drop shaft to the main tunnel)	Sprayed concrete lining	<1	Deep

** The site would be used for construction purposes for up to 5 years*
***In terms of construction depth – shallow (<10m) and deep (>10m).*

Code of Construction Practice

13.2.4 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 (Part A)* 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 dewatering from excavations to prevent silty water from entering watercourses, surface water drains and onto roads as per Environment Agency (EA) guidelines[2]. The contractor would have plans and equipment in place to deal with emergency 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 thought to be at risk.

c. Monitoring arrangements for dewatering permits and 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. The use of any materials for ground treatment would be agreed with the EA prior to use.

e. 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.

13.2.5 There are no site specific groundwater measures contained with the *CoCP Part B*.

Other measures during construction

13.2.6 The depth of the CSO drop shaft means that it would extend down into the lower part of the London Clay Formation, unit A2 and the base slab would extend down into the Upper Shelly Beds of the Lambeth Group (see Vol 13 Appendix K.1). Below the London Clay formation the Harwich Formation and Lambeth Group are expected to contain confined[v] groundwater bodies.

13.2.7 For the purpose of this assessment no dewatering of the upper aquifer is anticipated to be required. Instead, the construction of the CSO drop shaft would involve jacking (pressing) a ‘ring’ made up of concrete segments into the ground to form the shaft and to provide cutoff of the River Terrace Deposits and any minor groundwater inflows from the London Clay Formation. The shaft would then be excavated progressively as the segments are jacked into the ground. This form of construction is known as caisson shaft construction.

13.2.8 Once the segments extend far enough into the clay to provide a cut-off, the shaft would be constructed using underpinning techniques, whereby the shaft is progressively excavated and the linings are installed from within the shaft and connected to the previous ring above. To prevent possible inundation of the CSO drop shaft by groundwater from the Harwich Formation and the Lambeth Group, the Lambeth Group would be depressurised. Vacuum ejector wells[vi] would be drilled into the Lambeth Group around the outside of the jacking collar of the shaft and pumped to locally lower the water pressure in the Lambeth Group. Pumps would be placed in the wells and groundwater would be extracted and discharged directly to the River Thames on site, following any necessary treatment and subject to EA approval. The duration of pumping would be determined by ground conditions and groundwater volumes encountered; however, this is likely to be less than one year; the time required to build and excavate the shaft and connection tunnel. An estimate of the average dewatering needed at Chelsea Embankment Foreshore site is less than $200m^3/d$.

[v] Confined – a term used to describe an aquifer in which water is held under pressure, such that groundwater in a borehole penetrating a confined aquifer would rise to a level above the top of the aquifer

[vi] Vacuum ejector well – a low volume dewatering system.

13.2.9 The separation distance between the base slab and the top of the lower aquifer (comprising of the Upnor Formation at the base of the Lambeth Group) is approximately 13m and contains intervening aquitards[vii]. Due to the separation distance and intervening aquitards no depressurisation of the lower aquifer is anticipated to be required, and this is assumed for the purposes of this assessment.

13.2.10 The CSO drop shaft would be constructed with a primary lining of precast concrete segmental shaft linings, installed by caisson and underpinning techniques as describe above, and a cast in-situ secondary lining. Ground treatmentviii such as groutingix is anticipated to be required to further reduce inflows into the CSO drop shaft base, the connection tunnel and for the interception works to the low level sewer. For the purpose of this assessment no further ground treatment has been assumed.

Operation

13.2.11 A groundwater monitoring strategy is one of the project's environmental design measures (see Vol 3 Appendix K.1). This covers groundwater levels and groundwater quality, and would outline the future monitoring and actions in the event of trigger levels being exceeded.

13.3 Assessment methodology

Engagement

13.3.1 Vol 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 Chelsea 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 Chelsea Embankment Foreshore site given the hydrogeological setting and the method of construction used (see para. 13.1.4).

[vii] Aquitard – a poorly-permeable geological formation that does not yield water freely, but may still transmit significant quantities of water to or from adjacent aquifers a geological formation through which virtually no water moves.

[viii] Ground treatment – stabilisation of soils/rocks by injection of grouts and or freezing techniques.

[ix] Grouting – a thin, coarse mortar poured into various narrow cavities, such as rock fissures, to fill them and consolidate the adjoining objects into a solid mass.

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 the caisson and secant / sheet pile walls could obstruct groundwater flows with small-scale pumping from within the secant pile walls and towards the end of that year when depressurisation of Lambeth Group would be required. The baseline is not anticipated to change substantially between 2011 and Site Year 1 of construction (2017) and so baseline data from 2011 have formed the basis (base case) for the construction assessment

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 included in the cumulative effects assessment are presented in Vol 13 Table 13.3.1 below. The developments relevant to groundwater are those which contain basements and underground structures, GSHP's and Sustainable Drainage Systems (SuDS).

Vol 13 Table 13.3.1 Groundwater – construction base case and cumulative assessment developments (2017)

Development	Component or receptor relevant to groundwater	Construction base case	Cumulative effect assessment
Royal Hospital, Royal Hospital Road	None	✗	✗
Bullring Gate, South Grounds, Royal Hospital	None	✗	✗
South Grounds, Royal Hospital	None	✗	✗
Chelsea Barracks Chelsea Bridge Road London	Basement*	✗	✓
Battersea Power Station	Basement* SuDS* Licensed abstraction** (28/39/42/0074)	Phase 1 and Phase 2 complete	Phase 3 under construction
Riverlight, Tideway Industrial Estate	Basement* GSHP**	Blocks B, C, D, E and F complete	Block A under construction

Development	Component or receptor relevant to groundwater	Construction base case	Cumulative effect assessment
Northern Line Extension	Underground structures*	✗	✓

** Relevant to the upper aquifer*
*** Relevant to the lower aquifer*
Symbols ✓ applies ✗ does not apply

13.3.8 Section 13.5 details the likely significant effects arising from the construction at the Chelsea Embankment Foreshore site. Other nearby Thames Tideway Tunnel project sites which could give rise to additional effects on groundwater resources are Kirtling Street Pumping Station, and Blackfriars Bridge Foreshore. These Thames Tideway Tunnel project sites are therefore included in this assessment.

Operation

13.3.9 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 the Chelsea Embankment Foreshore site.

13.3.10 The assessment year applied to the operational assessment is Year 1 of operation. The baseline is not anticipated to vary significantly before the start of the operational phase in 2023; and therefore, baseline data from 2011 has 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.

13.3.11 The developments considered as part of the operational base case and the cumulative effects assessment is included in Vol 13 Table 13.3.2 below. The developments relevant to groundwater are those which would contain basements and underground structures, GSHPs and Sustainable Drainage Systems (SuDS).

Vol 13 Table 13.3.2 Groundwater – operational assessment (2023)

Development	Component or receptor relevant to groundwater	Operational base case	Cumulative effect assessment
Royal Hospital, Royal Hospital Road	None Licensed abstraction** (28/39/39/0225)	✗	✗
Bullring Gate, South Grounds, Royal Hospital	None Licensed abstraction** (28/39/39/0225)	✗	✗
South Grounds, Royal	None	✗	✗

Development	Component or receptor relevant to groundwater	Operational base case	Cumulative effect assessment
Hospital	Licensed abstraction** (28/39/39/0225)		
Chelsea Barracks Chelsea Bridge Road London	Basement*	✓	✗
Battersea Power Station	Basement* SuDs* Licensed abstraction** (28/39/42/0074)	Phase 1, 2, 3, 4 and 5 complete	Phase 6 and 7 under construction
Riverlight, Tideway Industrial Estate	Basement* GSHP**	✓	✗
Northern Line Extension	Underground structures*	✓	✗

** Relevant to the upper aquifer*
*** Relevant to the lower aquifer*
Symbols ✓ applies ✗ does not apply

13.3.12 Section 13.6 details the likely significant effects arising from the operation at the Chelsea 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

13.3.13 The construction assumptions relevant to this site are presented in Section 13.2.

13.3.14 For the purpose of assessment, the average amount of pumping required from outside of the shaft periphery at the Chelsea Embankment Foreshore site has been estimated at less than 200m^3/d.

13.3.15 The assessment of obstruction effects in Sections 13.5 and 13.6 is based on estimated hydraulic gradient[x] 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).

[x] Hydraulic gradient – the slope of the water table which drives groundwater movement.

13.3.17 It has been assumed that the separation distance of approximately 13m between the base of the CSO drop shaft and the lower aquifer is sufficient so that depressurisation of the lower aquifer would not be required at this site.

13.3.18 Groundwater movement in the upper aquifer is to the south towards the River Thames at this site.

13.3.19 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.

13.3.20 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

13.3.21 No site-specific pumping tests have yet been undertaken as part of the ground investigation. In the absence of site-specific hydrogeological data, published sources of hydrogeological information have been used in this assessment (see Vol 13 Appendix K.2).

13.3.22 Groundwater level data available to for this assessment is limited, with monitoring data available from two boreholes within the upper aquifer. This has meant that hydraulic gradients have only 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 within the upper aquifer.

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 assessments is supported by Vol 13 Appendix K (K.1 – K.9).

Current baseline

Hydrogeology

13.4.3 The CSO drop shaft would pass through Alluvium, River Terrace Deposits, and London Clay Formation. The base slab would pass through the Harwich Formation and be founded in the Upper Shelly Beds of the Lambeth Group. The superficial and solid geology in the vicinity of the site, as published by the British Geological Survey (BGS)[3], is shown in Vol 13 Figure 13.4.1 and Vol 13 Figure 13.4.2 respectively (see separate volume of figures).

13.4.4 The River Terrace Deposits form the upper aquifer and are classified by the EA as a secondary A aquifer[xi]. The Upnor Formation, Thanet Sands and Chalk form the lower aquifer and are classified by the EA as a principal aquifer[xii]. The London Clay Formation is expected to act as a confining layer between these two aquifers at the Chelsea Embankment Foreshore site. The Harwich Formation is expected to be water-bearing and to contain groundwater under pressure. In addition, the Lambeth Group is expected to contain several confined groundwater bodies, such as in the Upper Shelly Beds.

13.4.5 The depths and thicknesses of the geological layers have been determined by reference to six ground investigation boreholes located within 300m from the Chelsea Embankment Foreshore site: SR1087A, PR1088A, SR1089, PR1090, SR2067 and SR2068. The depths and thicknesses of geological layers encountered are summarised in Vol 13 Table 13.4.1.

Vol 13 Table 13.4.1 Groundwater – anticipated ground conditions/ hydrogeology

Formation	Top elevation* (mATD)	Depth below river bed (m)	Thickness (m)	Hydrogeology
Alluvium	100.0	0.0	1.4	Confining layer
River Terrace Deposits	98.6	1.4	2.85	Upper aquifer
London Clay				Aquiclude[xiii]
B	95.75	4.25	12.75	
A3ii	83.00	17.00	10.60	
A3i	72.40	27.60	2.90	
A2	69.50	30.50	11.10	
Harwich	58.4	41.60	0.10	Aquitard[vii]/ aquifer
Lambeth Group				Aquitards
USB	58.30	41.70	2.40	
UMB	55.90	44.10	5.70	

** Based on an assumed ground level of 105.4mATD and top elevation of over-water boreholes is approximately 5.4m below assumed ground level.*

[xi] Secondary aquifer – Either permeable strata capable of supporting local supplies or low permeability strata with localised features such as fissures (was previously preferred to as a minor aquifer).

[xii] Principal aquifer – a geological stratum that exhibits high inter-granular and /or fracture permeability (was previously referred to as a major aquifer)

[xiii] Aquiclude – a hydrogeological unit which, although porous and capable of storing water, does not transmit it at rates sufficient to furnish an appreciable supply for a well or spring.

USB–Upper Shelly Beds; UMB–Upper Mottled Beds.

Groundwater level monitoring

13.4.6 Groundwater level monitoring has been undertaken at a number of boreholes across the assessment area. The EA has a regional network of monitoring boreholes, mainly within the lower aquifer, across London, but unfortunately none are found in the vicinity of the Chelsea Embankment Foreshore site.

13.4.7 Information on groundwater levels for this assessment was collected from three off site ground investigation boreholes located within 300m of the Chelsea Embankment Foreshore site (PR1088A, SR1091 and SR1089). The locations of these boreholes around the site are shown in Vol 13 Figure13.4.3 (see separate volume of figures). These boreholes have response zones[xiv] in the River Terrace Deposits (PR1088A and SR1091) and in the Upper Shelly Beds (SR1089) and are monitoring groundwater levels in the upper aquifer and the underlying aquitard. The average, minimum and maximum recorded water levels are detailed in Vol 13 Table 13.4.2.

Vol 13 Table 13.4.2 Groundwater – recorded water levels

Monitoring borehole ID	Formation	Maximum (mATD)	Minimum (mATD)	Average over the period of record (mATD)
PR1088A	River Terrace Deposits	99.60 (June 2011)	98.76 (Nov. 2011)	99.20
SR1091	River Terrace Deposits	99.84 (Oct. 2010)	99.27 (Mar. 2012)	99.57
SR1089	Harwich Formation/ Upper Shelly Beds	84.44 (Feb. 2011)	80.59 (Nov. 2011)	82.91

13.4.8 Of the two monitoring boreholes within the River Terrace Deposits, the monitoring borehole SR1091 is closest to the Chelsea Embankment Foreshore site (at 280m) and therefore considered to be the most representative of groundwater level conditions in the River Terrace Deposits at the site. The recorded water levels in the River Terrace Deposits here range from 99.27 to 99.84mATD. These water levels consistently remain above the top of the formation at 98.6mATD, suggesting that this unit is fully saturated and confined by the overlying Alluvium at this location.

13.4.9 The recorded water levels (piezometric head) in the Harwich Formation/ Upper Shelly Beds range from 80.59 to 84.44mATD. These levels

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

consistently remain above the top of the Harwich Formation at 58.4mATD, suggesting that these units are fully saturated and are confined by the overlying London Clay Formation.

13.4.10 A plot of groundwater levels within the River Terrace Deposits or upper aquifer in the vicinity of the site is shown in Vol 13 Figure13.4.3 (see separate volume of figures). The two monitoring boreholes close to the site are parallel and in close proximity to the River Thames and as such it is difficult to determine the direction of groundwater flow. However it is expected that the direction of groundwater movement is with topography to the south in these shallow deposits. Further detail on water level monitoring is provided in Vol 13 Appendix K.3.

Licensed groundwater abstractions

13.4.11 There is one licensed groundwater abstraction from the River Terrace Deposits or upper aquifer located within 1km of the Chelsea Embankment Foreshore site.

13.4.12 The nearest licensed groundwater abstraction from the upper aquifer (28/39/39/0225) is located approximately 140m northeast of the Chelsea Embankment Foreshore site. A capture zone[xv] for this source, estimated using licence information (see Vol 13 Appendix K.4), remains at approximately 75m from the permanent foreshore structure. This source is not anticipated to be impacted by construction or operation at the Chelsea Embankment Foreshore site as no dewatering of the upper aquifer is anticipated to be required and the excavations would be sealed by the jacked caisson and secant pile walls.

13.4.13 The licensed abstractions from the lower aquifer (Chalk) would be unaffected due to construction taking place entirely within the upper aquifer, the London Clay Formation and the Upper Shelly Beds (Lambeth Group).

13.4.14 There are no known unlicensed groundwater abstractions located within 1km of the site.

Groundwater source protection zones

13.4.15 The Chelsea Embankment Foreshore site does not lie within a modelled Source Protection Zone (SPZ). The nearest SPZ lies at approximately 0.2km to the southeast and is designated to safeguard the Chalk (lower aquifer) from potentially polluting activities.

Environmental designations

13.4.16 There are no designations relevant to groundwater within 1km of the site.

Groundwater quality and land quality

13.4.17 Historical land use mapping, reviewed as part of the land quality assessment, identified no potentially contaminative land uses at the

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

Chelsea Embankment Foreshore site (see Vol 13 Appendix K.7 and Vol 13 Section 8).

13.4.18 The baseline groundwater quality data presented in Vol 13 Appendix K.7, Vol 13 Table K.7 has been sourced from the ground investigation and monitoring works undertaken as part of the Thames Tideway Tunnel project and includes data from monitoring boreholes located off site and within 1km (SR1091, PR1088, PR1094, SA1084) (for locations see Vol 13 Figure13.4.1 in the separate volume of figures). The data has been compared with the UK drinking water standards (The Water Supply Regulations, 2000)[4] or relevant Environmental Quality Standards (EQS) (River Basin Districts Typology, 2010)[5].

13.4.19 The data shows several exceedances of the relevant standards, including for ammonia, chloride, sodium, pesticides and turbidity at PR1088 (within 310m of the site), for heavy metals, polycyclic aromatic hydrocarbons (PAH's) and phenols at PR1094 (within 840m of the site) and for heavy metals and hydrocarbons at SA1084 (approximately 1km from the site). Further details on these contaminants are provided in Vol 13 Appendix K.7.

13.4.20 The EA monitors groundwater quality at a number of points across London. The nearest EA monitoring is at Dolphin Square at approximately 1km from the Chelsea Embankment Foreshore site. However this borehole monitors water quality in the lower aquifer only and is therefore not relevant as construction would take place entirely with the upper aquifer, the London Clay Formation and the Upper Shelly Beds (Lambeth Group).

13.4.21 The land quality data from the ground investigation boreholes used in the groundwater quality assessment show several exceedances of the human health screening values (EA, 2009)[6] (soil guideline values designed to be protective of human health) with respect to hydrocarbons and heavy metals within the River Terrace Deposits. Further detail is provided in the land quality assessment (see Vol 13 Appendix F).

Groundwater flood risk

13.4.22 There are no reported incidences of groundwater flooding in the vicinity of the site, based on information from the Royal Borough (RB) of Kensington and Chelsea Strategic Flood Risk Assessment (SFRA) (JBA and Entec, 2009)[7].

Groundwater receptors

13.4.23 Groundwater receptors which could be affected during construction or operation are summarised in Vol 13 Table 13.4.3 below. It can be seen that the only receptor of relevance to the Chelsea Embankment Foreshore site and which has therefore been assessed, is the upper aquifer.

Vol 13 Table 13.4.3 Groundwater – receptors

Receptor	Construction	Operation	Comment
Groundwater Body – Upper	✓	✓	Penetrated by CSO drop shaft, interception

Receptor	Construction	Operation	Comment
Aquifer			chambers & culverts
Groundwater Body – Lower Aquifer	×	×	CSO drop shaft does not extend into lower aquifer
Licensed abstractions– lower aquifer	×	×	Not impacted as no construction within the lower aquifer
Licensed abstractions – upper aquifer	×	×	Two abstractions, not impacted as no dewatering
Unlicensed abstractions	×	×	No known unlicensed abstractions within 1km radius of site
Planned developments and abstractions	×	×	Two licensed abstractions from lower aquifer

Note: Symbols ✓ applies × does not apply

Receptor sensitivity

13.4.24 The upper aquifer is classified by the EA as a secondary A aquifer and is allocated a medium value in terms of both quantity and quality in this assessment.

Construction base case

13.4.25 The construction base case in Site Year 1 is as per the current baseline and also includes any developments that are likely to be complete and partially or fully operational during construction at the Chelsea Embankment Foreshore site, and which would have the potential to lead to a change in the setting in respect to groundwater in the upper aquifer.

13.4.26 The basements associated with other developments identified in Vol 13 Table 13.3.1 could cause some disruption to groundwater flow in the upper aquifer. Any substantive changes from baseline conditions prior to construction would be detected by monitoring of groundwater levels in the upper aquifer.

13.4.27 The lower aquifer would not be impacted by the developments identified in Vol 13 Table 13.3.1 and it can be concluded that there would be no change to the base case in Site Year 1 of construction. These developments are therefore not considered any further in this assessment.

Operational base case

13.4.28 The operation base case is as per the construction base case. Therefore, it can be concluded that there would be no change to the base case at the start of operation.

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 Chelsea Embankment Foreshore site shows several exceedances of the relevant standards, including for ammonia, chloride, sodium, pesticides and turbidity at PR1088 (within 310m of the site), for heavy metals, polycyclic aromatic hydrocarbons (PAH's) and phenols at PR1094 (within 840m of the site) and for heavy metals and hydrocarbons at SA1084 (approximately 1 km from the site). The CSO drop shaft construction would be tight with the ground and there would be no dewatering of the upper aquifer. Therefore, there would be no potential for mobilisation of contamination at this site. The magnitude of this impact on the upper aquifer is assessed to be negligible.

13.5.2 Grouting would be required for interception works to the low level sewer around the annulus of the outside of the shaft for the interception works in the River Terrace Deposits and for the connection tunnel at the shaft base in the London Clay Formation, unit 2. Only the grouting in the River Terrace Deposit has been assessed here. Grouting in other geological layers would not have any impact on the upper aquifer. The sheet piling to be constructed around the CSO drop shaft excavation would ensure that no grout would enter into the upper aquifer. The magnitude of the impact on the upper aquifer is assessed to be negligible.

Physical obstruction

13.5.3 The construction of certain sub-surface structures on shore may disrupt local groundwater flows and alter groundwater levels within the upper aquifer.

13.5.4 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 the groundwater levels would rise during the construction phase at Chelsea Embankment Foreshore site by approximately 0.2m, based on an estimated hydraulic gradient of 0.004.

13.5.5 Based on the limited available data, groundwater levels in the upper aquifer (River Terrace Deposits) can reach 99.84mATD, which is approximately 5.6m below the existing ground surface at Chelsea Embankment Foreshore site (around 105.4mATD). However these water levels are confined and piezometric[xvi]. Therefore the small predicted rise in water levels (0.2m) on the north side of the Chelsea Embankment Foreshore site would result in increased pressure within the River Terrace Deposits rather than actual increased water levels (see explanation in Vol 2 Appendix K.2). This would result in a negligible impact on the upper aquifer.

[xvi] Piezometric – this is level to which water would rise to if there is a free surface open to the atmosphere.

Construction effects

13.5.6 By combining the impacts above with the receptor value, 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

13.5.7 A negligible impact on a medium value receptor, the upper aquifer for groundwater quality, would lead to a **negligible** effect.

13.5.8 Grouting would be required in the upper aquifer. A negligible impact on a medium value receptor, from the creation of pathways, would lead to a **negligible** effect.

Physical obstruction

13.5.9 The physical impact of all below ground activities upon the local groundwater levels is considered negligible. A negligible impact on the upper aquifer, a medium value receptor, would result in a **negligible** effect.

13.6 Operational effects assessment

Operational impacts

Physical obstruction

13.6.1 The presence of the CSO drop shaft, interception chamber and connection culvert in the upper aquifer may disrupt groundwater flow and alter groundwater levels.

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 operation phase at Chelsea Embankment Foreshore site by less than 0.1m, based on an assumed hydraulic gradient of 0.004.

13.6.3 Groundwater levels in the upper aquifer can reach 99.84mATD, which is approximately 5.6m below the existing ground surface at Chelsea Embankment Foreshore site. Given the small predicted rise in water levels (less than 0.1m) on the northern side of the structure and that the water levels in the upper aquifer are confined, the magnitude of this impacts has been assessed as negligible.

Seepage into CSO drop shaft

13.6.4 An estimate of the theoretical seepage volumes into the drop shaft at Chelsea Embankment Foreshore site is included in Vol 2 Appendix K.3. The estimated loss of water resources from the upper aquifer into the shaft would be 25m^3/annum (Vol 2 Appendix K, Vol 2 Table K.4) and 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 Chelsea 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 CSO drop shaft into the upper aquifer is 1.2m^3/annum (Vol 2 Appendix K, Vol 2 Table K.5). The higher heads outside the CSO drop shaft 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.

13.6.6 No other operational impacts are envisaged.

Operational effects

13.6.7 By combining the receptor value (para. 13.4.24) with the impacts above, the significance of the effects can be derived using the generic significance matrix (Vol 2 Section 2). The results are shown in the following sections.

Physical obstruction

13.6.8 Altering groundwater levels on the north side of the CSO drop shaft would be a negligible impact on a medium value receptor (upper aquifer), and would lead to a **negligible** effect.

Seepage into CSO drop shaft

13.6.9 Seepage of groundwater from the upper aquifer into the CSO drop shaft has been determined as a negligible impact on groundwater resources in the upper aquifers. This negligible impact on a medium value receptor, the upper aquifer for groundwater quantity, would lead to a **negligible** effect.

Seepage from CSO drop shaft

13.6.10 The impact from seepage from the CSO drop shaft on groundwater quality in the upper aquifer has been determined as a negligible impact. This negligible impact on a medium value receptor, the upper aquifer for groundwater quality, would lead to **negligible** effect.

13.7 Cumulative effects assessment

Construction effects

13.7.1 Two developments have been identified in Vol 13 Table 13.3.1 which could give rise to cumulative effects on groundwater through the inclusion of basements in the upper aquifer. It is considered that although there may be a local impact on the confined groundwater levels in the upper aquifer due to these developments, the impacts are not expected to be significant because in a majority of cases the developments are located a long distance away from the CSO site and down the hydraulic gradient, within the upper aquifer. The presence of confinement by an overlying layer of Alluvium and Made Ground, means that a build of pressure would result (not a physical rise in groundwater levels) as a result of any obstruction. Any substantive changes to the baseline conditions prior to construction would be detected by monitoring of groundwater levels in the upper aquifer.

Operational effects

13.7.2 One development has been identified in Vol 13 Table 13.3.2 which could give rise to cumulative effects on groundwater through the inclusion of a basement in the upper aquifer. It is considered that, although there may be an impact on the confined groundwater levels in the upper aquifer due to this development. The impact is not expected to be significant because of the distance of the development, which is 470m from the CSO site and also down the hydraulic gradient, within the upper aquifer.

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 therefore no mitigation is required.

13.8.2 For the operational phase, no significant effects are identified 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 13 Table 13.10.1 Groundwater – construction assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Upper aquifer (groundwater quality)	Deterioration in groundwater quality caused by creation of a pathway	Negligible	None	Negligible
	Deterioration in groundwater quality caused by grouting	Negligible	None	Negligible
Upper aquifer	Change in groundwater storage as a result of physical obstruction in upper aquifer	Negligible	None	Negligible

Vol 13 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 CSO drop shaft affecting groundwater resources	Negligible	None	Negligible
Upper aquifer	Deterioration in water quality in the upper aquifer from seepage out of CSO drop 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] *The Water Supply (Water Quality) Regulations* (2000). Available at: http://www.legislation.gov.uk/uksi/2000/3184/contents/made.

[5] *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/.

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

[7] JBA and Entec. *Strategic Flood Risk Assessment for the RB of Kensington and Chelsea Final Report* (Aug 2009).

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 14: Water resources - surface water

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 14: Water resources – surface water

List of contents

Page number

List of plates

Page number

List of tables

Page number

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 Chelsea 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.

14.1.2 The proposed development has the potential to affect surface water resources (ie, surface waterbodies including the tidal 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 surface 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 the residual effects both during construction and operation.

14.1.4 Two options have been considered: Option A is inter-tidal habitat or floodable public realm whereas Option B involves floodable public realm only. Both options involve construction within the inter-tidal area and the two would have the same impact/effect on surface water resources. The options are therefore not presented or reported separately for this topic.

14.1.5 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 addressed in Section 8. Effects on aquatic ecology are assessment 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.

14.1.6 This assessment covers the effects of the proposed development at the Chelsea Embankment Foreshore site and in particular in relation to the interception of the Ranelagh combined sewer overflow (CSO). It is however important to recognise that whilst the reduction in spills from the Ranelagh 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 in relation to the water quality improvements anticipated from the proposed Thames Tideway Tunnel project are assessed separately and presented in Volume 3 Project-wide effects assessment Section 14.

14.1.7 Plans of the proposed development as well as figures included in the assessment for this site are contained in a separate volume (Volume 13 Chelsea Embankment Foreshore Figures).

14.2 Proposed development relevant to surface water

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 Chelsea Embankment Foreshore site is partly located within the River Thames channel, which means that some of the proposed working area would be within the river bed. A temporary cofferdam would be constructed in the foreshore to enable construction of the permanent works site (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 tunnelling. In order to facilitate the use of barges, a campshed would be constructed adjacent to the working area.

14.2.4 A CSO drop shaft would be constructed at the site. Based on the geology at the site, it is not anticipated that extensive dewatering and or ground treatment would be required, although depressurisation (a form of dewatering) would be required in the Lambeth Group. See Section 13 of this volume for further details on the dewatering requirements.

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 the Chelsea Embankment Foreshore site from the Ranelagh CSO. There would therefore be a reduction in the frequency, duration and volume of spills from this CSO. In addition, a connection would be made to the northern Low Level Sewer No. 1 to control flows from other CSOs along the embankment.

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 parameter plan for the 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

---

[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)

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 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 project to assess 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 Section 14. A WFD assessment for the project as a whole is presented in Vol 3 Appendix L.2.

Engagement

14.3.2 Vol 2 documents the overall engagement which has been undertaken in preparing the *Environmental Statement*. Vol 2 Section 14 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 Chelsea Embankment Foreshore site.

Baseline

14.3.4 The baseline methodology follows the methodology described in Vol 2 Section 14. 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 Section 14. 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 Site 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 Section 14. 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 considered the developments that are scheduled to be complete and in operation by Site Year 1 (presented in Vol 13 Appendix N). The developments in Vol 13 Appendix N would not result in additional surface water receptors (ie, waterbodies) and are considered unlikely to result in changes in water quality as these developments are remote from the tidal Thames. The base case would therefore not change from that outlined above. The effects of construction activities at Chelsea Embankment Foreshore site would be limited to two sections of the river, namely the Thames Upper and Thames Middle waterbodies listed below in Vol 13 Table 14.4.1 below.

14.3.9 Section 14.5 details the likely significant effects arising from the construction at the Chelsea 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.

14.3.10 Phases of some of the developments identified in Vol 13 Appendix N would be under construction during Site Year 1. These developments have been considered in the cumulative effects assessment (see Section 14.7).

Operation

14.3.11 The assessment methodology for the operation phase follows that described in Vol 2 Section 14. There are no site-specific variations for undertaking the operational assessment of this site.

14.3.12 The assessment year for operation 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.

14.3.13 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 considered the developments that are scheduled to be complete and in operation by Year 1 of operation (presented in Vol 13 Appendix N). The developments in Vol 13 Appendix N would not result in additional surface water receptors and are considered unlikely to result in changes in water quality as these developments are remote from the tidal Thames. The base case would therefore not change from that outlined above.

14.3.14 Phases of some of the developments identified in Vol 13 Appendix N would be under construction during Site Year 1. These developments have been considered in the cumulative effects assessment (see Section 14.7).

14.3.15 The operational assessment uses the same assessment area identified above for the construction assessment.

14.3.16 Section 14.6 details the likely significant effects arising from the operation at the Chelsea Embankment Foreshore site.

Assumptions and limitations

14.3.17 The assumptions and limitations associated with this assessment are presented in Vol 2 Section 14. Based on the geology at the site, it is assumed that depressurisation (a form of dewatering) would be required in the Lambeth Group. 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 A list of all surface water receptors and their WFD status given in the River Basin Management Plan (EA, 2009)[4] (RBMP), which are either adjacent to the site or downstream of the site and therefore have the potential to be affected by the proposed development[ii], is included in Vol 13 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 13 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

[ii] The EA has provided advice on CSO excursion areas, 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.

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; there is a status objective of good by 2027. In addition, the tidal Thames is a valuable water resource, habitat, and source of amenity, recreation, and transport route throughout London.

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 There are two licensed surface water abstractions within 1km of the Chelsea Embankment Foreshore site.

14.4.7 The Chelsea Embankment Foreshore site is less than 1km upstream of the EA's Cadogan Automatic Quality Monitoring Station (AQMS) monitoring point, as shown on Vol 13 Figure 14.4.1 (see separate volume of figures). 2011 summary data from this monitoring point, which gives monthly 90 percentile values for ammonium (concentration that is exceeded 10% of the time) and 10 percentile values for dissolved oxygen (DO) (concentration that is exceeded 90% of the time) are presented below in Vol 13 Table 14.4.2.

Vol 13 Table 14.4.2 Surface water – Cadogan Pier AQMS 2011

Month	DO (mg/l) (10%)	Ammonium (mg/l) (90%)
January	11.06	4.15
February	9.18	0.57
March	8.44	0.84
April	5.89	1.54
May	6.15	1.84
June	3.70	1.68
July	3.17	1.90
August	3.04	3.06
September	4.34	4.04
October	5.60	6.24
November	5.22	4.80
December	8.09	4.41

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 Ranelagh 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 Chelsea Embankment Foreshore site and a more widespread effect along the tidal Thames of rapidly dropping DO levels. Vol 3 Section 14 details half-tide plots displaying the changes in DO levels along the tidal Thames.

14.4.9 Historical mapping has identified no contaminative uses on site and it is considered that there are no viable off-site sources of contamination within the 250m search radius[iii] which could have caused significant contamination within the site boundary. Intrusive testing identified no contaminants above human health[iv] screening values in the two samples tested. An assessment of potential on-site contamination is provided within Section 8 of this volume.

14.4.10 Grab sampling of foreshore sediments recorded concentrations of cadmium, copper mercury, lead, and zinc which were recorded to be elevated against the TEL[v] in at least one of the three samples tested (and in most case all three samples). Levels of mercury, lead and individual polycyclic aromatic hydrocarbon (PAH) compounds were recorded above both the TEL and PEL[9].

Current CSO operation

14.4.11 The current operation of the Ranelagh CSO has been characterised using the catchment model of the sewer system (see Vol 3 Section 14 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 on average 26 times in the Typical Year[vi]

b. the CSO spills for a total duration of 142 hours in the Typical Year

c. the spill volume from the CSO is approximately 283,000m^3 in the Typical Year, representing less than 1% of the total volume discharged to the tidal Thames in the Typical Year from all CSOs.

14.4.12 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 Ranelagh CSO has been defined as follows:

a. the CSO discharges 21,370kg of BOD in the Typical Year

b. the CSO discharges 710kg of ammonia in the Typical Year

c. the CSO discharges 2,960kg of TKN in the Typical Year.

14.4.13 Each discharge increases the risk of exposure to pathogens for river users who come into contact with the water. An assessment of health impacts

---

[iii] 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.

[iv] Assumes light industrial/ commercial screening values for the assessment of long term risk to human health (refer to assumptions and limitations).

[v] 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).

[vi] 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

upon recreational users of the tidal 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[vii]. 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.

14.4.14 Assuming the average 26 spills per annum from the Ranelagh CSO occur on separate days, there could be up to a maximum of 104 days per typical year where recreational users are at risk of exposure to pathogens in the vicinity of the outfall as a result of the Ranelagh CSO spills alone (Lane, C, Surman-Lee, S, Sellwood, J and Lee, JV , 2007)[11].

14.4.15 The operation of the Ranelagh CSO results in the discharge of sewage litter along with the discharge of effluent. It has been estimated by the *Thames 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 Ranelagh CSO and assuming litter tonnages are proportional to discharge volumes, this would indicate that approximately 71t of sewage derived litter is discharged from the Ranelagh CSO in the Typical Year. An assessment of the amenity effects of the sewage litter is given in Vol 3 Section 10.

Construction base case

14.4.16 As explained in Section 14.3, both the construction base case and the operational base case would therefore 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).

14.4.17 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

14.4.18 As noted above, the operational base case would be the same as the construction base case and would include water quality improvement achieved by the Lee Tunnel and the sewage works upgrades.

14.4.19 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.

14.4.20 Catchment modelling results of the base case have demonstrated that by Year 1 of operation (assessed using 2021 modelled assumptions), the

---

[vii] The EA has provided advice on CSO excursion areas[vii], 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.

frequency, duration and volume of spills from the Ranelagh CSO would have increased (as a result of increased population) beyond the current baseline as follows:

a. the CSO would spill 29 times in the Typical Year (three more than the current baseline)

b. the CSO would spill for 157 hours in the Typical Year (15 hours more than the current baseline)

c. the spill volume from the CSO would be approximately 306,000m^3 in the Typical Year (23,000m^3 more than the current baseline).

14.4.21 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 27,500kg of BOD in the Typical Year (6,130kg more than the current baseline)

b. the CSO would discharge 950kg of ammonia in the Typical Year (240kg more than the current baseline)

c. the CSO would discharge 3,800kg of TKN in the Typical Year (840kg more than the current baseline).

14.4.22 Following on from the interpretation of the current baseline as per para. 14.4.14, the number of risk days for river users being exposes to pathogens during the operational base case year (taking into account 2021 modelled assumptions) would be a maximum of 116 days in the Typical Year as a result of spills from the Ranelagh CSO alone.

14.4.23 Similarly, the tonnage of sewage derived litter discharged from the Ranelagh CSO can be expected to increase by approximately 8% from approximately 71t to approximately 77t 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 assessment of effects is required (eg, where the impact pathway has been removed). The second part of the section identifies any effects that may occur and the likely significance of these effects.

Construction impacts

Temporary land take and morphological changes

14.5.2 In order to accommodate the temporary works at the Chelsea Embankment Foreshore site, construction of a temporary cofferdam within the river channel would be required as described in Section 3 of this volume. The channel would be more constricted than at present and together with the new profile of the structure, 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 Minor amounts of sediment could be released during piling operations. 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[viii]. The proportion of this estimate that would originate from the Chelsea Embankment Foreshore site is approximately 84t.

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 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).

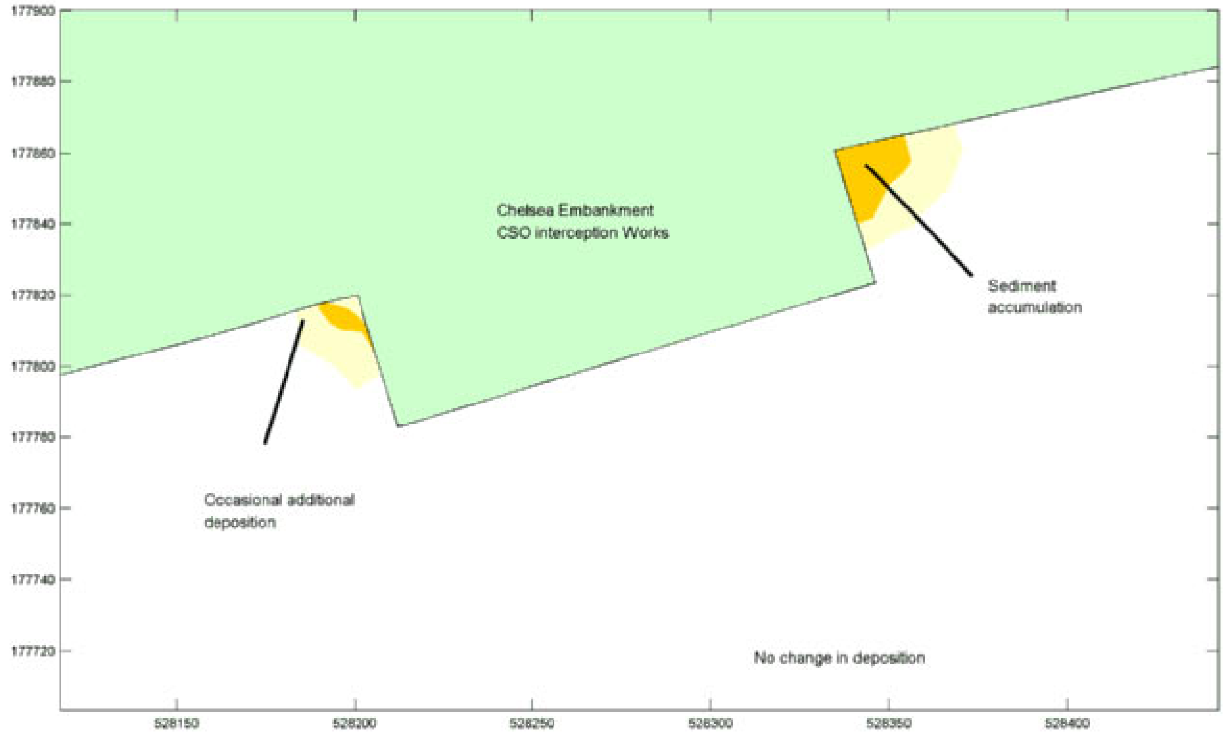
14.5.5 The tidal Thames is a high sediment environment and levels already present within the tidal Thames are estimated to be a peak of 4,000kg/s in the lower Thames estuary or more than 40,000t of sediment passing the site four times a day during spring tides. In this context, the volumes produced by 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 , 2006)[12] 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 Chelsea 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 13 Plate 14.5.1.

[viii] 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 13 Plate 14.5.1 Surface water – prediction deposition around temporary works at Chelsea 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 13 Plate 14.5.1) 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 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 Chelsea Embankment Foreshore site are as a result of the requirement for a cofferdam to be constructed in the river channel for both the main construction work and to house the permanent structures once construction is complete. The cofferdam would be constructed by driving sheetpiles 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) should remove the impact pathway.

14.5.10 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 is 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

14.5.11 Contamination has been recorded of the near surface sediments, although overall the mobility of metal and PAH contaminants has been recorded to be low. Given the current environment (ie, significant water flow and sediment movement), 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.

14.5.12 Any additional sediments input to the river as a result of construction processes would be minimal in comparison to the already high background levels (see para. 14.4.5) 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) 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.

14.5.13 Therefore, there is considered to be no impact from this source and this is not considered further within this assessment.

Surface water drainage

14.5.14 Once constructed, the cofferdam area and the drop shaft construction 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 built to the same height as 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.

14.5.15 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

14.5.16 The temporary cofferdam at the Chelsea Embankment Foreshore site may interact with Chelsea 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 Chelsea Embankment Foreshore site working area.

Dewatering

14.5.17 Based on the geology at the site, it is anticipated that depressurisation (a form of dewatering) would be required in the Lambeth Group. See Section 13 of this volume for further details on the dewatering requirements. Depending on the quality of the groundwater that is pumped out, there could be an impact on water quality of the tidal Thames.

14.5.18 Should any dewatering be required, settlement of suspended solids within the dewatering would minimise the levels of contaminants within the effluent, which tend to be associated with particulates. Additional treatment of the dewatering effluent, or remediation of groundwater, may also be carried out, if required and it is therefore considered that there is no pollution pathway and hence no impact from dewatering.

Construction effects

14.5.19 The potential surface water impacts identified above as likely as a result of construction at Chelsea Embankment Foreshore site 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 13 Table 14.4.1.

14.5.20 The WFD objectives set out in 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.

14.5.21 The significance of these effects has then been assessed based on the magnitude of the impacts as described in Vol 2 Section 14.5.

Temporary land take and morphological changes

14.5.22 The presence of the construction cofferdam in the channel would impact on the morphology of the tidal Thames in this location, altering it from its current state.

14.5.23 At the end of the construction, part of the riverbed would be reinstated following the removal of the temporary structures (see Vol 3 Appendix C4). The temporary change 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**. 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 the construction of the cofferdam may result in an area of slack 'dead' water between the construction area and the nearby Chelsea 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 Ranelagh 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 Ranelagh 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 two times per typical year (27 times less than the operational base case)

b. the CSO would spill for an average duration of ten hours (147 hours less than the operational base case)

c. the spill volume from the CSO would be approximately 19,000m^3 per typical year (287,000m^3 less than the operational base case).

14.6.3 The frequency, duration and volume of spills at Chelsea Embankment Foreshore site would therefore be reduced by approximately 94% 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 Ranelagh CSO would be a maximum of 8 days in the Typical Year (a reduction of up to 108 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 94%, from approximately 77t to approximately 4.6t, 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 2,700kg of BOD in the Typical Year (24,800kg less than the operational base case)

b. the CSO would discharge 100kg of ammonia in the Typical Year (850kg less than the operational base case)

c. the CSO would discharge 400kg of TKN in the Typical Year (3,400kg 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 Ranelagh CSO would be the following:

a. the CSO would spill on average two times per typical year (the same as the Year 1 of operation development case)

b. the CSO would spill for an average duration of ten hours (the same as the Year 1 of operation development case)

c. the spill volume from the CSO would be approximately 33,000m^3 per typical year (14,000m^3 more than the Year 1 of operation development case).

14.6.8 In summary, the model predicts that in the 2080 development case scenario the Ranelagh CSO at Chelsea Embankment Foreshore site would maintain spill frequency and duration but increase in total volume. This change in spill 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.

14.6.9 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 Section 14 and climate change is not considered further within this site assessment.

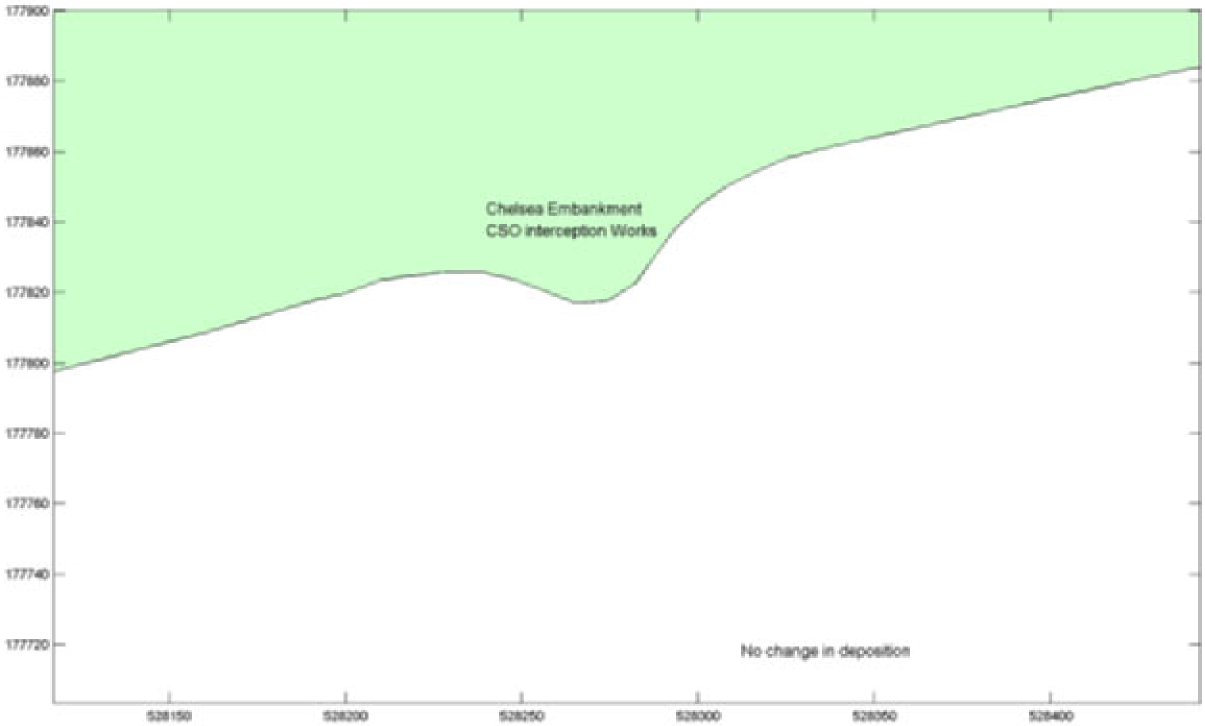
Permanent land take and morphological changes

14.6.10 In order to accommodate the permanent works at the Chelsea Embankment Foreshore site, construction of a permanent structure within the river channel would be required, as described in Section 3 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* as described in para. 14.2.12 and scour is not considered further with the assessment.

Deposition

14.6.11 The permanent works cofferdam would be likely to lead to changes in flows (velocities, directions) and cause changes in deposition of sediments around the Chelsea Embankment Foreshore site. Modelling carried out (Vol 3 Appendix L.3) has shown that there would be no deposition around permanent works at Chelsea Embankment Foreshore site, as shown below in Vol 13 Plate 14.6.1. Deposition is therefore not considered further within the assessment.

Vol 13 Plate 14.6.1 Surface water – prediction deposition around permanent works at Chelsea Embankment Foreshore site



Operational effects

Reduction in Ranelagh CSO spills

14.6.12 The reduction in spills from the Ranelagh CSO would represent an important contribution towards

a. meeting the requirements of the UWWTD[13] in relation to the Ranelagh 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.

14.6.13 Therefore, the reduction in spills would be 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 Chelsea

Embankment Foreshore site also depends on the project-wide improvements, as documented in Vol 3 Section 14.

14.6.14 The associated reduction in exposure to pathogens would greatly improve the conditions for recreational users of the tidal Thames around Chelsea Embankment Foreshore site, 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.

14.6.15 The reduction in sewage 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 land take and morphological changes

14.6.16 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 lead to 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**.

14.6.17 Impacts on channel morphology can also have an effect on ecological receptors, by changing habitat availability. This effect is outside the scope of the surface water assessment and 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 Of the phases of the developments described in Vol 13 Appendix N, which could potentially give rise to cumulative effects with the proposed development at Chelsea Embankment Foreshore site, is not considered that any would lead to cumulative effects on surface water. This is because the significant adverse effects that are considered likely for the construction phase at this site are associated with the proposed in-river structures. The cumulative developments in Vol 13 Appendix N are remote from the tidal Thames and are therefore unlikely to have significant effects on the channel morphology.

14.7.3 No significant cumulative effects have therefore been identified for the construction or operation phases at this site. Therefore the effects on surface water would 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

14.10.1 This topic assessment has considered both options for inter-tidal habitat or floodable public realm and given that there are not anticipated to be any differences, the assessment summary tables (see Vol 13 Table 14.10.1 and Vol 13 Table 14.10.2 below) reflects both options.

Vol 13 Table 14.10.1 Surface water – construction assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Thames Middle and Thames Upper	Temporary changes to channel morphology (cofferdam and associated scour protection construction)	Minor adverse	None	Minor adverse
Thames Middle and Thames Upper	Changes in aesthetic quality due to debris accumulation in slack water between structures	Minor adverse	None	Minor adverse

Vol 13 Table 14.10.2 Surface water – operational assessment summary

Receptor	Effect	Significance of effect	Mitigation	Significance of residual effect
Thames Middle and Thames Upper	Compliance with UWWTD and WFD. Improved water quality in the vicinity of the Ranelagh CSO by reduced pollutant loading and no reduction of DO levels due to reduced spill frequency, duration and volume from the Ranelagh CSO	Major beneficial	None	Major beneficial
Thames Middle and Thames Upper	Risk of exposure days to pathogens would be reduced to a maximum of 8 days in the Typical Year (a reduction of up to 108 days of risk of exposure)	Moderate beneficial	None	Moderate beneficial
Thames Middle and Thames Upper	Sewage derived litter discharge at Ranelagh CSO would be reduced by approximately 94% improving the aesthetic quality of the river locally	Moderate beneficial	None	Moderate beneficial
Thames Middle and Thames Upper	Change in channel morphology caused by permanent foreshore/in-channel structures	Minor adverse	See Section 5 of this volume	Minor adverse

References

[1] HM Government. *National Policy Statement for Waste Water: A framework document for planning decisions on nationally significant waste water* (March 2012). Available at: http://www.defra.gov.uk/publications/files/pb13709-waste-water-nps.pdf

[2] Department for Transport (DFT). *Transport Analysis Guidance* (WebTAG) (2003). Available at: http://www.dft.gov.uk/webtag/documents/overview/unit1.2.php

[3] The Council Directive 91/271/EEC concerning urban waste-water treatment. *The Urban Waste Water Treatment Directive*. Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31991L0271:EN:NOT

[4] Environment Agency. *River Basin Management Plan, Thames River Basin District* (2009)

[5] The United Kingdom Technical Advisory Group (UKTAG) to the WFD. Available at: http://www.wfduk.org/

[6] Environment Agency (2009). See citation above.

[7] Environment Agency (2009). See citation above.

[8] HR Wallingford (report prepared for the Environment Agency). *Thames Estuary 2100, Morphological changes in the Thames Estuary, Technical Note EP6.8, The development of an historical sediment budget* (2006)

[9] Canadian Council of Ministers of the Environment. *Sediment Quality Guidelines for the Protection of Aquatic Life*. Available at: http://st-ts.ccme.ca/

[10] Lane, C, Surman-Lee, S, Sellwood, J and Lee, JV. *The Thames Recreational Users Study Final Report.* (2007)

[11] Lane et al. See citation above.

[12] HR Wallingford. See citation above.

[13] Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment. See citation above.

Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Environmental Statement

Doc Ref: **6.2.13**

Volume 13: Chelsea Embankment Foreshore site assessment

Section 15: Water resources - flood risk

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

Hard copy available in

Box **27** Folder **A**
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

This page is intentionally blank

Thames Tideway Tunnel

Environmental Statement

Volume 13: Chelsea Embankment Foreshore site assessment

Section 15: Water resources – flood risk

List of contents

Page number

List of tables

Page number

This page is intentionally blank

15 Water resources – flood risk

15.1 Introduction

Background

15.1.1 This section forms a Flood Risk Assessment (FRA) for the Chelsea 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 Vol 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 13 Chelsea 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 elements of the proposed development relevant 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 is presented in section 13 of this volume. The assessment of effects on surface water is presented in section 14 of this volume.

15.1.5 A project-wide FRA has been undertaken and is presented in Volume 3 Project-wide 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 planning policy relevant to the proposed development is provided in Vol 13 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 NPS states that the Exception Test should be applied where it is not possible for the project to be located in zones of lower probability of flooding than Flood Zone 3.

15.1.10 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).

15.1.11 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 Section15.

15.1.12 The proposed development at Chelsea 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.

15.1.13 The proposed development would not be located on previously - developed land. However, as detailed in Vol 3 Section 15 no reasonably alternative sites on developable previously- developed land have been identified during the sites selection process and as such the proposed development at Chelsea Embankment Foreshore would satisfy part b) of the Exception Test.

15.1.14 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 foreshore component of 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 Element of the proposed development relevant to flood risk

15.2.1 The proposed development at this site is described in Section 3 of this volume.

15.2.2 The elements of the proposed development relevant to flood risk are set out below.

Construction

15.2.3 During the construction phase the proposed elements relevant to flood risk would include:

a. A cofferdam would be constructed in the foreshore to the same height as the existing flood defence.

b. A campshed would be constructed to the south of the cofferdam to allow barge mooring and the loading and unloading of material.

c. The tidal Thames flood defence wall situated between the proposed site and the embankment would be removed to allow for site access after the temporary cofferdam has been constructed.

d. The interception of the Ranelagh combined sewer overflow (CSO) would require the construction of an interception chamber and valve chamber. This would be constructed within the new foreshore structure and, once the system is operational, flows would be diverted through the valve chamber and into the CSO drop shaft. The existing Ranelagh CSO would be maintained to the same capacity throughout the construction period by an extension through the cofferdam. This would allow the CSO to remain operational during the construction period.

e. The connection to the Low Level Sewer No. 1, on the north side of Chelsea Embankment would require the construction of an overflow weir chamber, connection culvert and valve chamber connected to the CSO drop shaft.

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).

15.2.5 The CoCP (Section 8) states that no temporary living accommodation would be permitted onsite and that an evacuation route and safe refuge should be provided in the event of a flood event.

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[i] as

[i] The level to with the flood defences must be maintained to ensure that both the sites themselves and third-party land and assets in the surrounding area are protected from flooding.

detailed within the FRA. This is a requirement of the Thames River Protection of Floods Amendment Act 1879[2].

Operation

15.2.7 The permanent elements relevant to flood risk would include:

a. A new flood defence wall as part of the permanent works on the Chelsea Embankment Foreshore site. This would be designed to allow future raising in accordance with the Thames Estuary 2100 Plan (TE2100) (EA, 2012)[3] requirements. The crest height of the new flood defences would be set at the existing level of the flood defences and would be tied into adjacent flood defences.

b. The inter-tidal terraces between the embankment and the foreshore structure would sit below the defence level and would occasionally be flooded. The terraces would terraces that provide either inter-tidal habitat or floodable public realm space.

c. A new outfall of the Ranelagh CSO would be incorporated into the new river wall, with two sets of flap valves in series.

d. Following construction of the proposed development, the outfall from the Ranelagh CSO would be intercepted. Additionally, control would be provided to the northern Low Level Sewer No.1.

e. As the site is adjacent to the tidal Thames the surface water associated with the impermeable surfaces on the site would be discharged directly into the tidal Thames.

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 a screening exercise that identified relevant potential flood sources and pathways. The assessments of tidal and fluvial risk were based on the flood zones, which do not take into account 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 Section15.4.

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).

Tidal flood risk to the proposed development

Level of risk based on the flood zone

15.3.5 The Chelsea Embankment Foreshore site is comprised of two areas for the construction phase. The main construction area is located on the tidal foreshore of the tidal Thames, adjacent to the Chelsea Embankment. A smaller portion of the construction site is located inland on the Chelsea Embankment and with a small area of the adjacent Ranelagh Gardens.

15.3.6 The Environment Agency (EA) Flood Map identifies the site as being located within Flood Zone 3. The location of the site in relation to the flood zones is shown in Vol 13 Figure 15.3.1 (see separate volume of figures). As the main construction site is located within the foreshore of the tidal Thames, it is part of the active floodplain of the tidal Thames and subject to frequent tidal inundation. The site 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 "risk of flooding" to the main construction site (without the design measures) is considered to be very high.

15.3.7 The smaller construction site within Chelsea Embankment is not located within the foreshore and therefore does not lie within the functional floodplain. As the inland component of the construction site is located within Flood Zone 3a (although benefiting from the presence of flood defences) the risk of tidal flooding to the site is considered to be high (see methodology in Vol 2).

Existing tidal defences

15.3.8 A raised flood defence wall is aligned along the boundary between the tidal Thames and the Chelsea Embankment. The defence wall separates the foreshore and inland areas of the construction sites. The foreshore is therefore not protected from tidal flooding by flood defences other than the Thames Tidal Barrier located approximately 20km further downstream.

15.3.9 The EA has stated that the statutory flood defence level relevant to the Chelsea Embankment Foreshore site is 5.41m Above Ordinance Datum (AOD). The National Flood and Coastal Defence Database (NFCDD) (EA, 2011)[5] crest level of the flood defences along Chelsea Embankment is 5.41mAOD

15.3.10 Condition surveys of the flood defences carried out by the EA in April 2011 (EA, 2012)[6] confirm that the condition of the defence is in overall good condition (Grade 2).

15.3.11 The adjacent land behind the foreshore site is protected from flooding by defences and is therefore at residual risk from tidal flooding, which means that floodwaters could inundate the inland component of the site in the event of overtopping (for example if the Thames Barrier fails to close during a tidal event) or a failure of the flood defences as a result of a breach.

15.3.12 The Strategic Flood Risk Assessment (SFRA) for the Royal Borough (RB) of Kensington and Chelsea (JBA and Entec, 2010)[7] quantifies the residual risk in the event of a breach in the local defence wall or overtopping as a result of a failure of the Thames Barrier. A breach modelled at the southern entrance to the Royal Hospital (location KC2), east of the site shows the majority of the Chelsea Embankment and the proposed works being inundated during breach and overtopping scenarios. Chelsea Embankment, to the north of the site, is classified as high residual risk[ii]. However, this risk is residual and is not considered to compromise the long term operational function of the tunnel. Further detail regarding residual risk is provided within para. 15.5.4 and Vol.3 Section 15.

Tidal flood level modelling

15.3.13 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)[iii]) flood event.

15.3.14 The Thames Tidal Defences Joint Probability Extreme Water Level Study (EA, 2008)[8] provides modelled tidal flood levels for the 1 in 200 year (0.5% AEP) flood event for specific locations (model node locations) within the tidal Thames.

15.3.15 Vol 13 Table 15.3.1 presents the modelled tidal levels from this study for model node 2.29 which is the most relevant (ie, closest) to the site (Vol 13 Figure 15.3.1) (see separate volume of figures). 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); therefore the 2005 scenario (ie, the 'present day' scenario provided by the EA) produces the highest water level.

15.3.16 Vol 13 Table 15.3.1 also identifies that the existing level of flood defence close to the site is above the 1 in 200 year (0.5% annual exceedance probability [AEP]) tidal flood level; therefore the site is protected from tidal flooding to the statutory level.

Vol 13 Table 15.3.1 Flood risk – modelled water levels

Return period	Flood level (mAOD)	Statutory flood defence level (mAOD)
0.5% AEP (2005)	5.03	5.41
0.5% AEP (2107)	5.00	

[ii] This classification is given in areas that satisfy one of the following criteria: areas within 500m of the defence line with a water depth greater than 0.25m; areas further than 500m from the defence line with water depths greater than 0.6m; and areas within 500m of the defence line with no safe access or egress.

[iii] A flood with a 0.5% AEP has a one in 200 year probability of occurring

Tidal risk from the proposed development

New tidal defences

15.3.17 The presence of permanent structures within the foreshore has the potential to influence the flood risk to the site itself and to the surrounding environment. The proposed development includes raising the foreshore to adjacent land levels and building a new flood defence to the existing statutory level. 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 a new Flood Zone 3a. Therefore the risk of tidal flooding is considered to be high (see methodology in Vol 2). Potential risks are described further in paras. 15.3.19 to 15.3.32 and measures included within the design are outlined in Section 15.4.

15.3.18 It should be noted that a small part of the permanent works (the front part) would be set below the flood defence level and therefore occasionally floodable (due the flood defence being set back from the perimeter of the permanent structure.) This small portion of the site would therefore be classified as at very high risk of flooding.

Flood defence integrity

15.3.19 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 culvert connecting the Low Level Sewer No. 1 to the CSO drop shaft would pass under the flood defences south of the smaller temporary construction site and run west broadly parallel to the river wall. The alignment of the main tunnel and the Ranelagh CSO connection sewer is in front of the flood defences. Therefore there is the potential for these works to affect the integrity of the defences at this site.

15.3.20 The proposed design has been informed by consideration of settlement and the alignment and methods used have been selected to minimise it as far as possible.

15.3.21 A potential settlement of between 17mm and 42mm is estimated to occur across the river walls at the site (based on information provided by Thames Water). The flood defence levels following settlement is estimated to range from 5.37mAOD to 5.39mAOD. This could therefore result in the sections of the river wall falling below the statutory flood defence levels as a result of this degree of settlement.

15.3.22 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. The assessment indicated potential structural impacts on the flood defences at the site arising from increased water differential, 'Burland' damage[iv] and temporary removal of stone parapet wall.

15.3.23 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

15.3.24 During the construction phase, it is proposed to construct a cofferdam to the same height as statutory flood defence level (5.41mAOD) with the new river wall proposed at 6mAOD. The tidal Thames existing flood defence wall situated between the proposed foreshore site and the embankment would become redundant in terms of flood defence and the parapet would be removed to allow site access.

15.3.25 The permanent operational area would be protected from flooding through the construction of new flood defences. The defences run behind the intertidal terraces. The intertidal terraces cover/protect some infrastructure that does not require ground level access covers. The new flood defence would tie in with the existing defences, providing a continuous defence line along the embankment at all times.

15.3.26 Both temporary and permanent works to the flood defences have the potential to impact on the level of tidal flood risk to the site. In this case the proposed cofferdam and new flood defence wall would be constructed to the same height as existing flood defences, therefore providing the statutory standard of protection.

Scour management

15.3.27 The Thames Estuary 2100 Plan consultation document (TE2100) (EA, 2012)[9] includes an assessment of the tidal Thames foreshore at this location where there are long lengths of naturally eroding reaches of the tidal Thames. Results from this study show that works within the foreshore at the site may have an influence on downstream river structures if the pattern of sediment movement is greatly changed. In addition, should any permanent and 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.

15.3.28 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 Chelsea Embankment Foreshore site.

[iv] Tensile strains in gravity wall due to longitudinal differential settlement.

15.3.29 Scour is predicted at the Chelsea Embankment Foreshore site to be greatest during construction with maximum estimated scour depths to temporary works of up to 2.8m. The contraction scour has been estimated during construction to be less than 0.1m across the river bed and at 2m at the adjacent bridge piers and abutments.

15.3.30 During the permanent works local scour depths of up to 2.8m are predicted around the permanent works. Contraction scour has been estimated to be less than 0.1m. As a proactive approach permanent scour protection is envisaged at the base of the new flood defence wall.

15.3.31 Both the temporary and permanent works have therefore the potential to influence scour and /or deposition rates within the river and affect river structures including flood defences.

Loss of volume from the Tideway

15.3.32 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 result of the removal of flood storage on flood levels is propagated throughout the hydrological unit of the Thames reach and has been modelled on a project-wide basis.

15.3.33 The Chelsea Embankment Foreshore site is located within the reach of Chelsea to Westminster in the tidal and fluvial modelling study. The modelling identifies that for this reach the potential maximum decrease in peak water level is 0.013m during the temporary works scenario reducing to 0.004m during the permanent scenario. The modelling also identifies a potential maximum increase of 0.029m in peak water level during the temporary works scenario reducing to 0.014m during the permanent scenario. As identified in para.15.3.9 The flood defences at this site are at the statutory level. When the flood defence levels are compared to the 1 in 200 year tidal level for the year 2107 these would provide 0.41m in freeboard. These 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.

15.3.34 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

15.3.35 At this location along 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.

15.3.36 As the main construction site of the Chelsea Embankment Foreshore site is located within Flood Zone 3b, and as the tidal and fluvial floodplain cannot be distinguished in this location the risk of flooding from this flood source is considered to be very high.

15.3.37 The portion of the site located within the Chelsea Embankment is protected from flooding by defences. This part of the site is considered to be located within Flood Zone 3a and as the tidal and fluvial floodplain cannot be distinguished in this location the risk of flooding from this flood source is considered to be high. Further detail with regards to the approach followed for the assessment of fluvial flood risk is included in Vol 2.

Fluvial flood risk from the proposed development

15.3.38 As explained in Vol.2, it is considered that a fluvial flood event on the tidal Thames with a return period of 1 in 100 year (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. As such, the greatest risk posed by the tidal Thames is a combined tidal flood and fluvial flood risk.

15.3.39 As described above, the main component would be located in the functional floodplain of the tidal Thames. Para.15.3.28 summarises the findings of the project-wide modelling undertaken to assess the potential loss of storage within the tidal Thames associated with the foreshore sites.

Surface water flood risk to the proposed development

15.3.40 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.

15.3.41 As part of the Drain London Project[v] , a Surface Water Management Plan (SWMP) was prepared for the RB of Kensington and Chelsea (Halcrow, 2012)[10]. This identifies that the Chelsea Embankment Foreshore site is not located within a Critical Drainage Area[vi], which suggests that the site is relatively less susceptible to surface water flooding than other areas within the borough. Modelling results for the 1% AEP rainfall event plus climate change show areas of localised flooding of 0.25m–0.5m depth to the north of the Chelsea Embankment adjacent to the foreshore site.

15.3.42 Ground levels at the Royal Hospital South Gardens and Ranelagh Gardens rise towards the south, and are at approximately 5.4mAOD at the Chelsea Embankment, with the exception of the Bull Ring gates, where ground levels are at 4.2mAOD. The road levels of the Chelsea Embankment adjacent to the foreshore are approximately 4.8mAOD. The Chelsea Embankment rises away from the site to the east towards the Chelsea Bridge Road. In front of the river wall, the ground levels rise to 4.9mAOD. The land to the north of the site is greenfield, therefore surface water is likely to infiltrate during rainfall events and so is unlikely to flow towards the south in substantial quantities. Any surface water runoff

---

[v] A London wide strategic surface water management study undertaken by the GLA and London Councils

[vi] An area susceptible to surface water flooding

would be likely to be contained within the road channel of the Chelsea Embankment.

15.3.43 As the site has been identified to have a flood depth between 0.25m-0.5m, the flood risk from this source of flooding is considered to be medium (see methodology in Vol.2).

Surface water flood risk from the proposed development

15.3.44 An assessment of the likely significant effects of surface water from the Chelsea Embankment Foreshore site is provided in Section 14 of this volume.

15.3.45 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.

15.3.46 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 directly to the tidal Thames. Due to the tidal nature of the receiving watercourse, surface water runoff rates to the Thames would not increase surface water flood risk to the site or surrounding area and would therefore not require attenuation prior to discharge.

15.3.47 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.

15.3.48 Following the construction of the proposed development the risk of flooding from this source is considered to remain unchanged and therefore would be low.

Groundwater flood risk to the proposed development

15.3.49 Groundwater flooding occurs where groundwater levels rise above ground surface levels. Groundwater levels in the upper aquifer (river terrace deposits) have been recorded by Thames Water at borehole PR1088A and SR109. The average water levels in the boreholes are approximately 6.18m below ground level (bgl) and 5.80mbgl respectively. The ground investigation suggests that the upper aquifer is confined by the overlying alluvium at this location. Therefore groundwater levels would not rise above the top of the river terrace deposits.

15.3.50 As the upper aquifer is confined, there is no pathway for groundwater to reach the surface of the site. There is therefore no risk of groundwater flooding to the site (see methodology in Vol.2).

Groundwater flood risk from the proposed development

15.3.51 An assessment of the likely effects on groundwater at the Chelsea Embankment Foreshore site is provided in Section 13 of this volume.

15.3.52 The CSO drop shaft would pass through alluvium, river terrace deposits, London Clay and the Lambeth Group. Groundwater would be pumped from the Lambeth Group to prevent potential heave (upward movement) at the base of the shaft. Groundwater brought to the surface as a result of pumping, following treatment, would be discharged directly to the tidal Thames.

15.3.53 The presence of the CSO drop shaft creating a physical barrier has been assessed as having a predicted rise in water levels (less than 0.1m); however, this would result in increased hydraulic pressure within the confined unit rather than an increase of the water table. There is therefore no risk of an increase in groundwater flooding to the site as a result of the development

Sewers flood risk to the proposed development

15.3.54 The Low Level Sewer No.1 (2057mm diameter) runs in an easterly direction under Chelsea Embankment towards the Western Pumping Station.

15.3.55 The Ranelagh and King's Scholars Pond Storm Relief Sewer (KSP Sewer) (3048mm diameter) flows from the north, across the Ranelagh Gardens, towards the tidal Thames. The Sloane Street Sewer is a foul sewer (864mm by 1148mm egg shaped) that flows directly underneath the KSP and connects to the Low Level Sewer No. 1. The Ranelagh Sewer – Main line south section (2743mm diameter) also flows from the north towards the tidal Thames. These three sewers merge at Chelsea Embankment to form the Ranelagh CSO which discharges to the tidal Thames. Dry weather flows in the Ranelagh Main Line Sewer are diverted to the Low Level Sewer No. 1 under the northern footway of Chelsea Embankment. During storm conditions, flows continue towards the Ranelagh CSO and discharge to the tidal Thames.

15.3.56 If the capacity of the system was exceeded, or flows restricted from the CSO outfall, the combined sewerage would back up within the system, and surcharge through outlets, such as manholes and gullies, located along the length of the sewers. The pathway for this surcharged combined sewerage would follow the topography of the area in a southerly direction, towards the tidal Thames and along Chelsea Embankment towards Albert Bridge.

15.3.57 Thames Water flood records (Thames Water, 2012)[11] show that there have be no incidents of sewer flooding resulting from the surcharging of sewers inundating properties within 200m of the site since 1990.

15.3.58 Pathways are present for surcharged water to flow towards the site. However as there are no records of sewer flooding in the vicinity of the site, the risk of flooding from this source is considered to be low (see methodology in Vol.2).

Sewers flood risk from the proposed development

15.3.59 It is proposed that there would be a connection to the Low Level Sewer No.1 at the Chelsea Embankment, so that high flows (controlled with an overflow weir) are diverted to the main tunnel. This would help control the flows in the Low Level Sewer No. 1 towards the Western Pumping Station and the Western Pumping Station CSO. A connection culvert would be constructed from the overflow weir chamber to the CSO drop shaft, connecting it to the connection tunnel and the main tunnel.

15.3.60 The Ranelagh CSO would be intercepted within the foreshore of the tidal Thames. An interception chamber would be constructed on line with the existing CSO to divert flows via a valve chamber to the CSO drop shaft and to the connection tunnel. The flood risk during the construction phase would be managed using design measures described in Section 15.4.

15.3.61 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[vii]. Further detail is provided in Vol 3 Section 15.

15.3.62 At present sewage discharges from the Ranelagh CSO into the tidal Thames when the capacity of the system is exceeded. Following construction there would only be a restriction on sewage flows entering the main tunnel should the tunnel be full or unavailable. In this situation, flows would overflow from the existing Ranelagh CSO to the tidal Thames, ensuring no increase in flood risk compared to the existing situation.

15.3.63 Following the construction of the proposed development and new CSO connections, the flood risk from this source is considered to be unchanged and would remain as low.

Artificial sources flood risk to and from the proposed development

15.3.64 There are no nearby artificial flood sources eg, canals, reservoirs, which could lead to flooding of the site.

15.3.65 The flood risk from this source both to and from the proposed development is not applicable at this site and therefore has not been assessed further.

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.

[vii] The base case scenario comprises the sewage treatment works (STW) Improvements and Lee Tunnel in 2020s.

Tidal and fluvial

Construction

Flood defences

15.4.2 As discussed in para. 15.3.8 the proposed Low Level Sewer No. 1 connection culvert would pass under the flood defences south of the smaller temporary construction site and run west alongside the river wall. The path of the main tunnel and the Ranelagh CSO connection tunnel is in front of the existing flood defences. The tunnelling process has the potential to affect the integrity of these flood defences. During construction the level of the flood defences at the site would be monitored and mitigated in agreement with the asset owner and the EA as appropriate, to ensure crest heights of the flood defences at the site are maintained to the existing crest level. With this strategy in place no effects of settlement are anticipated.

15.4.3 As discussed in para. 15.3.24 a cofferdam would be constructed to the same height as the existing flood defence. This would ensure that the current level of flood protection and flood risk is maintained during construction. Further information is included in the CoCP (Section 8).

15.4.4 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.

Scour management

15.4.5 During construction the formation of scour would be monitored and mitigation proposed if the scour exceeds agreed trigger values.

15.4.6 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

15.4.7 Appropriate emergency planning procedures would be adopted by the contractor during the construction phase to mitigate the potential consequences in the event of a breach in the flood defence wall at the site or a failure of the Thames Barrier. Further information is included within the CoCP (Section 8).

Operation

Flood Defences

15.4.8 The permanent operational area would be protected from flooding through the provision of a new flood defence wall as outlined in para. 15.3.17. This would tie into existing flood defences, providing a continuous defence line along the Embankment at all times.

15.4.9 The new defences would be designed to ensure that future flood defence raising can be achieved to meet the TE2100 requirements.

15.4.10 Design options to preserve the structural stability 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.

15.4.11 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.

15.4.12 Flood defence level and structural integrity would be maintained while the stone parapet is temporarily removed.

15.4.13 As the new flood defence wall would be constructed to the same height as the existing flood defence, the residual flood risk to the site would be unchanged compared to the risk 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 appropriate and no further measures are required.

Loss of volume from the tideway

15.4.14 As discussed in para 15.3.32, the result 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 in 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 works has been designed to minimise the influence on river 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 works parameter plan (see separate volume of figures). 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 during construction would be drained and discharged to mains foul or combined sewers and where this is not practicable (for example due to risk of blockage due to excessive sediment loads), 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. These design measures would ensure that the risk of surface water flooding is managed during construction but would not reduce the overall level of flood risk associated with surface water.

Operation

Scour management – surface water discharge

15.4.19 As outlined in para. 15.3.46 it is intended to discharge surface water from the operational site directly into the tidal reaches of the River Thames (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.15.3.43 surface water runoff from the proposed site would be discharged directly to the tidal Thames. Due to the tidal nature of the receiving watercourse, surface water runoff rates to the Thames would not increase surface water flood risk to the site or surrounding area and would therefore not require attenuation prior to discharge. On-site storage would be provided to allow attenuation if necessary in the event of tide-locking of the surface water outfall.

Groundwater

Construction and operation

15.4.21 Groundwater monitoring is proposed during construction and operation. Groundwater resulting from the dewatering during construction would be pumped to the tidal Thames. Further measures regarding dewatering and 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 Ranelagh CSO would be maintained using flumes and flap values and extended through the cofferdam during the construction period.

Operation

15.4.23 The Ranelagh CSO would be intercepted within the foreshore of the tidal Thames. There would only be a restriction on sewage flows entering the main tunnel should the tunnel be full or unavailable. In this situation, flows would overflow through a new CSO to the tidal Thames, ensuring no increase in flood risk compared to the existing situation

15.5 Assessment summary

Flood risk

15.5.1 The Chelsea Embankment Foreshore site is located within Flood Zone 3b and Flood Zone 3a associated with the tidal 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 an increase in flood risk on the surrounding areas. Therefore no significant flood risk effects are likely.

15.5.3 Vol 13 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 new flood defence wall adjacent to the tidal Thames, the site would be protected from tidal flooding. The site would be a 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 tunnel and therefore no additional measures 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 13 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 13 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	Foreshore: Very high Inland: High (but residual)	Flood Defence height maintained. New flood defences built around the foreshore 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 repaired as required to maintain existing crest level.	No increase in tidal flood risk as a result of proposed development.	Inland: N/A as no above ground permanent structures are proposed Foreshore: High due to change from Flood Zone 3b to 3a (but risk is residual only)
Fluvial	tidal Thames	Foreshore: Very high Inland: High (but residual)	New flood defences built around the 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	No increase in fluvial flood risk as a result of proposed development.	Inland: N/A as no above ground permanent structures are proposed Foreshore: High due to change from Flood Zone 3b to 3a (but risk is residual only)

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
			and repaired as required to maintain existing crest level.		
Surface water	Surrounding area	Medium	Discharge surface water to tidal Thames.	No increase in surface water flood risk as a result of proposed development.	Medium
Groundwater	Underlying geology and groundwater levels restricted pathway	No risk	Dewatering during construction. Monitoring proposed during construction and operation.	No increase in groundwater flood risk as a result of proposed development.	No risk
Sewers	Local drainage system	Low	CSO maintained with flumes and flap valves during construction. The Ranelagh CSO would be intercepted within the foreshore of the tidal Thames.	No increase in sewer flood risk as a result of the proposed development.	Low
Artificial sources	None	Not applicable	Not applicable	Not applicable	Not applicable

** Definitions of these classifications are included in Vol 2*

() 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.

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

[4] Communities and Local Government. *National Planning Policy Framework (March, 2012).*

[5] Environment Agency. *National Flood and Coastal Defence Database.* (October, 2011)

[6] Environment Agency. *Flood Defence Data.(*received January 2012)

[7] JBA and Entec. *Kensington, Chelsea, Hammersmith and Fulham Strategic Flood Risk Assessment*. (2010).

[8] Environment Agency. *Thames Tidal Defences Joint Probability Extreme Water Levels 2008 Final Modelling Report.* (April 2008).

[9] Environment Agency (2009). *See citation above*.

[10] Halcrow. *Royal Borough of Kensington and Chelsea Surface Water Management Plan*. (2012).

[11] Thames Water. *Sewer Flooding Records*. (received June 2012)

This page is intentionally blank

Thames Water Utilities Limited
Clearwater Court, Vastern Road, Reading RG1 8DB

DCO-DT-000-ZZZZZ-060213