Section 48
Report on site selection process
Volume 1 / Main report
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Section 48: Report on site selection process

Volume 1: Main report
Thames Tideway Tunnel
Section 48: Report on site selection process
Volume 1: Main report

List of volumes

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  1. Site selection methodology paper (Summer 2011)
  2. Site selection background technical paper (Summer 2011)

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List of abbreviations

CSO combined sewer overflow
EU European Union
PS pumping station
SR storm relief
STW sewage treatment works
TBM tunnel boring machine
UK United Kingdom
1 Executive summary

1.1 The Thames Tideway Tunnel project in context

1.1.1 The Thames Tideway Tunnel project (the ‘project’) is a linear infrastructure scheme, the primary objective of which is to capture discharges from 34 of the most unsatisfactory CSOs that discharge into the River Thames in order to meet EU and UK legal requirements.

1.1.2 The combined sewage (untreated sewage combined with rainwater) that currently flows directly into the River Thames from CSOs would be captured and stored in the main tunnel system (the ‘main tunnel’) and the connection tunnels. The flows would then be transported along the tunnel, from west London to Abbey Mills in east London. From Abbey Mills, the flows would be transferred via the Lee Tunnel to Beckton Sewage Treatment Works (STW) for treatment.

1.1.3 The proposed route of the main tunnel would be approximately 25km long and would pass under the administrative areas of 14 London local authorities in order to intercept the identified CSOs.

1.1.4 The Site selection methodology paper and Site selection background technical paper are the main documents that guided our site selection process (both papers are provided in full, in Volume 2).

1.2 Purpose of this report

1.2.1 The Site selection methodology paper states that a final report will be produced in order to explain the whole site selection process and that this report will be made available as part of the publicity of the application for the proposed project under Section 48 of the Planning Act 2008. This Section 48: Report on site selection process has been prepared to fulfil part of that purpose.

1.2.2 There were two reports produced prior to this report. Firstly, the Project Overview (Summer 2010) was produced to provide an overview of the development of the scheme leading to the phase one consultation scheme. Secondly, the Phase two scheme development report (Winter 2011) provided an account of how the scheme evolved prior to phase two consultation. Both of these reports were published at each round of consultation and both are available on Thames Water’s website (http://www.thamestunnelconsultation.co.uk).

1.2.3 This report explains our approach in identifying the sites required to construct and operate the project. It describes each stage of the site selection process (as set out in our site selection methodology), how the methodology was implemented and the results of the process. In addition to an overview of the site selection process to date, it includes a post phase two consultation review of all the proposed sites and tunnel drives that make up the project in order to ensure that we have identified a suitable network of sites across the route for the Section 48 publicity stage.
1 Executive summary

1.2.4 This report explains the site selection process from inception through to publication of the proposed application under Section 48 of the Planning Act 2008. It provides information on:

a. the site selection methodology and how this was developed and applied

b. how we identified our area of search and assessed sites on our long list, draft short list and final short list

c. how we used our shortlisted sites in conjunction with engineering information on potential tunnel drive strategies to arrive at a preferred scheme that was consulted on as part of our phase one consultation exercise

d. the scheme development work that took place following phase one consultation, paying regard to the responses received

e. how we reconsidered our shortlisted sites and reassessed them in the light of updated engineering information on potential tunnel drive strategies to identify the preferred scheme that was consulted upon as part of our phase two consultation exercise

f. any further adjustments made to the preferred scheme in the light of information received at phase two consultation

g. confirmation of the proposed project (route, drive strategy and sites) that will be the subject of the proposed application for a Development Consent Order that will be published under Section 48 of the Planning Act 2008.

1.2.5 Volumes 3 to 5 of this report are the site appendices for the western, central and eastern sites. These volumes provide a detailed account of the site selection process for each site at each stage of the project up to Section 48 publicity.

1.3 Phase one consultation preferred scheme: site selection process

1.3.1 Section 4 of this volume explains how we followed the process described as Stage 1A to 1C in the Site selection methodology paper. It comprised: identification of sites for inclusion on a long list; assessment of sites on the long list and draft short list; and detailed review and assessment of all sites on the final short list alongside tunnelling options in order to produce the phase two preferred route, sites and drive strategy.

1.3.2 At phase one consultation, we presented our preferred scheme, with the aim of ensuring that all consultees had an opportunity to understand and influence our proposals at an early stage. This included presenting 22 preferred site locations, and indicating which ones were required as main tunnel drive or reception sites and which ones were required as CSO interception sites. The other shortlisted options were also presented so that our site selection process was transparent to everyone. We set out for each site the engineering, planning, environmental, community and property issues raised and considered during our site selection work.
Three options for the tunnel route were also presented, and the preferred route was identified as the Abbey Mills route.

1.4 Between phases one and two consultation: scheme development

1.4.1 We needed to develop the scheme following phase one consultation to take into account, where possible and appropriate, further engineering work indicating different technical requirements, new information and changes in circumstances for sites or the tunnel route, and/or the comments and suggestions we received from the consultation process. Section 5 of this volume examines these considerations and lists the outcomes for each site.

1.4.2 In terms of ongoing engineering progress, key developments include:

a. only 18 of the 34 CSOs are now required to be directly intercepted by the tunnel (the remainder will be controlled by other measures) – at phase one consultation we had concluded that 21 CSOs would need to be controlled via direct interception

b. river transport constraints between Putney Bridge and Hammersmith Bridge have influenced the consideration of a double drive site in this area

c. drive sites in London Clay now no longer require such large site areas

d. further work has found that a larger diameter tunnel than initially proposed is required at the western end to meet the flow and storage requirements of the tunnel.

1.4.3 Additional work by the engineering team was fed into this process and included more detailed engineering studies into some scheme components: ‘System master planning’ to consider the overall sewage system operations; construction, transport and river logistics studies; and field investigations and survey work.

1.4.4 We monitored the sites to establish whether there have been any changes in circumstances. Such changes have included the grant of planning permission, the start of redevelopment work on a site, changes in planning policy, new survey information or site acquisitions. Examples of sites where changes have occurred include Bell Lane Creek and Chambers Wharf.

1.4.5 The phase one consultation feedback has been analysed by all disciplines (engineering, planning, environment, community and property) to evaluate how we can respond to the key issues raised. With regard to site specific issues, we considered making changes to the proposals based on phase one consultation feedback in the following ways:

a. considering use of an alternative site in some cases

b. investigating alternative technical solutions for some sites

c. looking closely at what measures might be incorporated to address issues regarding the potential effects of the project across all sites.
1.4.6 With respect to the tunnel route, we took into account responses and concluded that the Abbey Mills option was still our preferred route.

1.4.7 Our *Site selection methodology paper* includes provision for a targeted repeat of the site selection process if necessary: a process we have called ‘back-checking’. The back-check process was designed to allow us to revisit our preferred sites if necessary and examine them again in more detail to check whether or not they are still the best sites to use. In some cases where changes have occurred, this has triggered the back-check process. Back-checks have been carried out for 12 sites in total.

1.5 **Phase two consultation preferred scheme: site selection process**

1.5.1 Section 6 of this volume explains how scheme development work since phase one consultation has informed the identification of sites and the tunnelling strategy that made up the phase two preferred scheme.

1.5.2 In order to allow decisions on the preferred scheme for the phase two consultation to be made, a range of technical documents were produced and assessments were undertaken so that each site and tunnelling option could be analysed systematically in accordance with our methodology, namely:

a. **Site suitability reports**: site suitability reports were completed for each new or amended site, assessing it in terms of its proposed use (eg, as a main tunnel drive or reception site or CSO site). The site suitability reports explain the considerations taken into account by every discipline when assessing each site on its own merit.

b. **Engineering options report**: an engineering options report was prepared to determine the various tunnelling drive options available to construct the main tunnel, in terms of linking one zone to the next. Long connection tunnel drive options were also considered.

1.5.3 This information was used to examine the following:

a. **Main tunnel sites**: each of the sites contemplated for main tunnel drive or reception sites was considered, with the most appropriate site identified for each of the zones. Some of these sites were the same as those put forward at phase one consultation and some sites are new sites.

b. **Analysis of main tunnel drive options**: tunnelling drive options were compared and evaluated to arrive at the preferred drive option and hence a set of preferred main tunnel sites.

c. **CSO sites**: each CSO was examined in relation to the principal requirements for that CSO and in order to identify the preferred CSO sites. Some CSO sites were the same as those put forward at phase one consultation and some sites are new sites. Where long CSO connection tunnels are required, regard was made to the most appropriate tunnelling drive option.
d. **Preferred phase two consultation scheme:** the outcome of this process was the identification of a preferred scheme for phase two consultation.

1.5.4 A clear comparison of what has changed between phases one and two consultation as a consequence of scheme development is provided in Table 1.1 below.

**Table 1.1 Principal differences between phase one preferred scheme and phase two preferred scheme**

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<td>Carnwath Road Riverside</td>
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<td>Jews Row</td>
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<td>Bridges Court Car Park</td>
<td>Falconbrook Pumping Station</td>
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- Technical solutions have removed the requirement for a CSO site at this location

**Preferred site name**

- Acton Storm Tanks: CSO site; connection tunnel reception
- Hammersmith Pumping Station: Main tunnel reception site; CSO site; connection tunnel drive
- Barn Elms: Sequential main tunnel double drive site; CSO site
- Putney Bridge Foreshore: CSO site; connection tunnel drive to main tunnel
- Bell Lane Creek: CSO site; connection tunnel drive to main tunnel; connection tunnel drive to King George's Park
- King George’s Park: CSO site; connection tunnel reception
- -
- Jews Row: CSO site; connection tunnel drive to main tunnel
- Bridges Court Car Park: CSO site; connection tunnel drive to main tunnel
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<td>Victoria Embankment Foreshore</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
<td>Victoria Embankment Foreshore</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blackfriars Bridge Foreshore</td>
<td>CSO site; drop shaft on line of main tunnel</td>
<td>Blackfriars Bridge Foreshore</td>
<td>CSO site; drop shaft on line of main tunnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Druid Street</td>
<td>CSO site; connection tunnel reception</td>
<td>-</td>
<td>Technical solutions have removed the requirement for a CSO site at this location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>King’s Stairs Gardens</td>
<td>Main tunnel double reception site; two connection tunnel drives</td>
<td>Chambers Wharf</td>
<td>Main tunnel single drive/single reception site; one connection tunnel reception</td>
<td></td>
<td></td>
</tr>
<tr>
<td>King Edward Memorial Park Foreshore</td>
<td>CSO site; connection tunnel drive to Butcher Row; all facilities in the foreshore; drop shaft on line of main tunnel</td>
<td>King Edward Memorial Park Foreshore</td>
<td>CSO site; no connection tunnel drive to Butcher Row; some facilities in the park; drop shaft on line of main tunnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase one preferred scheme</td>
<td>Phase two preferred scheme</td>
<td></td>
<td></td>
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<td>----------------------------</td>
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<tr>
<td><strong>Preferred site name</strong></td>
<td><strong>Site type</strong></td>
<td><strong>Preferred site name</strong></td>
<td><strong>Site type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butcher Row</td>
<td>CSO site; connection tunnel reception</td>
<td>-</td>
<td>Technical solutions have removed the requirement for a CSO site at this location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earl Pumping Station</td>
<td>CSO site; drop shaft on line of connection tunnel</td>
<td>Earl Pumping Station</td>
<td>CSO site; drop shaft on line of connection tunnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borthwick Wharf Foreshore</td>
<td>CSO site; drop shaft on line of connection tunnel</td>
<td>Deptford Church Street</td>
<td>CSO site; drop shaft on line of connection tunnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenwich Pumping Station</td>
<td>CSO site; connection tunnel reception</td>
<td>Greenwich Pumping Station</td>
<td>CSO site; connection tunnel drive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abbey Mills Pumping Station</td>
<td>Main tunnel single drive site</td>
<td>Abbey Mills Pumping Station</td>
<td>Main tunnel single reception site</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.6 **After phase two consultation: Site selection review prior to Section 48 publicity**

1.6.1 Section 7 of this volume describes the review of the phase two consultation scheme and outlines the main rational for our sites and tunnelling strategy on the Abbey Mills route. Figure 1.1 presents the proposed project as part of the publicity of the application under Section 48 of the Planning Act 2008.
Figure 1.1 Proposed project for Section 48 publicity
2 Introduction

2.1.1 In 2008, Thames Water decided there was a need to establish a systematic approach to investigate potential sites needed to construct and operate the proposed Thames Tideway Tunnel project (the ‘project’).

2.1.2 A bespoke site selection methodology was developed on account of the scale of the proposed project and the fact that construction would take place within a heavily constrained urban environment. Relevant policy and best practice were taken into account in devising the methodology. It was also subject to consultation with local authorities and other stakeholders and published before it was applied to all sites across the route.

2.1.3 The key principles utilised throughout the site selection process can be summarised as follows:
   a. application of best practice, reflecting the principles and requirements of relevant planning policy and sustainability guidance
   b. a collaborative, multidisciplinary approach taking into account engineering, planning, environment, community and property considerations and the exercise of professional judgement
   c. acknowledgement of the iterative relationship between site selection and engineering design processes and use of information available at each stage of project development.

2.1.4 It has always been Thames Water’s intention to be transparent, accountable and fair in implementing the methodology.

2.1.5 The aim of the site selection process was to try to identify realistic site alternatives. However it was recognised that London is a dense, complex urban environment and therefore most potential sites would be subject to some form of constraint or issues that may require mitigation measures to render them suitable sites for development activities.

2.1.6 Site selection methodology matters are discussed further in Section 3 of this report. The methodology and other key site selection background papers have been reproduced in full in Volume 2 of this report.

2.2 Purpose of this report

2.2.1 The Site selection methodology paper states that a final report will be produced in order to explain the whole site selection process and that this report will be made available as part of the publicity of the application for the proposed project under Section 48 of the Planning Act 2008. This Section 48: Report on site selection process has been prepared to fulfil part of that purpose. There were two reports produced prior this report. Firstly, the Project Overview (Summer 2010) report was produced to provide an overview of the development of the scheme leading to the phase one consultation scheme. Secondly, the Phase two scheme development report (Winter 2011) provided an account of how the scheme evolved prior to phase two consultation.
2.2.2 This report explains our approach to identifying the sites required to construct and operate the project. It describes each stage of the site selection process, as set out in our site selection methodology, how the methodology was implemented and the results of the process. In addition to an overview of the site selection process to date, it includes a post phase two consultation review of all the proposed sites and tunnel drives that make up the project in order to ensure that we have identified a suitable network of sites across the route for the Section 48 publicity stage.

2.2.3 This report explains the site selection process from inception through to publication of the proposed application under Section 48 of the Planning Act 2008. It provides information on:

a. the site selection methodology and how this was developed and applied

b. how we identified our area of search and assessed sites on our long list, draft short list and final short list

c. how we used our shortlisted sites in conjunction with engineering information on potential tunnel drive strategies to arrive at a preferred scheme that was consulted on as part of our phase one consultation exercise

d. the scheme development work that took place following phase one consultation, paying regard to the responses received

e. how we reconsidered our shortlisted sites and reassessed them in the light of updated engineering information on potential tunnel drive strategies to identify the preferred scheme that was consulted upon as part of our phase two consultation exercise

f. any further adjustments made to the preferred scheme in the light of information received at phase two consultation

g. confirmation of the proposed project (route, drive strategy and sites) that will be the subject of the proposed application for a Development Consent Order that will be published under Section 48 of the Planning Act 2008.

2.3 Background

2.3.1 London’s sewer system was designed by Sir Joseph Bazalgette in the 1850s to handle wastewater and rainwater runoff by means of a combined collection system. In order to prevent the sewers from flooding when overloaded, particularly during periods of heavy rainfall, combined sewer overflows (CSOs) were incorporated to discharge excess flows from the sewers into the Thames Tideway (the tidal reaches of the River Thames).

2.3.2 The capacity of the original and subsequently extended combined sewer system has now been substantially exceeded. Discharges of combined sewage (untreated sewage mixed with rainwater) into the Thames Tideway currently occur more than 50 times in a typical year, at an estimated volume of 39 million cubic metres.
Discharges must be reduced in order to comply with the Urban Waste Water Treatment Directive (UWWTD), and to abide by the UK Government's request for Thames Water to implement a solution.

Solutions to the problem of wastewater discharges into the Thames Tideway have been under examination for more than ten years. The project, in conjunction with the Lee Tunnel and upgrades to London's sewage treatment works, has been determined to be the most technologically sound and cost-effective means of controlling discharges and satisfying regulatory requirements. This has been confirmed by independent studies and by Thames Water.

The Secretary of State for Environment, Food and Rural Affairs, Caroline Spelman, issued a written Ministerial Statement on 7 September 2010 confirming the coalition Government's support for the construction of the tunnel to address unsatisfactory overflows from West London to Beckton. She declared that: “a Thames Tunnel continues to offer (by far) the lowest cost solution to the problem and I believe Thames Water should continue to press forward with this project working with Ofwat, the Environment Agency and Defra on the regulatory, commercial and planning processes”.

On the 26 March 2012, Caroline Spelman announced the designation of the Waste Water National Policy Statement. This National Policy Statement sets out a justification for new wastewater infrastructure and provides information on two potential nationally significant infrastructure projects, one of which is the Thames Tunnel project. The statement establishes the need for the Thames Tunnel project and allows us to take the project forward without facing unnecessary delays, while ensuring that local people have an opportunity to have a say on how their communities develop.

The project is a linear infrastructure scheme, the primary objective of which is to capture discharges from 34 of the most unsatisfactory CSOs that discharge into the River Thames in order to meet EU and UK legal requirements.

The combined sewage (untreated sewage combined with rainwater) that currently flows directly into the River Thames from CSOs would be captured and stored in the main tunnel system (the 'main tunnel') and the connection tunnels. The flows would then be transported along the tunnel, from west London to Abbey Mills in east London. From Abbey Mills, the flows would be transferred via the Lee Tunnel to Beckton Sewage Treatment Works (STW) for treatment.

The preferred route of the main tunnel would be approximately 25km long and would pass under the administrative areas of 14 London local authorities in order to intercept the identified CSOs.

In order to determine the preferred scheme, we have undertaken a site selection process, using a methodology that was adopted following consultation on the proposed methods with the relevant local authorities.
and pan-London stakeholders. The methodology is described in detail in the *Site selection methodology paper* (see Volume 2).

2.4.5 Further details of the project’s technical requirements are provided in the *Site selection background technical paper* (see Volume 2).

### 2.5 Sites required to construct and operate the project

2.5.1 The *Site selection background technical paper* explains the engineering requirements that have informed the site selection process. The key high level points are summarised below.

2.5.2 Two principal types of site would be required to construct and operate the project:

a. CSO sites (CSO interception works and connection tunnels)

b. main tunnel sites.

2.5.3 There would also be a requirement for minor works to take place at sites at various locations along the route of the main tunnel. These works have not generally formed part of the site selection process as they would be small in nature and dictated by engineering requirements, with the exception of certain works put forward as alternatives to CSO interceptions (see Volume 2, *Site selection background technical paper*, Table 2.1 and Section 3.2 for further discussion on ‘indirect’ control of CSOs).

**CSO sites**

2.5.4 The location of CSO sites is governed by the location of the existing combined sewers. Therefore the search area for CSO sites was localised around the vicinity of the existing CSO and was dependent on the sewer network upstream and downstream of the current overflow structure and the river outfall/outlet location.

2.5.5 Construction works at CSO sites would normally take place over two and a half to three and a half years; however, depending on the complexity and scale of the construction activities required, the period may extend up to five years.

2.5.6 CSO site size requirements would vary depending on the combination of circumstances at each site. The size of sites situated in London

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1 Since the *Site selection methodology paper* was first developed in 2008 and in various reports produced along the way, there have been some changes to phrases and terms on the project. The main change that is relevant to site selection is the terms used to refer to different types of site, which have been updated to use more specific terms for main tunnel sites. There are potentially three types of site required to construct the main tunnel: a. main tunnel drive sites; b. main tunnel reception sites and c. main tunnel intermediate sites. In the *Site selection background technical paper* the site area requirements and site activities set out are similar for main tunnel reception sites and main tunnel intermediate sites. Therefore, the site selection methodology was used to identify and shortlist two different types of main tunnel site: a. main tunnel drive sites and b. main tunnel reception/intermediate sites. At the start of the site selection process, these two site types were termed: a. ‘main shaft sites’ (later termed ‘main tunnel drive sites’) and b. ‘intermediate shaft sites’ (later termed ‘main tunnel intermediate sites’ and also ‘main tunnel reception sites’).
Clay/Lambeth Group/Thanet Sand formation geology would range from 1500m$^2$ to 5000m$^2$. Sites situated in Chalk geology would range from 1500m$^2$ to 7500m$^2$. Occasionally, for CSO sites in Chalk, which would require a large, deep drop shaft using diaphragm wall techniques and a large connection tunnel, sites may need to be 12,000m$^2$.

**Main tunnel sites**

2.5.7 The area of search for main tunnel sites extends as far west as the westernmost CSO to be intercepted by the main tunnel (Acton CSO) and as far east as the end point for treatment, which is Beckton STW. An area 500m north and 500m south of the River Thames defined the northern and southern edges of the area of search, although it was acknowledged that these limits needed to be applied flexibly.

2.5.8 It was also necessary to extend the area of search to Abbey Mills Pumping Station once we recognised the potential to use this site as the end point of the main tunnel (transferring flows from Abbey Mills to Beckton STW via the Lee Tunnel).

2.5.9 Main tunnel sites comprise two types of site:

a. main tunnel drive sites
b. main tunnel reception sites.

2.5.10 We also identified that there may be a need for main tunnel intermediate sites.

2.5.11 Main tunnel drive sites would be used to install and then drive the tunnel boring machine (TBM), and would need to be able to accommodate excavated material, primary lining and support facilities.

2.5.12 Main tunnel reception sites would be used to remove the TBM from the tunnel at the end of the drive.

2.5.13 Where an intermediate site was required, it would be used to gain access to the tunnel bore during construction for inspection, maintenance and secondary lining, if necessary.

2.5.14 Main tunnel drive sites would generally be required for six years for construction purposes and both main tunnel reception sites and intermediate sites would be required for four to five years.

2.5.15 In terms of size, main tunnel drive sites would normally be between 18,000m$^2$ and 20,000m$^2$, depending on the geology, and main tunnel reception sites and intermediate sites would be between 5,000m$^2$ and 7,500m$^2$. If required, a main tunnel double drive site (used for two drives, driving the tunnel in opposite directions) would be between 20,000m$^2$ and 40,000m$^2$ in size, again depending on the geology.

2.5.16 During phase one consultation, we received comments in relation to site size. We re-examined our assumptions and concluded that it was possible to consider smaller sites in non-Chalk geology locations (approximately from Hammersmith Bridge to the Battersea area). We took this into account in reviewing sites prior to phase two consultation. It is possible to achieve smaller sites by raising the height of buildings and
structures, and by reducing the time that excavated material would be stored on site. For example, by adopting such measures, a main tunnel drive site could be reduced from approximately 18,000m$^2$ to approximately 15,000m$^2$. However, the more constrained construction activities become, the more likely it is that there might be adverse impacts on factors such as transport of materials, construction periods, cost, and health and safety. The size of sites in Chalk (approximately from Shad Thames to Abbey Mills) cannot generally be smaller than 20,000m$^2$ due to the large area needed for slurry processing activities.

2.6 **Report structure**

2.6.1 This report is divided into the following sections, which detail the site selection process in a broadly chronological manner:

a. **Section 3: Site selection methodology.** This section explains how we devised and consulted on our site selection methodology, and provides an overview of our approach.

b. **Section 4: Phase one preferred scheme: Site selection process.** This section explains how the preferred sites and route presented at phase one consultation were identified.

c. **Section 5: Between phases one and two consultation: Scheme development.** This section describes why further scheme development work was required following phase one consultation and why further site selection work was undertaken.

d. **Section 6: Phase two preferred scheme: Site selection process.** This explains how the preferred sites and route presented at phase two consultation were identified.

e. **Section 7: After phase two consultation: Review prior to Section 48 publicity.** This section describes the review process and summarises the rationale for our proposed route, drive strategy and sites for Section 48 publicity.
3 Site selection methodology

3.1 Purpose

3.1.1 This section describes the site selection methodology that was developed and agreed prior to being systematically applied in order to identify the sites required to construct and operate the project.

3.1.2 We decided that it was important to develop a bespoke site selection methodology given the scale of the proposed project and the fact that construction would take place within a heavily constrained urban environment. We had regard to relevant policy and best practice in devising our methodology. We also consulted potentially affected local authorities and other stakeholders on our proposed methodology.

3.1.3 The Site selection methodology paper and Site selection background technical paper are the main documents that guided our site selection process (the latest versions of both papers are provided in full in Volume 2).

3.2 Consultation on methodology

3.2.1 Prior to identifying any site that might be needed for the project, we recognised that it was important to consult on our draft methodology in order to ensure that it represented the most appropriate means of selecting the sites required.

3.2.2 The draft Site selection methodology paper was subject to two rounds of consultation with the potentially directly affected London local authorities and other strategic pan-London stakeholders in Autumn/Winter 2008 and Spring 2009. As part of the 2008 consultation, we held a series of three workshops to provide additional background information on the project to stakeholders and to provide them with an opportunity to discuss the site selection methodology (and Stakeholder and community engagement strategy (May 2009)) in more detail.

3.2.3 The general approach and principles behind the methodology were broadly supported by consultees. Beyond the overall support for the methodology, most comments related to detailed aspects of the methodology and were grouped under the following topic headings: number and distribution of main tunnel sites; availability of land; use of the river; site restoration and after-use; additional assessment criteria; environmental mitigation; local authorities input on the site selection process; engagement on potential sites; confidentiality of sites under consideration (prior to the preferred site stage); route to consent; cumulative impact of CSO sites; relationship of the project with other infrastructure projects; and Thames Water’s relationship with potentially affected London local authorities and other stakeholders.

2 In light of new government guidance on consultation, this strategy was revised and became the Statement of Community Consultation and Community Consultation Strategy, which were subject to further rounds of consultation in Autumn 2011)
3 Site selection methodology

3.2.4 Each of the comments was considered and addressed as appropriate and a number resulted in changes to the draft methodology. These changes involved providing further justification or clarification of the proposed approach in light of the comments raised or including additional information or activities.

3.2.5 The Site selection methodology paper was finalised, distributed to consultees and published in May 2009.

3.2.6 A third round of consultation on changes to the Site selection methodology paper was carried out in Summer 2011. The changes were incorporated to reflect the introduction of an additional phase of consultation on the project. No concerns were raised in relation to the amendments and they have had no bearing on the approach and principles set out and followed in the agreed methodology.

3.2.7 The Site selection methodology paper was re-distributed to consultees and re-published in Summer 2011 (see Volume 2).

3.3 Principles of site selection

3.3.1 The key principles utilised throughout the site selection process can be summarised as follows:

a. application of best practice, reflecting the principles and requirements of relevant planning policy and sustainability guidance

b. a collaborative, multidisciplinary approach taking into account engineering, planning, environment, community and property considerations and the exercise of professional judgement

c. acknowledgement of the iterative relationship between site selection and engineering design processes and the use of information available at that stage of the project development.

3.3.2 It has always been Thames Water’s intention to be transparent, accountable and fair in how sites are selected, and this started with the preparation, consultation and publication of the Site selection methodology paper. The methodology was developed in the absence of any statutory requirement or specific guidance other than the general planning policy principles set out in Planning Policy Statement 1: Delivering Sustainable Development (2005) (PPS1) and Planning Policy Statement 10: Planning for sustainable waste management (2005) (PPS10). The methodology approach was broadly supported by the affected local authorities and pan London bodies. Since the publication of the methodology, PPS1 has been cancelled and replaced with the National Planning Policy Framework however the relevant principles that were included in PPS1, which underpinned Thames Water’s approach to site selection, remain.

3.3.3 We are also aware that since the publication of our methodology, the National Policy Statement for Waste Water (NPS) has been designated and is now the primary planning policy document for consideration of the Thames Tunnel (NPS) scheme. The NPS was devised having regard to relevant national planning policy documents. In the event of any conflict between the NPS and any other policy document, the NPS prevails for the
purposes of the determination of an application for a development consent order for a Nationally Significant Infrastructure Project. The NPS does not specifically require an applicant to undertake a particular site selection process in preparing an application for a development consent order. However there is a generic policy for assessment of waste water schemes in the NPS, relating to land use which accords with the principles in PPS 1, and acknowledges that whilst the re-use of previously developed land can make a major contribution to sustainable development this may not always be possible for some forms of infrastructure.

3.3.4 Overall therefore the approach taken in the methodology accords with the national policies and the NPS. The implementation of the methodology has broadly followed these principles and used a high level assessment of the adopted local policies that are consistent with these national policies.

3.3.5 The aim of the site selection process was not to try to identify every piece of land within the defined search area, but rather to identify realistic alternative sites. It should also be recognised that as London is a dense, complex urban environment, most potential sites are subject to some form of constraint or issues that may require mitigation measures to render them suitable sites for development activities.

3.4 Overview of approach

3.4.1 Figure 3.1 overleaf illustrates the site selection process.
3. Site selection methodology

Figure 3.1 Site selection flowchart

Thames Tunnel site selection methodology
Main tunnel and CSO sites

Preliminary stage
- Define site requirements and areas of search
- Produce draft methodology 12-week consultation period on draft methodology
- Data collection

Consultation, review and feedback
- Methodology
  - Review responses and make revisions
  - Consultees to comment on revised methodology and summary of comments (28 days)
  - Send consultees final methodology

Stage 1
Site identification, criteria and assessment

- Long list
  - Table 2.2
- Draft short list
  - Table 2.3
  - Project team review workshop
  - Summary of shortlisted sites
- Final short list
  - Site suitability reports
  - Engineering options reports
  - Project team optioneering workshops
  - Preferred scheme report
- Preferred list

Stage 2
Consultation on preferred list of sites

- 12-week consultation period
  - Stakeholder briefings
  - Exhibitions
  - Information giving

Stage 3
Selected sites

- Review consultation responses and technical assessments
- Revise and determine if any key sites may drop out then find replacement sites
- Confirm or modify list of preferred sites to arrive at selected sites
- Final report on site selection process
- Monitor selected sites

Back-checking and targeted repeat of stages 1-3 in event of material changes in circumstance and/or to find new replacement sites, if needed:
- Identify and assess new potential replacement sites by working back through the process
- Create an updated list of preferred sites
- Carry out a targeted consultation exercise on these new sites
- Analyse consultation responses
- Incorporate any new replacement sites into selected list of sites

Final list
Send to consultees:
- Notify consultees of list of selected sites and final report on site selection process and future opportunities to comment on Thames Tunnel project

3.4.2 The following sections provide further detail on the preliminary stage and the three main stages of the site selection process.
3.5 Definition of site area of search

3.5.1 We identified potential sites for the construction and operation of the main tunnel within an area of search that extended from west London to Beckton STW and 500m either side of the banks of the River Thames. We sought to identify sites that might be suitable for two categories of main tunnel site:

a. main tunnel drive sites
b. main tunnel reception sites and intermediate sites (which require a similar site size).

3.5.2 The site search area excluded London’s four World Heritage Sites and existing housing within concentrated residential areas. The desktop search exercise was conducted by examining sources such as aerial photographs, Ordnance Survey maps and atlases.

Figure 3.2 Initial site search area: Main tunnel sites

3.5.3 We approach the site search area for CSO sites in a different way. It is more localised than the search area for the main tunnel sites described above as CSO sites is more constrained by the location of the existing CSOs. Each CSO had its own area of search, and the extent of each area of search varied depending on the sewer network upstream and downstream of the current overflow structure and the river outfall/outlet location. It is not possible to define a universally applicable site search area. However, all CSO sites needed to be as close to the existing line of the sewer as practicable, subject to the availability of suitable sites in the vicinity. The search area could also include the river.

3.5.4 Generally, we defined ‘a site’ as an area with boundaries that could be readily distinguished and defined of sufficient size to accommodate at
least the drop shaft. We exercised professional judgement to determine whether sites were potentially large enough to accommodate either a main tunnel site or CSO site, or whether they could be linked to another site in order to perform that function. We also had regard to practical river linkages (ie, distance from and route to the river).

3.6 **Overview of stages of the methodology**

3.6.1 In summary, the *Site selection methodology paper* comprises three main stages, which are set out below.

**Stage 1**

3.6.2 This stage comprises a site identification and filtering process, carried out in three main parts:

- a. 1A: creation of a long list of potential sites, along with an explanation of how information will be verified and moved to part 1B;
- b. 1B: creation of a short list of potential sites, along with an explanation of how information will be verified and moved to part 1C;
- c. 1C: creation of a preferred list of sites, along with an explanation of how information will be verified and moved to Stage 2.

**Stage 2**

3.6.3 This stage involves consultation on the preferred scheme. The consultation included seeking feedback on:

- a. a series of preferred CSO sites and main tunnel sites
- b. a preferred main tunnel route
- c. other previously considered sites and routes.

3.6.4 The overall output from Stage 1 is identification of the preferred scheme to be taken forward for consultation. The consultation activities applied to all the preferred sites identified, ie main tunnel sites and CSO sites. More details on how consultation was carried out are contained in the *Statement of community consultation* and the *Community consultation strategy*.

3.6.5 It should be noted that the *Site selection methodology paper* describes the overall process in terms of stages, but the external consultations was referred to in terms of phases of the project. In order to explain the relationship between these processes, each phase of consultation undertaken is discussed separately below. Following phase one consultation, we undertook a targeted repeat of Stage 1, which led to our preferred scheme for phase two consultation. After phase two consultation was followed by Stage 3 and a review of the scheme.

**Phase one consultation**

3.6.6 We launched our phase one consultation on 13 September 2010 for a period of 14 weeks until 20 December 2010. We subsequently decided to extend this to a total of 18 weeks, and the consultation closed on 14 January 2011. Phase one consultation included a series of staffed exhibitions across the preferred route. It provided an opportunity to hear
the views of communities living in the vicinity of the preferred and shortlisted sites, statutory consultees and any other interested parties across all three potential main tunnel routes.

3.6.7 During phase one consultation we consulted on the need for the project; the alternatives to a tunnel; our work to establish our preferred scheme (including other shortlisted sites and routes considered); engineering, planning, environmental, community and property issues raised and considered during our site selection work; and our initial ideas for the permanent structures once construction work is complete.

3.6.8 We undertook a range of pre-consultation activities to ensure that the phase one consultation was as effective as possible, and a variety of activities were undertaken as part of our core phase one consultation. These activities are described in our Report on phase one consultation.

3.6.9 The Report on phase one consultation included an analysis of the consultation responses received and provided recommendations as to where further work was required. The report also identified potential mitigation measures to address issues raised by the local community and stakeholders. Consultation comments and recommendations relating to site selection matters were then fed into a targeted repeat of Stage 1 (‘back-check’) of the site selection process. Along with further technical information, the back-check process helped to inform and shape the development of the phase two preferred scheme.

**Phase two consultation**

3.6.10 Following publication of the original Site selection methodology paper, the Government announced its intention to bring the project within the remit of procedures for nationally significant infrastructure projects established by the Planning Act 2008.

3.6.11 In order to ensure that consultees had an opportunity to participate early in the process while options were still under consideration (and, where possible, influence the scheme), Thames Water decided that it would be appropriate to have two phases of consultation, in which proposed changes to the phase one preferred scheme would be consulted on.

3.6.12 We launched our phase two consultation on 4 November 2011 for a period of 14 weeks until 10 February 2012. Phase two consultation again included a series of staffed exhibitions across the preferred route at venues as close as possible to the preferred sites. The Report on phase two consultation sets out the process we undertook in order to carry phase two consultation and analyse the feedback.

**Stage 3**

3.6.13 This is last stage in the Site selection methodology paper. Stage 3 includes the back-check process. If any of the main tunnel, intermediate or CSO sites are eliminated for any reason, if there are significant changes of circumstances in relation to existing sites or combinations of sites, if new or replacement sites are required or found, or if the engineering design develops in unexpected ways, we would need to undertake a targeted repeat of Stages 1 to 3 in order to fill in any site gaps.
3.7 Application of the methodology

3.7.1 The methodology was subject to consultation with local authorities and other stakeholders and was published before it was applied to all the sites across the route. We implemented the site selection methodology in order to arrive at the preferred sites and the preferred route that make up the preferred scheme.

3.7.2 The first stage of the process is described as Stage 1A to 1C in the Site selection methodology paper. This stage comprised: identification of sites for inclusion on a long list; assessment of sites on the long list and draft short list; and detailed review and assessment of all sites on the final short list, alongside tunnelling options, to produce the preferred sites and the preferred route that make up the preferred scheme. Section 4 describes this process for the scheme presented at phase one consultation in full and Section 6 adds further detail on how it was applied to the scheme presented at phase two consultation.

3.7.3 Stage 2 of the methodology was to undertake consultation on the identified sites. The main consultation issues are summarised in sections 4, 5 and 6 of this report and a full account is provided in the Report on phase one consultation, Report on phase two consultation and the Report on consultation for the submission of the application.

3.7.4 Stage 3 of the Site selection methodology paper was to review the identified sites, complete a targeted repeat as required and select the final sites. The targeted repeat or back-check carried out between the phase one and phase two consultation is described in Section 5, and the review of the proposed sites for Section 48 publicity is described in Section 7.

3.7.5 After Section 48 publicity, a final review will be undertaken to consider any comments and any new information. This final review will be presented in the Final report on site selection process.
4 Phase one preferred scheme: Site selection process

4.1 Introduction

4.1.1 This section explains how we implemented the site selection methodology in order to arrive at the preferred sites and preferred route presented at phase one consultation.

4.1.2 This stage of the process is described as Stage 1A to 1C in the Site selection methodology paper (see Volume 2). It comprised: identification of sites for inclusion on a long list; assessment of sites on the long list and draft short list; and detailed review and assessment of all 123 sites on the final short list alongside tunnelling options in order to produce the preferred sites and preferred route that make up the preferred scheme.

4.1.3 The Preferred Scheme Report, which was prepared for phase one consultation, explains in detail how we identified the phase one consultation scheme. The remainder of this section summarises the information set out in that report as summarised in the Project Overview.

4.1.4 All the information and assessments contained in Section 4 are based on the information available at the time that related to this stage in the project’s development.

4.2 Main tunnel routes

4.2.1 In developing the preferred phase one scheme, we considered a range of routes for the alignment of the main tunnel. The River Thames route was the original route proposed, which would allow the tunnel to run west to east, broadly following the River Thames to Beckton STW. The Rotherhithe Route was considered as it could potentially shorten the tunnel without taking the route too far away from the CSOs that need to be intercepted. The Abbey Mills Route was also considered after further design work found that there was the potential to connect the main tunnel to the Lee Tunnel at Abbey Mills Pumping Station.

4.2.2 The three proposed routes are described below and illustrated in figure 4.1:

a. River Thames Route: the alignment of this route would broadly follow the river from west London to Beckton STW. The route would cut across the Greenwich Peninsula, reducing the length of the tunnel at a location where no CSOs need to be intercepted along the river. This route was derived from the 2006 Option Development Report.\(^3\)

b. Rotherhithe Route: the alignment of this route is similar to the River Thames route, but would cut across the Rotherhithe Peninsula as well

as the Greenwich Peninsula, which would reduce the length of the main tunnel by approximately 1.8km but would also require longer connection tunnels from some CSOs to the main tunnel.

c. Abbey Mills Route: this route is different to the River Thames and Rotherhithe routes as it would connect the main tunnel to the head of the Lee Tunnel at Abbey Mills Pumping Station. The upstream tunnel system would be the same as the other two routes between west London and Rotherhithe, but it would then move north east away from the River Thames to Abbey Mills Pumping Station. The length of the main tunnel would be approximately 9km shorter than the River Thames Route. The length of the connection tunnels would increase east of where the tunnel would diverge from the river towards Abbey Mills. The flows from the main tunnel would be transferred to Beckton STW via the Lee Tunnel.
In developing the phase one preferred scheme, we identified sites for all three route alignments described above.
4.3 **Stage 1: Overview**

4.3.1 There were three main parts to the identification, assessment and filtering process of sites across all of the three main tunnel routes at Stage 1:

a. 1A: creation of a long list of potential sites
b. 1B: creation of a short list of potential sites
c. 1C: creation of a preferred list of sites.

4.3.2 The creation of each of the above lists for CSO and main tunnel sites is described below.

4.4 **Part 1A: Creation of a long list of sites**

**CSO sites**

4.4.1 The long list of CSO sites was created by conducting a desktop survey of the land either side of the existing sewers for the 34 unsatisfactory CSOs in order to identify potential sites of an appropriate size. The extent of the search varied for each CSO depending on the sewerage system.

4.4.2 It is preferable for CSO sites to be close to the sewer requiring interception in order to simplify construction and the connection to the main tunnel. Some flexibility was introduced so as not to restrict the number of potential sites, given the need to identify enough sites to find the most suitable sites, in accordance with our methodology. In this respect, we did not set any fixed distances between the CSO site and the interception of the sewer overflow; instead, we exercised professional judgement to identify sites in proximity to the sewer.

4.4.3 Through this process, we identified 373 potential sites for the long list of CSO sites (at this point, all three potential tunnel routes were still under consideration).

**Main tunnel sites**

4.4.4 We created the long list of main tunnel sites by conducting a desktop survey of the land within the site search area by London local authority. We examined sources such as aerial photographs, Ordnance Survey maps and atlases.

The search extended from west London to Beckton STW and 500m either side of the banks of the River Thames, as shown in Figure 3.2. The site search area excluded London's four World Heritage Sites and existing housing within concentrated residential areas.

4.4.5 This search allowed us to identify sites that might be suitable for two categories of main tunnel site:

a. main tunnel drive sites
b. main tunnel reception sites and intermediate sites (these were considered together as the size of site required is similar).

4.4.6 Through this search, we identified 769 potential sites for the long list of main tunnel sites (at this point, all three potential tunnel routes were still
Phase one preferred scheme: Site selection process

under consideration). Sites on the long list were plotted on a map using a
geographical information system (GIS).

4.5 Part 1B: Creation of a draft short list of sites

Assessment criteria

4.5.1 We assessed the potential main tunnel sites and CSO sites on the long list
against the considerations and values set out in table 2.2 of the Site
selection methodology paper under the headings of engineering, planning,
environment, community and property. For CSO sites, we added an
additional engineering criterion to the assessment at Table 2.2 entitled
‘Location (proximity to sewer to be intercepted)’ in order to take account of
whether the interception was within, adjacent to or remote from the CSO
site. This allowed us to undertake a preliminary high-level assessment of
sites.

Results of the assessment of the long list of sites

4.5.2 Following reviews and engineering design developments relevant to site
selection, we selected 109 out of 769 potential main tunnel sites and 152
out of 373 potential CSO sites for the draft short list. We exercised
professional judgement in the application of planning, environmental,
community and property considerations and emerging engineering design
requirements in order to determine whether or not a site should move from
the long list to the draft short list of sites.

4.6 Part 1B: Creation of the short list of sites

Assessment criteria

4.6.1 The next part of the process comprised an assessment of potential main
tunnel and CSO sites on the draft short list against more detailed
engineering, planning, environmental, community and property
considerations, as set out in table 2.3 of the Site selection methodology
paper, utilising technical knowledge and professional judgment. For CSO
sites, we added an additional engineering criterion to the assessment at
Table 2.3 entitled ‘Connection feasibility’ in order to take account of how
simple or complex the connection would be.

4.6.2 This stage of the assessment built upon the information collected at the
long list stage, focussing on more detailed considerations for each site and
allowing for further refinements. This assessment was not intended to be
exhaustive, and we recognised that if further issues were identified as the
project evolved, they would also be included for assessment and back-
checking purposes.

Results of the assessment of the draft short list of sites

4.6.3 On completion of this stage, and taking into account engineering design
developments relevant to site selection, we selected a total of 59 of 109
potential main tunnel sites and 77 of 152 potential CSO sites for the draft
short list of sites.
4.6.4 The majority of the main tunnel sites recommended for the draft shortlist of sites were located on operational industrial land, including land occupied and in active use by warehouses and industrial wharves, followed by sites in public open space and parkland. A much lower number were located on vacant land, construction plots or vacant industrial land. The remainder of the sites included sports grounds, playing fields, vacant wharves, riverside basins, general commercial land, foreshore, operational Thames Water land and car parks.

4.6.5 The majority of the CSO sites recommended for the draft short list of sites were located on industrial land. A much lower number were located on land occupied by general commercial businesses or by an operational Thames Water pumping station. The remainder were located on parking areas, playgrounds, gardens, roads and public footpaths, or wooded areas.

4.6.6 The purpose of the Table 2.3 assessment was to identify factors that would be likely to prevent development from taking place; identify restrictions that would need to be addressed for a site to be taken forward to the next stage; and to identify sites that were least constrained and therefore most suitable for development. For example:

a. In engineering terms, we considered a site to be ‘least suitable’ for development as a main tunnel drive site if there was no wharfage available and access by road was severely restricted.

b. In planning and environment terms, we considered a site to be ‘least suitable’ for development if there were a number of designations that would conflict with the use of the site for the project and could not be adequately resolved or mitigated.

c. In property terms, a site was considered to be ‘least suitable’ for development if it was in the ownership of the Crown or a public body, for operational reasons or if acquisition costs were likely to be excessive.

d. In community terms, a site was considered to be least suitable for development if it was in close proximity to sensitive receptors and the characteristics of the area also needed to be considered.

Consultation on provisional short list of sites

4.6.7 Before finalising the short list of sites, we arranged a series of meetings with the potentially affected London local authorities and other pan-London statutory consultees to discuss the provisional short list. These were held between July and September 2009 in order to verify that no specific sites or general site location factors had been overlooked in our assessment process and to seek confirmation, as far as possible, that the most appropriate sites had been identified for inclusion on the short list.

4.6.8 This consultation was undertaken on a confidential basis to avoid undue anxiety and potential blight within the local community. This approach accords with the Government’s 1999 Code of Practice on the Dissemination of Information.
4.6.9 Overall, there was general support from stakeholders for the implementation of the site selection methodology up to the provisional short list stage. There were concerns raised over the use of parks and open space for construction sites, and the impact of the proposals on regeneration opportunities and sites that have planning permission. The use of foreshore areas was less well received by Port of London Authority and Environment Agency representatives, but there was a more positive reaction from the London local authorities due to the constraints of the urban environment.

4.6.10 All consultees supported the use of river transport for main tunnel sites, where feasible. Some consultees queried why river transport could not be promoted for CSO sites in the same way as for main tunnel sites. Suggestions to potentially use permanent works adjacent to or on the river as viewing areas were also raised by some local authorities, and this opportunity was examined further.

4.6.11 At the majority of meetings, consultees were able to provide site specific comments for some or all of the shortlisted sites within their area. A number of consultees provided additional written comments following the meeting.

4.6.12 This local authority and stakeholder consultation process led to further refinements to the short list and seven main tunnel sites and six CSO sites were removed from the provisional short list. These sites were generally removed either because they were no longer available as other development had commenced (or was due to commence) on site, or because a number of stakeholders raised serious concerns regarding suitability.

4.6.13 We also undertook a further round of consultation with potentially affected London local authorities and other pan-London statutory consultees on the provisional short list between January and March 2010. We took the opportunity to verify comments previously submitted and to update information, where appropriate. This process further informed the selection of the preferred sites.

Results of assessment of the final short list of sites

4.6.14 We selected 52 out of 109 potential main tunnel sites and 71 out of 152 potential CSO sites in order to arrive at our final short list, with a total of 123 sites. Parallel design development activities had revised the number of CSOs requiring direct interception from 34 to 21 (or 22 on the Thames River or Rotherhithe routes) (see Site selection background technical paper (Spring 2010) available on Thames Water website).

4.6.15 All the final shortlisted sites are shown in Table 4.1 (main tunnel sites) and Table 4.4 (CSO sites) in Sections 4.8 and 4.9 below.
4.7 **Part 1C: Creation of the preferred list of sites**

4.7.1 This section describes the third part of Stage 1 and how we assessed the sites on the short list and the potential tunnelling drive options in order to arrive at the preferred list of sites.

4.7.2 The preferred list of sites was created from a total of 123 shortlisted sites, which were split across 21 CSO sites and 11 main tunnel site zones. This process involved three steps; the first two took place concurrently and the third step brought together the findings of the first two stages:

a. We assessed the suitability of all sites on the final short list in more detail in **site suitability reports**.

b. An **engineering options report** was produced which sets out tunnel drive options and CSO connection types for the three potential route alignments, with regard to the availability and spacing of main tunnel shortlisted sites.

c. **Optioneering workshops** were held to bring together the disciplines to discuss key factors from the site suitability reports and engineering options report in order to determine the preferred drive options and associated sites.

4.7.3 It should be noted that there is an important relationship between tunnel drive optioneering and site selection. It is necessary to consider how the potential main tunnel sites link together to form possible drive options for construction of the main tunnel and to consider that shortlisted main tunnel sites were assigned to particular zones. Furthermore, it was important to recognise how the various combinations of zones and types of main tunnel site (drive or reception) were identified as possible drive options by taking into account the system design and engineering requirements for the project.

4.7.4 The remainder of this section provides a summary of the above activities and the subsequent selection of the phase one preferred scheme. The process described above to identify our preferred scheme for phase one consultation was also reported in our **Preferred Scheme Report** and summarised in the **Project Overview** published at phase one consultation.

4.8 **Site suitability reports**

4.8.1 We produced individual site suitability reports for each of the sites on the final short list (CSO and main tunnel sites) which specifically addressed the following disciplines:

a. engineering

b. planning

c. environment

d. community

e. property.
4.8.2 A summary of all pre-phase one consultation site suitability reports is provided in Volumes 3 to 5, Appendices A to W, Section 2 in each appendix.

4.8.3 We collected detailed site level data and exercised professional judgement and experience of similar tunnelling and large infrastructure projects in order to assess each of the sites. Each site suitability report contained site-specific information and an explanation of how the site would be used. For example, a main tunnel site might serve as a main, intermediate/reception site, or in combination (known as a ‘split site’). A CSO site might be large or small depending on the construction activities required, and main tunnel sites could be combined with CSO sites.

4.8.4 The specific considerations relevant to each of the disciplines are set out in more detail below.

**Engineering**

4.8.5 The engineering considerations for each shortlisted site comprised various drawings (described below) and a written assessment.

4.8.6 The site-specific drawings outlined:
- available information on (a) existing and known proposed tunnels, (b) significant underground utilities and (c) geological strata below the site
- an indicative construction layout, including potential road access and, where applicable, jetty/wharfage facilities
- an indicative operational layout showing the main permanent above-ground features and potential permanent access.

4.8.7 Generic photographs of typical construction activities for main tunnel sites and CSO sites were provided. The drawings and the photographs aided all disciplines to assess sites.

4.8.8 Engineering assessments commented on accessibility, construction works considerations, permanent works considerations and any significant health and safety issues.

4.8.9 The final conclusion of the engineering assessment recommended the general level of suitability of the site in engineering terms, based on the relevant considerations and professional judgement.

**Planning**

4.8.10 The planning assessment for each shortlisted site was carried out in four parts, which focused on the relevant planning history and the identification and review of associated planning policies and designations. It also considered the consultation responses from local authorities and strategic pan-London consultees, as part of on-going engagement process.

4.8.11 The first part of the planning assessment considered the planning history of the site for the preceding five years (based on the normal period of validity of planning permissions), which was taken from the Local Planning Authority online database.
4.8.12 Where a significant extant permission was found, for example for a major redevelopment, we considered the details of the application. During visits to short listed sites, we checked if any development had commenced on site. If we found no reasonable level of development activity on site, the timescales for implementation of the planning permission remained unknown and we recorded a planning issue against the site. Where development had commenced on site, the status was re-evaluated at the workshop, taking account of the nature of the new proposal, and the site was not progressed further.

4.8.13 The second and third parts of the planning assessment focused on the existing policy context of each site. This was conducted through a map-based desktop appraisal of designations from each of the affected London local authorities and covered areas such as:

a. existing and proposed site allocations
b. public open space
c. Metropolitan Open Land
d. tree preservation orders
e. sites of importance for nature conservation (SINCs)
f. listed buildings
g. conservation areas
h. archaeology priority areas
i. safeguarded wharves
j. Thames Policy area
k. protected views
l. opportunity and regeneration areas
m. contaminated land
n. air quality protection zones
o. strategic transport routes
p. pedestrian and cycle routes.

4.8.14 The planning context section provided a factual list of the planning designations applicable, both on and adjacent to each shortlisted site, supported by a short summary of the wording of each related planning policy.

4.8.15 This section was followed by a planning commentary on how likely the proposed main tunnel and CSO construction works were in conformity with relevant policies and potential mitigation measures. Consideration was also given to how any post-construction permanent structures may affect identified designations.

4.8.16 Site designations relating to heritage, landscape, ecology and transport were assessed from a policy point of view and further assessments were carried out by specialists as part of the environment assessment.
4.8.17 The fourth element incorporated the factual comments received from local authorities and strategic pan-London stakeholders in response to a series of on-going consultations that were undertaken during 2009 and 2010. All shortlisted sites were presented for comment. The local authorities were also presented with information on the planning history and an audit of local community groups for verification.

4.8.18 The final conclusion of the planning assessment recommended the general level of suitability of sites in planning terms, based on the relevant considerations and professional judgement.

**Environment**

4.8.19 Considerations of environmental matters concentrated on nine technical specialists:

a. transport
b. archaeology
c. built heritage and townscape
d. water resources – hydrogeology and surface water
e. ecology (aquatic and terrestrial)
f. flood risk
g. air quality
h. noise
i. land quality.

4.8.20 Each technical specialist conducted an appraisal of potential impacts arising from the construction works and operational structures. The appraisal was based on a desktop review of existing data, information obtained through site visits and on professional judgement. The appraisal for each of the technical specialists identified receptors that may be affected, the nature of possible impacts on these receptors, potential requirements for mitigation, and further studies to minimise or avoid adverse impacts. This information was subsequently taken into consideration in determining the likely site suitability for each technical specialist.

4.8.21 Subsequent to the individual appraisals for each technical specialist, we formed an overall conclusion of site suitability in environmental terms and gave appropriate consideration to the findings of all the environmental technical specialists. We took account of the value and number of receptors likely to be affected, the type of measures likely to be required to avoid or reduce adverse impacts, the potential to mitigate adverse impacts, and the level of suitability attributed to the site by each specialist. The environment conclusion was based on the potential cumulative environmental impacts associated with each site and the application of the specialists’ professional judgement.
Community

4.8.22 This assessment focused on any important socio-economic and community impacts and issues. We based these considerations on professional judgement, information gained from site visits and relevant desktop data and research.

4.8.23 The main areas for consideration were as follows:

a. review of the social economic profile of the area surrounding the site
b. identification of potential issues and impacts from the use of the site on the local community.

4.8.24 The consideration of issues and impacts focused on the potential implications of using a site for the project from a community perspective, such as proximity to sensitive receptors and impact on local businesses. These issues were identified, commented on and any potential mitigation measures suggested, where appropriate.

4.8.25 The conclusions of the community assessment identified the general level of suitability of the site in community terms, based on the relevant considerations listed above and the exercise of professional judgement.

Property

4.8.26 The property considerations focused on issues of procedural risk and the potential for compensation events. We established the level of suitability of a site through a cumulative process, which sought to consider relevant property factors based on available data and professional judgement. The property assessment also used the planning history to inform acquisition valuations of the shortlisted sites and consider prospects for acquisition.

4.8.27 The consideration of shortlisted sites by the property team focused on the following topics:

a. ownership and tenancy details
b. Crown Land or Special Land
c. property valuation comments
d. disturbance compensation
e. off-site statutory compensation
f. site acquisition cost assessment
g. other statutory enquiries.

4.8.28 The property conclusions provided a view on the general level of suitability of the site in property terms, based on the relevant considerations above and the exercise of professional judgement.
4.9 Engineering options report

4.9.1 As a further part of 1C, we produced an engineering options report was prepared in accordance with the Site selection methodology paper and in tandem with the site suitability reports.

4.9.2 The Engineering Options Report (Spring 2010) defined engineering requirements and set out the three main tunnel routes to be taken forward for evaluation. It explained how possible options for delivering the three main tunnel routes have been determined. Possible permutations of tunnel drive scenarios to identify all the feasible drive options, based on the potential number of TBMs used and the main tunnel sites that they could be driven from and received at, for the three tunnel routes and potential shortlisted sites were established in a systematic manner for evaluation.

4.9.3 A discussion of engineering factors to be taken into account (along with planning, environment, property and community factors) in order to determine the preferred sites and associated drive options was also included.

4.9.4 The Engineering Options Report (Spring 2010) described the control and interception of CSO flows, tunnel hydraulic requirements and functional and operational requirements of the system. It described the geology along the route and the implications for the construction of the project, as well as the tunnel engineering and construction requirements and methods. In particular, it clearly set out that the spacing of main tunnel sites, and therefore number of main tunnel sites required, was influenced by the following factors:

a. The TBM types must be appropriate to the geological conditions.

b. There is a need to deliver the project on time.

c. The risk of TBM breakdowns/servicing requirements, and the severity and frequency of these, would increase with the length of the drive.

d. The emergency egress of the construction workforce would become more difficult the longer the length of the drive.

4.9.5 The report explained that to the west of Tower Bridge, all the three proposed routes followed the route of the River Thames. The options for the main tunnel drive and CSO connections for the western end of the scheme were therefore considered as a single alignment option. To the east of Tower Bridge, the three routes were different and were considered separately.

4.9.6 The 52 main tunnel sites on the short list fell principally into two types of site required to construct the main tunnel:

a. main tunnel reception/intermediate sites only

b. main tunnel drive sites (also suitable as reception/intermediate sites).

4.9.7 The characteristics of these site types are described in the Site selection background technical paper (Spring 2010) (see Thames Water website). Furthermore, each shortlisted site is described in detail, and its suitability
for the proposed use assessed and documented in its respective site suitability report.

4.9.8 To assess the total number of combinations of tunnel drive options, the shortlisted sites were grouped into a number of main tunnel zones based on the geographical proximity of sites. We identified 11 zones and Zones S1 and S5 were the same across all three route options. Figure 4.2 illustrates the main tunnel site zones.

Figure 4.2 Main tunnel site zones

4.9.9 Table 4.1 below identifies the shortlisted main tunnel sites within each zone and identifies the type of use for which they were assessed. A more detailed assessment is contained in the specific site suitability report for each of these sites.

Table 4.1 Main tunnel sites by site zone

<table>
<thead>
<tr>
<th>Site zone</th>
<th>Site ID</th>
<th>Site name</th>
<th>Local authority</th>
<th>Site usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>S13RD</td>
<td>St Paul's School playing fields</td>
<td>Richmond</td>
<td>Reception/intermediate site</td>
</tr>
<tr>
<td></td>
<td>S33HF</td>
<td>Vacant land and Thames Water Hammersmith Pumping Station, Chancellor's Road</td>
<td>Hammersmith and Fulham</td>
<td>Reception/intermediate site</td>
</tr>
<tr>
<td>S2</td>
<td>S17RD</td>
<td>Barn Elms</td>
<td>Richmond</td>
<td>Single main drive or reception/intermediate site</td>
</tr>
<tr>
<td>S3</td>
<td>S18WH</td>
<td>Feathers Wharf, The Causeway</td>
<td>Wandsworth</td>
<td>Reception/intermediate site</td>
</tr>
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<td></td>
<td>S69HF</td>
<td>Whiffin Wharf and Hurlingham Wharf, Carnwath Road</td>
<td>Hammersmith and Fulham</td>
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<tr>
<td>S70HF</td>
<td>Carnwath Road</td>
<td>Hammersmith</td>
<td></td>
<td>Reception/intermediate site</td>
</tr>
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</table>
### Phase one preferred scheme: Site selection process

#### Site selection process

<table>
<thead>
<tr>
<th>Site zone</th>
<th>Site ID</th>
<th>Site name</th>
<th>Local authority</th>
<th>Site usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S72HF</td>
<td>S72HF</td>
<td>Industrial Estate, Carnwath Road</td>
<td>Hammersmith and Fulham</td>
<td>Reception/intermediate site</td>
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<td>S4</td>
<td>S76HF</td>
<td>Imperial Wharf, Imperial Crescent/Townmead Road</td>
<td>Hammersmith and Fulham</td>
<td>Reception/intermediate site</td>
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<td></td>
<td>S08KC</td>
<td>Foreshore, Chelsea Wharf</td>
<td>Kensington and Chelsea</td>
<td>Reception/intermediate site</td>
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<tr>
<td>S5</td>
<td>S61WH</td>
<td>Battersea Park</td>
<td>Wandsworth</td>
<td>Double main, single main or reception/intermediate site</td>
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<tr>
<td></td>
<td>S68WH</td>
<td>Battersea Power Station</td>
<td>Wandsworth</td>
<td>Split double main drive, single main drive or reception/intermediate site</td>
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<td></td>
<td>S69WH</td>
<td>Industrial/warehouses, Cringle Street</td>
<td>Wandsworth</td>
<td>Split double main drive, split single main drive, or split reception/intermediate site</td>
</tr>
<tr>
<td></td>
<td>S72WH</td>
<td>Cringle Street (Cringle Wharf)</td>
<td>Wandsworth</td>
<td>Split double main drive, split reception/intermediate or reception/intermediate site</td>
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<tr>
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<td>S73WH</td>
<td>Industrial/warehouses, Tideway Walk</td>
<td>Wandsworth</td>
<td>Split double main drive, split single main drive or reception/intermediate site</td>
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<td>S74WH</td>
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<td>S79WH</td>
<td>Tideway Industrial Estate, Tideway Walk</td>
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<td>Split double main drive, split single main drive or reception/intermediate site</td>
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<td>S80WH</td>
<td>Thames Water Heathwall Pumping Station/Middle Wharf, Nine Elms Lane</td>
<td>Wandsworth</td>
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<td>S87WH</td>
<td>Warehouses, Post Office Way</td>
<td>Wandsworth</td>
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<td></td>
<td>S04WR</td>
<td>Open space, Grosvenor Road</td>
<td>Westminster</td>
<td>Reception/intermediate site</td>
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<td></td>
<td>S11WR</td>
<td>Foreshore, adjacent to Riverwalk House and Vauxhall Bridge</td>
<td>Westminster</td>
<td>Reception/intermediate site</td>
</tr>
<tr>
<td>S6</td>
<td>S54SK</td>
<td>King’s Stairs Gardens, Jamaica Road</td>
<td>Southwark</td>
<td>Single main drive or reception/intermediate site</td>
</tr>
</tbody>
</table>
## Phase one preferred scheme: Site selection process

### Site zone | Site ID | Site name | Local authority | Site usage
--- | --- | --- | --- | ---
S7 | S020T | Shadwell Basin | Tower Hamlets | Single main drive or reception/intermediate site
S021T | King Edward Memorial Park | Tower Hamlets | Single main drive or reception/intermediate site
S024T | Heckford Street Trading Centre | Tower Hamlets | Split reception/intermediate site
S025T | Heckford Street Business Centre | Tower Hamlets | Split reception/intermediate site
S036T | Limehouse Basin | Tower Hamlets | Reception/intermediate site

S8 | S71SK | Open space at Durand’s Wharf, Rotherhithe Street | Southwark | Reception/intermediate site
S065T | Sir John McDougal Gardens, Westferry Road | Tower Hamlets | Single main drive or reception/intermediate site
S070T | Slipway adjacent to Old Bellgate Place, Westferry Road | Tower Hamlets | Reception/intermediate site
S74SK | South Dock marina boat yard, Calypso Way | Southwark | Reception/intermediate site
S01LM | Convoys Wharf | Lewisham | Double main drive, single main drive, split single main drive or reception/intermediate site
S02LM | Pepys Park | Lewisham | Split single main drive or reception/intermediate site

S9 | S021G | Piper’s Wharf, marine engineer yard, Banning Street | Greenwich | Reception/intermediate site
S024G | Industrial warehouse, Christchurch Way | Greenwich | Split single main drive site
S025G | Enderby’s Wharf and offices, Christchurch Way | Greenwich | Single main drive or reception/intermediate site
S033G | Morden and Primrose Wharves, Peterboat Close | Greenwich | Single main drive or reception/intermediate site
S047G | Car park adjacent to jetty, East Parkside | Greenwich | Split main drive or reception/intermediate site
S048G | Vacant land, East Parkside | Greenwich | Single main drive or reception/intermediate site
### Site zone

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Site name</th>
<th>Local authority</th>
<th>Site usage</th>
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<tr>
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<td>Reception/intermediate site</td>
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<td>S055G</td>
<td>Vacant land between Peartree Way and Horn Link Way</td>
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<td>Split single main drive or reception/intermediate site</td>
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<td>S84NM</td>
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<td></td>
<td>S86NM</td>
<td>Three Mills Studios</td>
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Main tunnel drive sites are sites that can be used as main tunnel double or single drive sites.
Reception/intermediate sites can be used for either purpose.
Split sites are sites that are too small on their own but could be used in combination with other site(s) to form a suitable site.
4.10 Main tunnel drive options

4.10.1 This section of the report outlines the available drive options identified, based on the use of zones as described above in Section 4.9. For each of the main tunnel routes, a number of drive options existed. The drive options are based on the number of TBMs used and the number of main tunnel sites from which they can be driven. This approach differentiates between sites from which tunnels can be driven in either one or two directions. In order to establish the range of drive options, we considered each drive between two site zones, with a main tunnel drive site in one zone and a main tunnel reception site in another. By combining different drive lengths between shaft sites, a number of options can be established. By further applying some basic constraining assumptions (e.g., maximum and minimum drive lengths, useable site areas, etc), the total number of options was reduced to a reasonable level.

4.10.2 Section 4.11 (main tunnel sites) takes into account the suitability of potential sites within each drive option to evaluate the relative merits of each potential drive option in order to arrive at a preferred list of main tunnel sites. The sequence of the process followed is set out below:

a. Identify a series of potential drive options based on the 11 zones (drive options needed to have regard to zones in which a main tunnel site is an absolute requirement; for example, at the end of the main tunnel in either Zone S11 Abbey Mills or Zone S10 Beckton, depending on the route alignment).

b. Identify the most suitable main tunnel drive site and most suitable main tunnel reception site in each zone. It was possible for no suitable sites to be identified in some zones. This was acceptable if there was no absolute requirement to have a site in that zone (e.g., change of geology).

c. Evaluate the drive options using a series of comparisons, taking into account the relative suitability of the most suitable site in one zone compared to the most suitable site in a neighbouring or alternative zone.

d. Identify the preferred drive option, and thus the preferred sites.

4.10.3 All the feasible drive options were identified based on the potential number of TBMs required and the sites that they could be driven from and to. Based on the grouping of site zones and the maximum and minimum drive lengths defined below, we identified that between three and six TBMs would be needed to construct the main tunnel.

4.10.4 For the western end of the project, from Zones S1 to S5 in isolation, one or two TBMs could be used. For the eastern end, from Zones S5 to S10 or...
S11 where there were three tunnel route alignment options, two, three or four TBMs could be used.

4.10.5 The list of feasible drive options at this point in the project was developed based on the following engineering considerations:

a. The duration of the construction period would not exceed six years.

b. Theoretically, the maximum practical drive length was estimated to be 12km from a main tunnel drive site in London Clay.

c. Consequently, due to geology, we considered that a tunnel must be driven from S5 towards S6 in order to minimise risk to the programme (conversely, to drive from Zone S6 towards S5 was considered undesirable as the risk to the programme would be significantly increased).

d. The minimum economic drive length was 3km because of the time and effort required to install and remove the TBM, with the exception of Zones S1 to S2, where S2 represented the only zone available near the western end of the scheme that contained a potential drive site.

e. Main tunnel drive sites required an area of 20,000m² in Chalk and 18,000m² elsewhere. Where a drive was proposed in two directions, the equivalent size of two drive sites could be required, or a site with an area of 36,000m² to 40,000m².

4.10.6 The list of main tunnel drive options was considered in a series of preferred scheme optioneering workshops, which brought together representatives of the engineering, planning, environment, community and property teams to consider the merits and demerits of potential options. These workshops were based on the drive options that were established in the Engineering Options Report (Spring 2010). The list of potential main tunnel drive options presented at the optioneering workshops is included at Table 4.2.

### Table 4.2 Summary of drive options

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<thead>
<tr>
<th>Zone</th>
<th>Route</th>
<th>Drive option</th>
<th>Hammersmith</th>
<th>Barn Elms</th>
<th>Wandsworth Bridge</th>
<th>Lots Road</th>
<th>Battersea</th>
<th>Shad</th>
<th>Limehouse</th>
<th>Convoys</th>
<th>Charlton</th>
<th>Beckton</th>
<th>Abbey Mills</th>
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<th>Zone</th>
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<th>Drive option</th>
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### Phase one preferred scheme: Site selection process

#### Report on site selection process

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#### Rotherhithe

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**Legend:** The following nomenclature/legend is used in the table to define the types of site required in the defined zones. Where 'd' denotes drive site, 'r' denotes reception site and 'i' denotes intermediate site. The tunnel is driven from a 'd' drive location to a 'r' reception location.
Table 4.2 demonstrates that there were three drive options in Zones S1 to S5 that were the same across all three tunnel routes; and then in Zones S5 to S11 there were 16 drive options for the River Thames route, eight drive options for the Rotherhithe route, and eight drive options for the Abbey Mills route. The table shows that the feasible drive options required seven main tunnel sites (either drive or reception) for the River Thames or Rotherhithe routes to Beckton STW, or five main tunnel sites for the Abbey Mills route.

The potential requirement for a drive or reception site in each zone was linked to the direction in which each section of the tunnel would be constructed, that is, the direction in which the TBM would ‘drive’ the tunnel from one site (drive site) to another (reception site) and the maximum length of tunnel drive that could be achieved (see paragraph 4.10.5 above).

**Optioneering workshops**

Following production of the site suitability reports and the *Engineering Options Report* (Spring 2010), the project team held a number of optioneering workshops to consider and focus on the detailed contents of the site suitability report for each shortlisted site and the engineering options report referred to above.

The workshops provided a multidisciplinary forum in which the relative benefits and disbenefits identified by each of the disciplines were compared against each other.

We made comparisons by identifying zones for the main tunnel sites (based on optimum tunnel drive lengths and other engineering requirements) in order to consider the most effective tunnelling drive strategy for connecting the main tunnel sites and the CSO sites. We made comparisons between potential main tunnel drive sites and reception sites in order to select the most suitable site within each discrete zone along the main tunnel route (no drive option required sites in all zones). Comparisons between tunnelling drive options were then made in order to select the preferred drive option. The sites associated with the zones of the preferred drive option (and preferred route) were identified as the preferred main tunnel sites. These sites were discussed and recommendations were agreed at optioneering workshops.

Following the workshops, a *Preferred Scheme Report* was prepared to supplement the reports preceding the workshops. The *Preferred Scheme Report* made final recommendations to Thames Water on the list of preferred sites.
4.11 Main tunnel sites

4.11.1 The production of site suitability reports and the *Engineering Options Report*, and the optioneering workshop process, allowed us to identify preferred main tunnel sites for each of the three overall main tunnel route options: ‘River Thames Route’, ‘Rotherhithe Route’ and ‘Abbey Mills Route’.

4.11.2 We identified the most suitable site within each zone; this process is summarised in this section and described in more detail in the Appendices (see Volumes 3 to 5, Appendices G, L, R and W, Section 2 in each Appendix).

4.11.3 However, it should be noted that the project would not require sites within all eleven zones. It would require a site within certain zones, some of which are fixed (ie, the zones at the beginning and end) and some of which can be compared to neighbouring zones, in order to choose the most suitable site within that broad location.

4.11.4 Each sub section below outlines the most suitable site in each of the different site zones. It should be noted that these sites do not represent the final preferred sites selected for phase one consultation, simply the most suitable site in that zone for the purpose of comparing drive options. The starting point to identify the most favourable means of constructing the main tunnel was to choose a site in each zone in order to compare drive options based on the zones and choose a workable drive option, having regard to engineering, planning, environment, community and property considerations.

4.11.5 Preferred sites could only be identified once the drive options had been evaluated in the context of available sites, as described in Section 4.12 below.

**Zone S1 Hammersmith**

4.11.6 Prior to phase one consultation, we identified S33HF Hammersmith Pumping Station and the surrounding land as our preferred site for a main tunnel reception site in Zone S1 Hammersmith. We also proposed to use this site to connect the local CSO to the main tunnel and drive a connection tunnel to Acton Storm Tanks.

4.11.7 Two sites were shortlisted and Hammersmith Pumping Station was identified as the preferred site as it was a brownfield site, and it allowed for the main tunnel and CSO site to be combined. A potential query over availability was raised by planning and property as there was a planning permission for development across the whole site. However, the former industrial site had been cleared and remained undeveloped for a number of years.

4.11.8 The alternative site, St Paul’s School Playing Fields, was discounted as it was a greenfield site and subject to a Metropolitan Open Land designation. Moreover, it was not practicable to provide wharfage/jetty facilities given the severe navigational restrictions west of Hammersmith Bridge.
4.11.9 Volume 3, Appendix G, Section 2 gives further details on the identification of this site at this stage.

Zone S2 Barn Elms

4.11.10 Prior to phase one consultation, S17RD Barn Elms was identified as the most suitable site in this zone (it was the only shortlisted site in this zone).

4.11.11 S17RD Barn Elms was considered a suitable site as it provided the opportunity to combine a main tunnel site with a CSO connection site; it had the potential for river access for transportation of materials and was some distance from residential properties. It was recognised that use of the site would have an impact on a number of planning and environment designations.

4.11.12 Volume 3, Appendix G, Section 2 provides further details on the identification of the Barn Elms site at this stage.

Zone S3 Wandsworth Bridge

4.11.13 Prior to phase one consultation, no sites were identified as suitable for use as a main tunnel drive site in Zone S3 Wandsworth Bridge. We identified four sites (S69HF, S70HF, S72HF and S18WH) that would be suitable as main tunnel reception sites, but no drive options required this type of site in this location.

Zone S4 Lots Road

4.11.14 Prior to phase one consultation, no sites were identified as suitable for use as a main tunnel drive site in Zone S4 Lots Road. We identified two main tunnel reception sites (S76HF and S08KC), but no drive options required this type of site in this location.

Zone S5 Battersea

4.11.15 Prior to phase one consultation, the most suitable site within this zone was S79WH/S80WH Tideway Walk. This site would also be used to intercept and connect the Heathwall Pumping Station CSO and the South West Storm Relief CSO to the main tunnel.

4.11.16 We shortlisted 11 potential main tunnel sites, but two (S04WR and S11WR) were not considered further as they were only suitable as reception/intermediate sites. Table 4.2 shows that a main tunnel drive site was needed in this zone for all drive options.

4.11.17 S79WH/S80WH Tideway Walk was identified as the preferred site for this location (combined with S72WH, S73WH and S74WH for a double drive). These sites offered the opportunity to combine the main tunnel site with the interception of two CSOs and they provided good road access and potential river access. They would also make use of a safeguarded wharf and an existing industrial area.

4.11.18 Other shortlisted sites were discounted for a number of reasons such as the impact on features in Battersea Park (S61WH), the conservation area, the distance from the two CSOs to be intercepted; the impact on the Grade II* listed building and setting of Battersea Power Station (S68WH/S69WH), in addition to high acquisition costs, main tunnel alignment difficulties, the distance from the two CSOs; and no river access.
at the Warehouse on Post Office Way (S87WH) which also conflicted with the US Embassy proposal.

4.11.19 Volume 4, Appendix L, Section 2 provides further details on the identification of this site at this stage.

**Zone S6 Shad**

4.11.20 Prior to phase one consultation, the most suitable site within this zone (the only shortlisted site in this zone) was S54SK King’s Stairs Gardens.

4.11.21 It was noted that while S54SK was potentially suitable for a main tunnel drive or reception site, we considered that it was better suited to a reception site, which would have less impact on the local area and community. We also noted that suitable mitigation would need to be explored from the perspective of all disciplines in order to address issues such as residential amenity.

4.11.22 A main tunnel drive or reception site was required in this zone for some, but not all, of the drive options identified in Table 4.2.

4.11.23 There were risks associated with tunnelling through different types of geology and different types of TBM appropriate to the geological conditions. There is a change in geology from the Lambeth Group and the Thanet Sand Formation (Zone S5 Battersea) to Chalk (Zone S6 Shad – approximately 500m to the east of Tower Bridge). Typically an earth pressure balance (EPB) TBM would be used to tunnel through the London Clay and Lambeth Group west of Tower Bridge and a slurry TBM for eastern drives through the Chalk. Based on engineering risks, drive options from Zones S5 (Battersea) to S7 ( Limehouse) were less desirable than drive options from Zone S5 (Battersea) to Zone S6 (Shad). This meant that the EPB TBM would have to tunnel further into the Chalk rather than changing more quickly to a slurry TBM, which would be more appropriate to the geological conditions.

4.11.25 S76SK Chambers Wharf site had been on our draft short list but did not proceed to the final short list. We were aware that a developer had secured planning approval for housing on this site. Site clearance and demolition work had also started on site.

4.11.26 Volume 5, Appendix R, Section 2 provides further details on the identification of the site at this stage.

**Zone S7 Limehouse**

4.11.27 Drive options for the River Thames route and Abbey Mills route required a site within this zone, but not for the Rotherhithe route.

4.11.28 Prior to phase one consultation, four sites were shortlisted and the most suitable drive or reception site within this zone was identified as S021T King Edward Memorial Park.

4.11.29 In summary, this was because, when compared to other sites in this zone, it was less constrained and offered the opportunity to combine a main tunnel site with a CSO site, and would allow river access.
4.11.30 Other potential shortlisted sites were discounted on the basis of small size, impact on businesses, community concerns, high acquisition costs and difficulties with river access (S024T/S025T Heckford Street), as well as the requirement to infill a marine basin, the project cost and risk, and the impact on residential dwellings (S020T Shadwell Basin and S036T Limehouse Basin).

4.11.31 Volume 5, Appendix R, Section 2 provides further details on the identification of this site at this stage.

**Zone S8 Deptford**

4.11.32 Drive options for the River Thames route and Rotherhithe route required a site within this zone, but not for the Abbey Mills route.

4.11.33 Prior to phase one consultation S01LM Convoys Wharf was identified as the most suitable drive or reception site within this zone.

4.11.34 We shortlisted six sites and S01LM was identified as most suitable as it was a brownfield site and a safeguarded wharf with good river access.

4.11.35 The five alternative shortlisted sites were discounted largely because of greater adverse effects on the local community (S065T Sir John McDougal Gardens, Westferry Road and S02LM Pepys Park) or because they were only suitable for a reception site and would likely give rise to environmental and community concerns and conflict with planning policy (S070T Slipway adjacent to Old Bellgate Place, Westferry Road, S71SK Open space at Durand’s Wharf, Rotherhithe Street and S74SK Boatyard, Calypso Way).

**Zone S9 Charlton**

4.11.36 Drive options for the River Thames route and Rotherhithe route required a site within this zone, but not for the Abbey Mills route.

4.11.37 Prior to phase one consultation, S061G Riverside Wharf, Herringham Road was identified as the most suitable site within this zone.

4.11.38 We shortlisted 16 sites in total and S061G was identified as it could be combined with the Charlton Storm Relief CSO site, and it is industrial land in an industrial area with good road and river access.

4.11.39 All of the other potential shortlisted sites, with the exception of S085G (ie, this site could be used as a combined main tunnel and CSO site since the sewer to be incepted runs through this site), would increase the scope of engineering works by necessitating a separate site for the CSO, which would increase the impacts on the local community.

**Zone S10 Beckton**

4.11.40 Drive options for the River Thames route and Rotherhithe route required a site within this zone, but not for the Abbey Mills route.

4.11.41 Prior to phase one consultation, we identified the most suitable drive and/or reception site in this zone as S82NM Beckton STW. No other sites were shortlisted.

4.11.42 S82NM was judged suitable given that it is owned by Thames Water and is the end point for the overall project.
Zone S11 Abbey Mills

A main tunnel drive or reception site was required within this zone for all of the Abbey Mills route drive options but not for the River Thames route or the Rotherhithe route.

Prior to phase one consultation, we identified the most suitable site in this zone as S84NM Abbey Mills Pumping Station. We considered that this site offered the advantage of making use of a Thames Water site while avoiding the impact on existing businesses on the two alternative sites (S85NM and S86NM).

The two alternative sites were discounted on the basis of community impacts and conflict with planning policy in particular.

Volume 5, Appendix W, Section 2 provides further details on the identification of this site at this stage.

Summary of main tunnel sites by zone

Table 4.3 below summarises the conclusions of our assessments of the most appropriate sites within each zone prior to phase one consultation. Further details for main tunnel sites are provided in Volumes 3 to 5, Appendices G, L, R and W, Section 2 in each appendix.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Zone name</th>
<th>Single drive site</th>
<th>Double drive site</th>
<th>Reception site</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Hammersmith</td>
<td>-</td>
<td>-</td>
<td>S33HF Hammersmith Pumping Station</td>
</tr>
<tr>
<td>S2</td>
<td>Barn Elms</td>
<td>S17RD Barn Elms</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S3</td>
<td>Wandsworth</td>
<td>No shortlisted sites</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S4</td>
<td>Lots Road</td>
<td>No shortlisted sites</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S5</td>
<td>Battersea</td>
<td>Tideway Walk S79WH+S80WH</td>
<td>Tideway Walk S72WH + S73WH + S74WH + S79WH + S80WH</td>
<td>-</td>
</tr>
<tr>
<td>S6</td>
<td>Shad</td>
<td>S54SK King's Stairs Gardens</td>
<td>-</td>
<td>S54SK King's Stairs Gardens</td>
</tr>
<tr>
<td>S7</td>
<td>Limehouse</td>
<td>S021T King Edward Memorial Park</td>
<td>-</td>
<td>S021T King Edward Memorial Park</td>
</tr>
<tr>
<td>S8</td>
<td>Deptford</td>
<td>S01LM Convoys Wharf</td>
<td>S01LM Convoys Wharf</td>
<td>S01LM Convoys Wharf</td>
</tr>
<tr>
<td>S9</td>
<td>Charlton</td>
<td>Riverside Wharf, industrial area, Herringham Road S061G</td>
<td>Riverside Wharf, industrial area, Herringham Road S061G, S085G and C34XJ</td>
<td>Riverside Wharf, industrial area, Herringham Road S061G</td>
</tr>
<tr>
<td>S10</td>
<td>Beckton</td>
<td>Thames Water</td>
<td>-</td>
<td>Thames Water</td>
</tr>
</tbody>
</table>
Conclusion within each zone

<table>
<thead>
<tr>
<th>Zone</th>
<th>Zone name</th>
<th>Single drive site</th>
<th>Double drive site</th>
<th>Reception site</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Beckton STW S82NM</td>
<td></td>
<td>Beckton STW S82NM</td>
</tr>
<tr>
<td>S11</td>
<td>Abbey Mills</td>
<td>S84NM Abbey Mills Pumping Station</td>
<td>-</td>
<td>S84NM Abbey Mills Pumping Station</td>
</tr>
</tbody>
</table>

NB: No intermediate sites were required for any of the zones

4.12 Analysis of main tunnel drive options

4.12.1 This section explains how we considered the available drive options and most suitable sites identified for each zone, as described above, and how we compared and evaluated them in order to arrive at the preferred sites. The evaluation took into account engineering, planning, environment, community, and property considerations. Decisions were taken collectively by representatives of all five disciplines on the basis of the balance of merits and demerits.

4.12.2 As explained previously, we needed to identify a series of sites that could work together to enable construction of the project. The drive options did not rely on the availability of a drive or reception site within each zone and, as detailed above in Section 4.11 and summarised in Table 4.3, some zones were excluded altogether. The choices between drive options therefore tended to reflect the suitability of the identified site within one zone, when compared to the identified sites within another zone.

4.12.3 Sites within certain zones were essential for the completion of the project, either because they were at the start or end of the route, or because maximum tunnel drive lengths or a change in geology necessitated a site in that location. For these zones, choices tended to reflect whether the site was more or less suitable for a drive site (which generally had greater impact than a reception site) when compared to other potential options. It should also be noted that all options required a main tunnel drive site in Zone S5 (Battersea).

Preferred main tunnel drive options

4.12.4 Prior to phase one consultation, in order to assess the suitability of the main tunnel drive options identified and having regard to the comparative advantages and disadvantages of the most appropriate site identified in each zone, we used a series of comparisons to choose between the drive options outlined in Table 4.2.

4.12.5 The choices between drive options therefore tended to reflect the suitability of the identified site within one zone, when compared to the identified sites within neighbouring zones.

4.12.6 Having carried out each comparison, it was possible to eliminate a number of drive options and associated preferred sites until the list was reduced to the preferred tunnel drive option for each of the three routes.
4.12.8 As the western part of the project was the same for all three routes, this is described first below, followed by a description of the drive options for the eastern part for each of the three potential routes. As specific sites had now been identified, we will no longer refer to the ‘zones’ as in earlier sections.

**Western end drive options: All tunnel routes**

4.12.9 There were three drive options (W1 – W3) for the western section that were the same across all three routes, see Table 4.2. A comparison between drive options W1 and W2 is discussed, followed by the reasons why drive option W3 was eliminated.

4.12.10 The main decision required to establish the preferred drive option for the western end drive options required us to compare the use of:

a. Tideway Walk site as a double drive site, meaning that a main tunnel site may not have been required at Barn Elms at all.

b. Tideway Walk site as a single drive site, meaning that the Barn Elms site would be a drive site to drive the TBMs both eastwards and westwards. Programme constraints would have allowed these two tunnels to be driven sequentially from Barn Elms (thereby avoiding the need for two large shafts).

**Comparison 1: Tideway Walk (Zone S5) as a main tunnel double drive option (Option W2) compared to a single main tunnel drive site with the tunnel driven from Barn Elms (Zone S2) (Option W1)**

Figure 4.3 Comparison 1: Western section main tunnel drive sites

4.12.11 Option W2 would require a main tunnel double drive site at Tideway Walk that would be used to drive two tunnels simultaneously to drive the tunnel towards the east (see sections below). Option W1 would require a main tunnel single drive site at Barn Elms that would be used to drive two
tunnels sequentially. The main issues that influenced the decision are presented below.

**4.12.12 Considerations in favour of a main tunnel single drive site at Barn Elms as opposed to a main tunnel double drive site at Tideway Walk included the following:**

a. Existing and proposed wharf and jetty facilities at Tideway Walk may not be able to support simultaneous tunnel drives in both directions due to barge loading and movement constraints in this busy section of the river.

b. In order to meet the hydraulic and pneumatic requirements of the project, it would be necessary to have a shaft on the line of the tunnel with the ability to ventilate the main tunnel between Hammersmith and Tideway Walk, at or near Barn Elms. This means that a main tunnel site would be required at this location, regardless of the drive options at Barn Elms.

c. The size of site (at this point assumed to be 40,000m²) required for a double drive at Tideway Walk might significantly conflict with regeneration aspirations for the Nine Elms area.

d. The extensive use of land at Tideway Walk would have a very high land acquisition cost.

e. A larger number of existing occupiers at Tideway Walk would need to be relocated.

f. Use of Tideway Walk as a double drive site would increase the impact of vehicle movements on the surrounding area.

g. Barn Elms, although designated as Metropolitan Open Land and public open space, could accommodate a single drive site without causing unacceptable conflict with planning policies due to the extent of remaining open space and number of facilities on the site.

**4.12.13 Conversely, considerations in favour of a double drive site at Tideway Walk included the following:**

a. A double drive site at Tideway Walk would entail potential cost savings by sharing worksite facilities or appointing a single contractor to construct the two drives. However, there would be construction procurement issues associated with combining the two drives into one large contract.

b. It would be preferable to have no impact upon Metropolitan Open Land and public open space at Barn Elms.

c. The use of Barn Elms could result in potential amenity impacts on nearby residents, and ecological and archaeological impacts. However, we considered it likely that these effects could be mitigated.

d. The double drive options from Tideway Walk through to Hammersmith Pumping Station (option W2) would reduce the number of main tunnel drive sites required, which we considered would have fewer issues associated with setting up and operating the tunnelling worksites. The
overall tunnelling costs would also be lower because there would be no need to dismantle and re-launch the TBM.

4.12.14 Based on the above issues, on balance, the preference was to use Barn Elms as a main tunnel single drive site (Option W1), eliminating drive Option W2. Prior to phase one consultation, the preferred drive option utilised part of the Barn Elms site to drive the main tunnel to both the west and east (Option W1). The westward drive would be received at the Hammersmith Pumping Station site. The TBM would be brought back to the Barn Elms site and driven out of the same shaft towards the east, and then be received at the Tideway Walk site. Tideway Walk would therefore only be required as a single drive site for an eastbound drive (ie, it would be a reception shaft for the tunnel from the west).

4.12.15 Drive option W3 was discounted because it would also require a double drive shaft site at Tideway Walk, in addition to a single drive site at Barn Elms, meaning that it would be subject to the same disadvantages at Tideway Walk discussed above and would be considerably more constrained in cumulative terms.

**Figure 4.4 Discounted option W3: Western section main tunnel drive sites**

4.12.16 The preferred drive option in the western section, as identified before phase one consultation, is illustrated in figure 4.5 below.
There were 16 drive options for the eastern section of the River Thames route, see Table 4.2.

All the drive options utilised the Tideway Walk site as a main drive shaft site for the main tunnel heading eastwards. Prior to phase one consultation, the preferred drive option comprised a reception site in King’s Stairs Gardens and three other main tunnel drives to a site in a westward direction from Beckton STW to Herringham Road, a drive from Herringham Road to Convoys Wharf and a drive from Convoys Wharf to King’s Garden Stairs (Option E1).

Four comparisons were made in order to differentiate between the 16 drive strategies and establish the preference. These are discussed below.

It should be noted that drive option E1 (preferred for the River Thames route) and E17 (preferred for the Rotherhithe route) would be the same, and that similarly, drive options E2 to E8 (for the Abbey Mills route) and drive options E17 to E24 (for the Rotherhithe route) would also be the same.
4.12.21 We needed to choose between two drive options that used either King’s Stairs Gardens or King Edward Memorial Park as a main tunnel site. The sites could be used as drive or reception sites, depending on the drive options. It was noted that these sites would also be used as a drive site for the smaller connection tunnels to collect flows from CSO numbers CS28X, CS29X and CS30X. The main considerations identified were as follows:

a. The additional length of the main tunnel drive from Tideway Walk to King Edward Memorial Park would increase the challenges associated with tunnelling through Chalk at the end of the drive. This would result in the need for additional maintenance stoppages in order to maintain or modify the TBM’s cutting equipment.

b. In planning terms, the distinction and preference between the two sites was made on the basis of availability of alternative public open space. King Edward Memorial Park is within a defined public open space deficiency area, so the impact of loss of open space would be considerably more severe. Policy conflict would be significant and it would be difficult to locate suitable replacement facilities, if not impossible. We concluded that we should minimise the use of King Edward Memorial Park.

c. Use of King Edward Memorial Park would provide the opportunity to combine the main tunnel works with the North East Storm Relief CSO
interception works, thus saving the cost of a separate CSO drop shaft. However, the cost and programme issues associated with the longer drive to King Edward Memorial Park were judged to outweigh the additional site cost. Although the use of King’s Stairs Gardens would also result in the temporary loss of a sizeable portion of public open space, Southwark Park is located directly south of the site so there would be access to alternative open space, as well as the opportunity to upgrade existing facilities as part of any mitigation measures. There is no similar area near King Edward Memorial Park.

d. King Edward Memorial Park is located within a conservation area and the proposals would result in impacts on this designation and possible indirect impacts on two nearby listed buildings. Conversely, there are no conservation areas or listed buildings at or adjacent to King’s Stairs Gardens. It was considered that there would be less opportunity to provide acceptable mitigation for townscape impacts at King Edward Memorial Park than at King’s Stairs Gardens.

e. In environmental terms, both sites have the potential to result in noise disturbance and air quality impacts on nearby residential receptors, and works at either site would require extensive mitigation measures to ensure that residential effects would be reduced to acceptable levels. Given the layout and proximity of nearby receptors, this could be more difficult to achieve at King’s Stairs Gardens, which has a higher number of adjacent dwellings along two of its boundaries, although much would depend on the mitigation techniques, working methods and working hours that prove to be viable.

4.12.22 Based on the above issues, the preference prior to phase one consultation was to use the King’s Stairs Gardens site as a main tunnel site, eliminating Options E9 to E16.
4.12.23 We needed to choose between drive options that would use the King’s Stairs Gardens or Convoys Wharf site as a drive site for the tunnelling work between them. It was noted that King’s Stairs Gardens could only be a reception site for the drive from Tideway Walk, as it was not considered feasible to drive in the opposite direction, due to programme constraints associated with the deeper shaft at King’s Stairs Gardens, which would take too long to build within the allowable period. The main considerations identified were as follows:

a. Convoys Wharf has established river wharf facilities that would assist in the removal of excavated material by barge.

b. Minimising works on the King’s Stairs Gardens site would reduce the loss of public open space. Therefore, using King’s Stairs Gardens as a reception site (taking a smaller area) would be preferable in planning and community terms.

c. From an environmental and community perspective, and given the proximity of adjacent housing to King’s Stairs Gardens, acceptable mitigation for noise and air quality impacts was considered to be more
easily achievable for a main tunnel reception site than for a main tunnel drive site, and therefore it would be preferable to use it as a reception site.

4.12.24 Based on the above issues, the preference prior to phase one consultation was to use Convoys Wharf as the main tunnel drive site for construction of the main tunnel to King’s Stairs Gardens. It was noted that the King’s Stairs Gardens site would need to be used to drive smaller connection tunnels and would therefore still be used to service smaller, but significant, tunnelling operations. It was also noted that this requirement would counter some of the benefits of using this site as a main tunnel reception site rather than a main tunnel drive site as, for example, excavated material from the connection tunnels would need to be handled here. However, the level of service and construction activity required for smaller tunnelling operations, including the handling of excavated material, would be less than that required for a main tunnel drive site. The decision to prefer King’s Stairs Gardens as a reception site and to drive two CSO connection tunnels also took account of the need to mitigate the impact on the public open space required, and to seek to avoid prolonged land acquisition procedures.

Comparison 4: River Thames route: Drive (Options E1 and E2) compared to reception (Options E3 and E4) at Beckton STW

Figure 4.8 Comparison 4: River Thames route (eastern drive direction choice)

4.12.25 At the eastern end of the scheme, there was a choice of drive direction for the larger drive site to be located at either Beckton STW or Herringham Road. The main considerations identified were as follows:
a. Beckton STW is a site owned by Thames Water and should be utilised as fully as reasonably practicable.

b. A drive site at Beckton STW would make efficient use of land, which would be consistent with both the existing and proposed use.

c. The Beckton STW site covers a substantial area and would also be used as a tunnel drive site for the Lee Tunnel. It was considered unlikely to give rise to significant conflict with planning policy.

d. Beckton STW was likely to have established worksite and jetty arrangements following the construction of the Lee Tunnel, offering potential construction cost savings. No programme conflicts were anticipated.

e. Environmentally, drive options that would make use of existing drive infrastructure (in this case at Beckton STW, as provided by the preceding Lee Tunnel construction works) would generally be preferable to establishing new drive facilities at another location. For this reason, it would be preferable to use Beckton STW as a drive site rather than a reception site.

f. Full use of Beckton STW would minimise the impact on third parties and therefore also result in lower compensation costs.

g. As Beckton STW is a large Thames Water-owned site, it would be preferable to use it as a drive site from a community impact perspective, as this would negate the need for a drive site in another location that would be likely to have greater community impacts. The disruption caused by use of the site and the need for after-use structures would likely have less impact on the local community because of the existing context and related infrastructure.

4.12.26 Based on the above issues, the preference prior to phase one consultation was to drive the main tunnel from Beckton STW, eliminating Options E3 and E4.
Comparison 5: River Thames route: Double drive at Convoys Wharf (Option E2) compared to single drives at both Convoys Wharf and Herringham Road (Option E1)

Figure 4.9 Comparison 5: River Thames route (Convoys Wharf to Herringham Road drive direction choice)

4.12.27 The remaining decision was to determine the direction of the main tunnel drive between Convoys Wharf and Herringham Road. If this were to be driven in an easterly direction, then Convoys Wharf would become a double drive site and Herringham Road a reception site only (from two directions), whereas if the main tunnel were to be driven towards the west, then both sites would be single drive sites.

4.12.28 The main issues identified in favour of using Convoys Wharf as a double drive site were as follows:

a. A double drive site at Convoys Wharf would bring potential cost savings by sharing worksite facilities or appointing a single contractor to construct the two drives. However, there would be construction procurement issues associated with combining the two drives into one large contract.

b. The double drive site would consolidate working areas and reduce the overall number of independent tunnelling worksites along the River Thames, which would also reduce the issues associated with setting up and operating tunnel construction sites. This would include interfaces with third-party assets and maintenance of access to the site. However, there would still be a need for a main tunnel site and a CSO interception structure at Herringham Road, which would also require a significant worksite area.

c. Convoys Wharf is a large and vacant site, it was considered preferable from a community impacts perspective to locate a double drive site there. This would focus the more disruptive works associated with drive sites and larger after-use structures in a location where there would only be limited potential impact on the local community.
4.12.29 The main issues in favour of using two single drive sites identified were as follows:

a. A double drive would involve a significant land purchase at Convoys Wharf and would potentially delay proposed redevelopment of the site by others until the construction works were completed. Postponement of the planned development at Convoys Wharf to make way for the project construction phase would incur a significant compensation cost. The single drive would offer the potential to use the site simultaneously with the proposed redevelopment – a potentially satisfactory scenario for both the landowner and the local planning authority.

b. The size of the permanent structures left on the Convoys Wharf site would impact on the overall compensation cost and the ability to redevelop the site for alternative future uses. A single drive would leave a similar residual sterilised footprint.

c. The single drive would reduce the number of shafts required and the associated costs (compared with double drive set-ups, which may require double shafts for concurrent working). We assumed that a second main tunnel shaft would be provided for the double drive site. If a single shaft were used for both drives, it would take longer to complete the tunnel works because the launch of the two drives would need to be staggered.

d. A double drive would involve a significant scale of temporary infrastructure within the river and increased vehicular movements on narrow residential routes around Convoys Wharf.

e. Environmentally, we would prefer a single drive from Convoys Wharf as there would be less potential impact on the Grade II listed Olympia building than from a double drive. There would also likely be less impact on archaeological features on the site (including a Scheduled Ancient Monument).

f. One element of the Convoys Wharf site is a protected wharf and the remainder has been identified for large-scale residential redevelopment. Confining works to the protected area (assuming this would be permitted), should minimise the development compensation cost.

4.12.30 Based on the above issues, the preference prior to phase one consultation was for two single drives from Convoys Wharf and Herringham Road, eliminating Option E2.
4.12.31 Prior to phase one consultation, the preferred drive option for the River Thames route was Option E1, as illustrated in figure 4.10 below.

**Figure 4.10 River Thames route: Preferred drive option**

4.13 **Eastern section drive options for the Rotherhithe route**

4.13.1 There were eight drive options for the eastern section of the Rotherhithe route, see Table 4.2. The preferred Rotherhithe route drive option was identical to the River Thames route drive option discussed above. It would utilise the combined Tideway Walk site to drive the tunnel eastward to a reception site in King’s Stairs Gardens, and include main tunnel single drive sites at Convoys Wharf, Herringham Road and Beckton STW, each used to drive westwards to the adjacent site on the route (as represented by Option E17).

4.13.2 The only difference between the two routes was the tunnel alignment between King’s Stairs Gardens and Convoys Wharf, with the Rotherhithe route taking a shorter path across the Rotherhithe Peninsula. Comparisons 2, 3 and 4 discussed above therefore apply equally to the Rotherhithe route, eliminating Options E18 to E24.
4.13.3 Prior to phase one consultation, the preferred drive option for the Rotherhithe route was Option E17, as illustrated in Figure 4.11 below.

**Figure 4.11 Rotherhithe route: Preferred drive option**

4.14 **Eastern section drive options for the Abbey Mills route**

4.14.1 There were eight drive options for the eastern section for the Abbey Mills route, see Table 4.2

4.14.2 Prior to phase one consultation, the preferred Abbey Mills route drive option for the eastern section was to drive from both the Tideway Walk and Abbey Mills sites to the King’s Stairs Gardens site, where the TBMs would be removed (Option E25).

4.14.3 We considered options that would use Convoys Wharf as a main tunnel site in conjunction with King’s Stairs Gardens. Other options included using either King’s Stairs Gardens or King Edward Memorial Park. These options were also subdivided into options that could drive in either direction to or from the Abbey Mills Pumping Station complex.

4.14.4 We made the following three comparisons in order to establish the preferred drive option.
4.14.5 We needed to choose between drive options that would pass through Convoys Wharf and those that would not. For the options that would use Convoys Wharf, it would still be necessary to use a site at King’s Stairs Gardens as a main tunnel reception site and a connection tunnel drive site. Connection tunnels would also be required in order to link the Deptford and Greenwich CSOs to the main tunnel.

4.14.6 For the shorter route option, additional lengths of connection tunnel would be required to collect the Deptford SR and Greenwich PS CSO flows.

4.14.7 The main considerations identified in favour of not using Convoys Wharf were as follows:

a. The longer route through Convoys Wharf would use one more TBM and the main tunnel would be 3km longer, which would add significant extra cost, together with the additional construction and health and safety issues associated with tunnelling. This would be partially offset by a reduced connection tunnel length for the Earl PS, Greenwich PS and Deptford SR CSOs.

b. The options that would use Convoys Wharf would require a larger site if Convoys Wharf were used as a double drive site. This would involve
additional acquisition costs and considerations associated with third-party interfaces.

c. A drive from Convoys Wharf that would utilise Abbey Mills as a reception site only was not considered to be the most efficient use of a Thames Water-owned site, compared to a site not owned by Thames Water.

d. Use of Convoys Wharf could give rise to impacts on the Grade II listed Olympia building and archaeological features (including a Scheduled Ancient Monument).

4.14.8 The considerations identified in favour of using Convoys Wharf were as follows:

a. The level of planning policy conflict and disruption to public open space facilities would be significantly increased with the use of either King’s Stairs Gardens or King Edward Memorial Park as main tunnel drive sites.

b. The use of Convoys Wharf as a main tunnel double drive site would avoid the need to use King’s Stairs Gardens or King Edward Memorial Park as a main tunnel drive site, although a main tunnel reception site with connection tunnel drives would still be required. This would likely result in reduced impacts on communities when compared to locating a main tunnel drive site in either park, as well as reduced noise disturbance and air quality impacts on nearby residential receptors.

4.14.9 Based on the above issues, the preference prior to phase one consultation was to use the shorter drive option that would not pass through Convoys Wharf, eliminating Options E29 to E32.

**Comparison 7: Abbey Mills route: King’s Stairs Gardens (Options E25 and E26) compared to King Edward Memorial Park (Options E27 and E28)**

4.14.10 This comparison followed the same arguments as the River Thames route and Comparison 2: River Thames route: King’s Stairs Gardens (Options E1 to E8) compared to King Edward Memorial Park (Options E9 to E16) discussed above for the choice between King’s Stairs Gardens and King Edward Memorial Park. As before, the preference prior to phase one consultation was for drive options that would use King’s Stairs Gardens in favour of King Edward Memorial Park, eliminating Options E27 and E28.
4.14.11 There was a choice of drive direction between King’s Stairs Gardens and Abbey Mills Pumping Station and to locate the drive site at either King’s Stairs Gardens or at Abbey Mills Pumping Station.

4.14.12 The main considerations identified in favour of using Kings Stairs Gardens as a drive site were as follows:

   a. Removal of excavated material by river would be more efficient at King’s Stairs Gardens due to its location on the River Thames. This was compared with the Abbey Mills Pumping Station site on the River Lee, which would have constraints on the size of the barges and movements could only be at high tide.

   b. Vehicular access to the worksite at Abbey Mills Pumping Station would need to pass through some residential areas.

4.14.13 The main considerations identified in favour of using Abbey Mills Pumping Station as a main tunnel drive site were as follows:

   a. Abbey Mills Pumping Station site is owned by Thames Water and should be fully utilised as far as reasonably practicable.

   b. Driving from Abbey Mills Pumping Station would minimise the impact on public open space and residential amenity at King’s Stairs Gardens, although significant connection tunnels would still be constructed from the King’s Stairs Gardens site, meaning that there would still be an impact on neighbouring residential uses.

   c. The Abbey Mills Pumping Station site was judged to be relatively unconstrained when compared to King’s Stairs Gardens, particularly in terms of the number of sensitive receptors. It is, however, located within a conservation area.
4 Phase one preferred scheme: Site selection process

d. It is more likely that noise and air quality impacts could be adequately mitigated for a drive site at Abbey Mills Pumping Station than at King’s Stairs Gardens.

e. There would be a compensation cost for the replacement of open space at King’s Stairs Gardens.

f. The potential long-term impacts of the after-use structures required on site would likely have a lesser effect on the local community at Abbey Mills Pumping Station than similar works at King’s Stairs Gardens.

4.14.14 Based on the above issues, the preference prior to phase one consultation was to drive from Abbey Mills Pumping Station to King’s Stairs Gardens, using drive Option E25 as illustrated below, thereby eliminating Option E26.

**Figure 4.14 Abbey Mills route: Preferred drive option of eastern section**
4.14.15 The preferred drive option for all three main tunnel route alignments, as identified before phase one consultation, is shown in figure 4.15 below.

**Figure 4.15 All routes: Summary of preferred drive options**

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4.15 **CSO sites for each tunnel route option**

4.15.1 This section explains the process of identifying the preferred CSO sites (relating to the existing CSOs) for each tunnel route prior to phase 1 consultation. The choice of preferred sites was made at the optioneering workshops.

4.15.2 A detailed account of the site selection process for most CSO sites is included in the appendices to this document and should be referred to for further information (see Volumes 3 to 5, specific appendix references are given below for each relevant CSO).

4.15.3 Each site was considered, exercising professional judgment, and compared to the alternatives for each CSO. Identifying a site as a preferred site did not necessarily mean that it was free from constraints.

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4 Please note that prior to and during phase one consultation there were three CSOs listed in Table 4.4:

1) Jews Row: Wandle Valley Storm Relief (CS08A) and Falconbrook Storm Relief (CS08B) - both CSOs could be intercepted on one site due to the layout of the sewer network,

2) Shad Thames Pumping Station and

3) Holloway Storm Relief that were not pursued after phase one consultation.

Further investigations found that these three CSOs could be controlled indirectly. Therefore these three CSOs no longer needed a site as part of the site selection process. The details of these three CSOs prior to phase one consultation are provided in Sections 4.15 and 4.14 below. The reason why later development is noted here is to explain why these CSOs do not have their own appendix. However, further detailed information is provided in the Preferred Scheme Report, at Section 5: CSO sites and Section 8.2: CSO connections. The explanation of why they dropped out of consideration is discussed in this report in Section 6.7, and in Section 3.2 of the Site selection background technical paper (Summer 2011 - see Volume 2). Maps for these three CSOs sites have been included in this section as the other CSOs have maps in the appendices.

In relation to the Charlton Storm Relief CSO, which is only relevant to the River Thames and Rotherhithe routes, we have presented it here in order to cover the process we followed prior to identify Abbey Mills as our preferred route, prior to and following phase one consultation. Therefore again it has no appendix and a map of the shortlisted and preferred sites is provided at the end of this section.
Rather, it meant that it was considered the most suitable, or least constrained, site in a required location.

4.15.4 Table 4.4 shows all the shortlisted CSO sites considered and identifies (in bold text) the preferred site for each CSO, as identified at the optioenering workshops and presented at phase one consultation. The preferred CSO sites were the same across all three route options unless otherwise noted in Table 4.4.

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<tr>
<th>CSO Name</th>
<th>Site ID</th>
<th>Site name/description</th>
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<tbody>
<tr>
<td>Acton Storm Relief</td>
<td>C01XF</td>
<td>Former hospital, Netheravon Road South</td>
</tr>
<tr>
<td></td>
<td>C01XT</td>
<td>Car Park, Welstead Way</td>
</tr>
<tr>
<td></td>
<td>C01YC</td>
<td><strong>Acton Storm Tanks</strong></td>
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<tr>
<td>Hammersmith Pumping Station</td>
<td>C04XA</td>
<td>Foreshore, adjacent to Chancellors Wharf</td>
</tr>
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<td></td>
<td>C04XG</td>
<td>Frank Banfield Park</td>
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<td></td>
<td>C04XJ</td>
<td><strong>Hammersmith Pumping Station (Chancellor’s Road)</strong></td>
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<tr>
<td></td>
<td>C04XL</td>
<td>Near Hammersmith Pumping Station off Distillery Road</td>
</tr>
<tr>
<td></td>
<td>C04XM</td>
<td>Adjacent to Hammersmith Pumping Station off Distillery Road</td>
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<tr>
<td>West Putney Storm Relief</td>
<td>C05XA</td>
<td>Foreshore, adjacent to Barn Elms</td>
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<td>C05XD</td>
<td>Boat repair yard, off Putney Embankment</td>
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<td></td>
<td>C05XE</td>
<td>Leaders Gardens, Putney Embankment</td>
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<tr>
<td></td>
<td>C05XQ</td>
<td><strong>Barn Elms</strong></td>
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<td>Putney Bridge</td>
<td>C06XA</td>
<td>Foreshore, adjacent to Putney Bridge and St Mary’s Church</td>
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<td>C06XB</td>
<td><strong>Putney Bridge Foreshore (adjacent to Putney Bridge and Lower Richmond Road)</strong></td>
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<td>C06XC</td>
<td><strong>Putney Bridge Foreshore (junction of Lower Richmond Road and Putney Embankment)</strong></td>
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<td></td>
<td>C06XJ</td>
<td>Foreshore, end of Brewhouse Street</td>
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<tr>
<td>Frogmore Storm Relief – Bell Lane</td>
<td>C07AB</td>
<td>LB Wandsworth maintenance depot, Dormay Street</td>
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<th>CSO Name</th>
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<tr>
<td>Creek (CS07A)</td>
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<td>Parking to rear of properties fronting Buckhold Road and Broomhill Road</td>
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<td>C07BF</td>
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<td>C08AA/C08BA</td>
<td>Foreshore, end of Jews Row, near Wandsworth Bridge</td>
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<td>C08AC/C08BD</td>
<td><strong>Concrete plant, Pier Terrace, Jews Row</strong></td>
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<td>C08AH/C08BJ</td>
<td>Open space off Old York Road, Swandon Way</td>
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<td><strong>Bridges Court Car Park (York Road)</strong></td>
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<td>C09XD</td>
<td>York Gardens, adjacent to York Road</td>
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<td></td>
<td>C09XE</td>
<td>York Gardens adjacent to Pennethorne House</td>
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<td>Ranelagh (and connection to the northern Low Level Sewer No.1)</td>
<td>C14XA/CLLAA</td>
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<td>Heathwall Pumping Station (C16X) and South West Storm Relief (C17X)</td>
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<td>Foreshore, adjacent to Heathwall Pumping Station, Nine Elms Lane</td>
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<td>C17XA</td>
<td>Foreshore, adjacent to Middle Wharf, Nine Elms Lane</td>
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<td>C17XB</td>
<td><strong>Heathwall Pumping Station (including Middle Wharf)</strong></td>
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<td>Clapham Storm Relief (C19X) and Brixton Storm Relief (C20X)</td>
<td>C19XA</td>
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<td></td>
<td>C20XA</td>
<td>Foreshore, adjacent to SIS building and Vauxhall Bridge</td>
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<td></td>
<td>C20XH</td>
<td>Open Space, Claylands Road</td>
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<td></td>
<td>C20XS</td>
<td><strong>Albert Embankment Foreshore</strong></td>
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<td>Regent Street</td>
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<td>C22XC/CLLAD</td>
<td>Victoria Embankment Gardens</td>
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<tr>
<td>Fleet Main</td>
<td>C27XA/CLLAE</td>
<td>Blackfriars Bridge Foreshore</td>
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<td>C28XA</td>
<td>Foreshore, near Butler’s Wharf, Shad Thames</td>
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<td>C28XE</td>
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<td>North East Storm Relief</td>
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<td>King Edward Memorial Park Foreshore (on Abbey Mills route)</td>
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<td>King Edward Memorial Park</td>
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<td>(on River Thames and Rotherhithe routes)</td>
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<td>C30XA</td>
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<td>Parking and seating in St. George’s</td>
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<td>C31XK</td>
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<td></td>
<td>C31XY and</td>
<td><strong>Earl Pumping Station</strong></td>
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<td>The AHOY Centre, junction Borthwick Street and Deptford Green</td>
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<td>C32XC</td>
<td>Gardens of block of flats fronting Deptford Green</td>
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<td>Greenwich Pumping Station</td>
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<td>C33XH</td>
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<td>C33XU</td>
<td>Greenwich Pumping Station (medium site)</td>
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<td>C34XH</td>
<td>Depot, junction Herringham Road and New Lydenburg Street</td>
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<td>C34XJ</td>
<td>Stone Foundry, access road off Woolwich Road</td>
</tr>
<tr>
<td></td>
<td>C34XK</td>
<td>Recycling plant, New Lydenburg Street</td>
</tr>
</tbody>
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Note: Site IDs and site names/description were used as an internal mechanism to keep track of sites, but they may be updated as necessary.

4.15.5 The following paragraphs summarise the reasons why each preferred site was identified over alternative shortlisted sites. The appendices to this report and the Preferred Scheme Report contain more detailed information.

**Acton Storm Relief CSO**

4.15.6 Three sites were shortlisted for the interception of this CSO, although one site (Chiswick Maternity Hospital) was later discounted as it became unavailable due to residential development on site.

4.15.7 Prior to phase one consultation, C01YC Acton Storm Tanks was our preferred site for CSO interception. In summary, this site was identified because it is an existing Thames Water site, it generally accords with planning policy and it would have fewer impacts on residential amenity than the other potential site (C01XT Welstead Way car park).

4.15.8 Volume 3, Appendix A, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

**Hammersmith Pumping Station CSO**

4.15.9 Five sites were shortlisted for the interception of this CSO.

4.15.10 Prior to phase one consultation, C04XJ Hammersmith Pumping Station (off Chancellors Road) was identified as the preferred site and was to be
used as part of the preferred main tunnel site (S33HF Vacant Industrial
land by Hammersmith Pumping Station) for construction purposes. In
summary, C04XJ was selected due to its proximity to the existing pumping
station, the potential to combine work with main tunnel reception site
works, and the reduced impact on the local community.

4.15.11 Other shortlisted sites were discounted for a variety of reasons including
the impact on the local community and the loss of open space (C04XG);
environmental, amenity and access concerns (C04XA); the presence of
existing underground sewers and extended road closures (C04XM); and
fragmentation of the development site (C04XL).

4.15.12 Volume 3, Appendix B, Section 2 provides further details on the
identification of this site as the preferred site prior to phase one
consultation.

**West Putney Storm Relief CSO**

4.15.13 Four sites were shortlisted for the interception of the West Putney Storm
Relief CSO.

4.15.14 Prior to phase one consultation, C05XQ, the southeast corner of Barn
Elms sports fields, was our preferred site for CSO interception (and was
sited alongside the main tunnel site S17RD Barn Elms). In summary, this
site was chosen for CSO interception as it would allow us to combine
works with a main tunnel site. It would also allow efficient working area
and would require fewer enabling works than other site options.

4.15.15 Other shortlisted sites were discounted for a variety of reasons including
environmental, planning policy and community concerns (C05XD); loss of
a park, impact on the local community and conflict with planning policy
(C05XE); and environmental, amenity and engineering concerns (C05XA).

4.15.16 Volume 3, Appendix C, Section 2 provides further details on the
identification of this site as the preferred site prior to phase one
consultation.

**Putney Bridge CSO**

4.15.17 The existing sewerage system is configured so that two large sewers join
together beneath the main road junction at the southern end of Putney
Bridge, just upstream of the CSO discharge point. Both branches of the
sewerage network need to be intercepted. Consequently, the only viable
location to intercept all flows for the Putney Bridge CSO is below the point
at which the two sewers meet. Therefore, four sites were shortlisted, all of
which were located in the foreshore.

4.15.18 Two shortlisted sites were to the west (upstream) and two to the east
(downstream) of Putney Bridge. It should be noted that foreshore sites
can be flexible, so in effect the choice was either to the west or east of
Putney Bridge.

4.15.19 At phase one consultation, the preferred site identified was the foreshore
west of Putney Bridge (C06XB). In summary, we identified this site as it
was considered that, when compared to alternatives, it had the fewest
constraints and would minimise adverse construction effects on the multiple sensitive receptors located on the eastern side of the bridge.

4.15.20 Other shortlisted sites were discounted for a variety of reasons including the impact on the Grade II listed St Mary’s Church and its users to the east of Putney Bridge and the impact on the conservation area (C06XA and C06XJ); and environmental and community issues (C06XC).

4.15.21 Volume 3, Appendix D, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

Frogmore Storm Relief – Bell Lane Creek CSO

4.15.22 Two sites were shortlisted for the interception of this CSO.

4.15.23 Prior to phase one consultation, C07AF Small Business, Bell Lane Creek, was our preferred site for CSO interception. This site was chosen as, while it would require relocation of the existing business, it would avoid displacing the existing council maintenance depot that occupies site C07AB.

4.15.24 Volume 3, Appendix E, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

Frogmore Storm Relief – Buckhold Road CSO

4.15.25 Two sites were shortlisted for the interception of this CSO.

4.15.26 C07BF King George's Park was our preferred site at phase one consultation. In summary, this site was identified as it would allow efficient working and would result in fewer impacts on residential amenity than the alternative shortlisted site.

4.15.27 The alternative shortlisted site (C07BD) was not preferred because of concerns regarding proximity to residential dwellings, loss of car parking, the impact on the conservation area and conflict with planning policy.

4.15.28 Volume 3, Appendix F, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

Jews Row – Wandle Valley Storm Relief and Falconbrook Storm Relief CSO

4.15.29 Three sites were shortlisted for the interception of this CSO (see footnote in paragraph 4.15.2 above).

4.15.30 Prior to phase one consultation, we identified C08AC/BD, a concrete batching plant, as our preferred site to intercept these CSOs. It was chosen as it was considered suitable by all disciplines, subject to land-based interception of the CSO. It is a safeguarded wharf with good road access, and would require fewer enabling works than the foreshore site.

4.15.31 The two alternative shortlisted sites were discounted because of the extent of the enabling works required and the impact on amenity and environmental concerns (C08AA/BA); and engineering concerns and loss of a park and children’s playground (C08AH/BJ).
4 Phase one preferred scheme: Site selection process

**Falconbrook Pumping Station CSO**

4.15.32 Four sites were shortlisted for the interception of this CSO.

4.15.33 Prior to phase one consultation, our preferred site was C09XC Bridges Court car park. This site was identified as, while it had a number of constraints, it was considered the most suitable on balance, particularly in community terms, as well as potential access to the strategic road network and the potential for efficient, cost-effective construction.

4.15.34 Other shortlisted sites were discounted for a variety of reasons including constrained access, environmental amenity concerns, conflict with planning policy, and health and safety issues (C09XA); and access concerns and community impacts from loss of open space and noise, dust and visual disturbance (C09XD and C09XE).

4.15.35 Volume 3, Appendix H, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

**Lots Road Pumping Station CSO**

4.15.36 Only one site was shortlisted for the interception of this CSO.

4.15.37 Prior to phase one consultation, C10XA Cremorne Wharf Foreshore was our preferred site. We recognised that a variety of mitigation measures would be required.

4.15.38 Volume 4, Appendix J, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

**Ranelagh CSO**

4.15.39 Only one site was shortlisted for the interception of this CSO and connection to the northern Low Level Sewer No.1.

4.15.40 Prior to phase one consultation, our preferred site was C14XA Chelsea Embankment Foreshore (west of Chelsea Bridge). We recognised that use of this site would require a high degree of mitigation.

4.15.41 Volume 4, Appendix K, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

**Heathwall Pumping Station and South West Storm Relief CSO**

4.15.42 Prior to phase one consultation, we identified Tideway Walk (S79WH/S80WH/ C17XB) as our preferred site for the interception of these two CSOs as well as our preferred main tunnel drive site in the Battersea area. The site comprised Heathwall Pumping Station including Middle Wharf and land adjacent to the Tideway Walk site.

4.15.43 Three CSO sites were shortlisted: one for the Heathwall Pumping Station outfall and two for the South West Storm Relief CSO. All the shortlisted CSO sites were located next to, or overlapped with Tideway Walk.
4.15.44 S79WH/S80WH/C17XB was identified as the preferred site as it was land-based, would optimise the use of Thames Water-owned land and would not jeopardise future use of the safeguarded wharf.

4.15.45 The alternative shortlisted sites (C16XA and C17XA) were discounted as they were foreshore sites, which would introduce increased construction costs and health and safety risks, and would result in a loss of river flood volume and foreshore habitat.

4.15.46 Volume 4, Appendix M, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation (also see Volume 4, Appendix L, Section 2 for details on Tideway Walk).

Clapham Storm Relief and Brixton Storm Relief CSO

4.15.47 In total, four sites were shortlisted for consideration for the interception of these CSOs.

4.15.48 Prior to phase one consultation, our preferred site for interception of both CSOs was C20XS Albert Embankment Foreshore. In summary, this site was preferred because, compared to the alternatives, it would have the least impact on residential amenity, allow access and minimise the impact on the flow of the river.

4.15.49 Alternative shortlisted sites were discounted due to: lack of access to C19XA; the use of C20XH also required additional use of C19XA because C20XH alone would not allow interception of the Clapham Storm Relief CSO; and lack of access and conflict with planning policy (C20XA).

4.15.50 Volume 4, Appendix N, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

Regent Street CSO

4.15.51 A site was needed to intercept the Regent Street CSO and connect the northern Low Level Sewer No.1 to the main tunnel. Two sites were shortlisted for this CSO.

4.15.52 Prior to phase one consultation, C22XA Victoria Embankment Foreshore was our preferred site. In summary, this site was preferred as it was considered less likely to give rise to conflict with planning policy, particularly relating to heritage and open space designations, compared to the other shortlisted site (C22XC). It would also reduce the risk of working alongside the District and Circle line underground tunnels.

4.15.53 Volume 4, Appendix P, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

Fleet Main CSO

4.15.54 A site was needed to intercept the Fleet Main CSO and to connect the northern Low Level Sewer No.1 to the main tunnel.

4.15.55 Only one site was shortlisted for the Fleet Main CSO and northern Low Level Sewer No.1. This site, C27XA Blackfriars Bridge Foreshore, was
Phase one preferred scheme: Site selection process

our phase one consultation preferred site. While the site would require careful mitigation, it is the only potentially suitable site.

4.15.56 Volume 4, Appendix Q, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

**Shad Thames Pumping Station CSO**

4.15.57 In total, three sites were shortlisted for the interception of this CSO (see footnote in paragraph 4.13.2 above).

**Figure 4.16 Shortlisted sites for Shad Thames Pumping Station CSO**

4.15.58 Prior to phase one consultation, C28XE Druid Street was identified as our preferred site for the interception of this CSO. It was chosen as it offered direct access from Druid Street. The Storm Relief Sewer passes through the site, which would avoid the need for an interception chamber outside the site. The site would also affect fewer dwellings and businesses than the foreshore site.

4.15.59 The alternative shortlisted sites were discounted because of the numbers of residents and businesses that would be affected and poor access (C28XA); and restricted access and the requirement for an interception chamber outside the site (C28XF).

**North East Storm Relief CSO**

4.15.60 Two sites were shortlisted for the interception of this CSO. The identification of a preferred site for this CSO was also influenced by which of the three main tunnel alignments would be selected.

4.15.61 For the River Thames route and Rotherhithe Route, C29XB King Edward Memorial Park was our preferred site. For the Abbey Mills Route, our preferred site was C29XA King Edward Memorial Park Foreshore.


4.15.62 Prior to phase one consultation, our preferred site was C29XA King Edward Memorial Park Foreshore because we chose the Abbey Mills Route as our preferred tunnel route.

4.15.63 Volume 5, Appendix S, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

**Holloway Storm Relief CSO**

4.15.64 Three sites were shortlisted for the interception of this CSO (see footnote in paragraph 4.13.2 above).

**Figure 4.17 Shortlisted sites for Holloway Storm Relief CSO**

![Shortlisted sites for Holloway Storm Relief CSO](image)

4.15.65 Prior to phase one consultation, C30XG Butcher Row was identified as our preferred site for the interception of this CSO. This was because it would allow for an efficient site layout, it was vacant, it had better access to the road network than the alternatives, it would have less impact on the conservation area, and greater opportunity to mitigate noise impacts.

4.15.66 The two alternative shortlisted sites were discounted because of access problems and impact on residential properties (C30XA); and loss of park/play space, the impact on conservation area, the impact on cycle/pedestrian route and less opportunity to mitigate noise impacts (C30XD).

**Earl Pumping Station CSO**

4.15.67 Six sites were shortlisted for the interception of this CSO.

4.15.68 Prior to phase one consultation, our preferred site was C31XY/XZ Earl Pumping Station (and adjoining industrial premises). In summary, the six shortlisted sites were selected primarily to make use of a Thames Water
site and keep all new CSO assets within an extended operational Thames Water site. The sites were also in an existing industrial setting.

4.15.69 Alternative shortlisted sites were discounted for a variety of reasons including the need to relocate a boatyard (C31XC); construction costs, health and safety issues, loss of river flood volume and foreshore habitat (C31XA); the impact on residential amenity (C31XB); and disruption to local residents and loss of car parking (C31XK).

4.15.70 Volume 5, Appendix T, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

Deftford Storm Relief CSO

4.15.71 Three sites were shortlisted for this CSO.

4.15.72 Prior to phase one consultation, our preferred site was C32XA Borthwick Wharf Foreshore. In summary, this site was preferred as it had the greatest potential to provide the required working area and, while access would be constrained, river barges could potentially be used to deliver some materials. Careful investigation would be required to determine mitigate measures.

4.15.73 The alternative shortlisted sites (C32XB and C32XC) would have been challenging in terms of providing a safe and efficient working area and it was more difficult to resolve access issues than at the preferred site.

4.15.74 Volume 5, Appendix U, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.

Greenwich Pumping Station CSO

4.15.75 Three sites were shortlisted for the interception of this CSO.

4.15.76 Prior to phase one consultation, our preferred site was C33XU Greenwich Pumping Station. In summary, it was judged the most suitable site as it would make use of an existing Thames Water site, with resulting operational efficiencies and a controlled environment.

4.15.77 The foreshore site (C33XA) was discounted because of its proximity to a World Heritage Site and difficulties in securing construction access. The front of the Greenwich Pumping Station (C33XH) was discounted as its use would have had a greater impact on Thames Water operations and it is in closer proximity to the Grade II listed pumping station and nearby dwellings.

4.15.78 Volume 5, Appendix V, Section 2 provides further details on the identification of this site as the preferred site prior to phase one consultation.
Charlton Storm Relief CSO

4.15.79 Four sites were shortlisted for the interception of this CSO (see footnote in paragraph 4.13.2 above). This CSO only related to the River Thames and Rotherhithe main tunnel routes, which subsequently were not selected as the preferred routes.

Figure 4.18 Shortlisted sites for Charlton Storm Relief CSO

4.15.80 Prior to phase one consultation, our preferred site was C34XB Herringham Road (Tarmac plant). In summary, it was judged the most suitable site as it would make use of a brownfield site located on the river and there was a potential to use a safeguarded wharf. There was also the potential to combine a main tunnel and CSO drop shaft on one site.

4.15.81 The foreshore site (C34XA) was discounted because of its proximity to the Thames Barrier and less suitable access arrangements. The other land-based sites (C34XJ, C34XH and C34XK) were less suitable as they would all require a longer connection culvert because they are located further from the CSO. Conversely, combining construction of the CSO interception works and the main tunnel shaft on one site would reduce the impact of general disruption and noise on local businesses in this area.

4.15.82 CS34XB is also located further from residential properties than C34XJ and would have less impact on access to the Lyndenberg commercial estate than C34XH or C34XK.
4.16 **CSO connection tunnel drive options**

**CSO connection types**

4.16.1 CSOs that need to be intercepted can be connected to the main tunnel in different ways. The *Engineering options report* (Spring 2010 - see Thames Water website) considered five possible connection types, which can be summarised as follows:

a. **Type A - CSO connection type**: where a connection tunnel would be connected to the main tunnel via a shaft on the main tunnel.

b. **Type B - CSO connection type**: where a connection tunnel would be connected directly to the main tunnel. This would be possible where the main tunnel is located in competent ground, such as London Clay, where a direct tunnel-to-tunnel connection would be possible.

c. **Type C - CSO connection type**: where two or more CSOs would be intercepted and brought together before being connected to the main tunnel, either directly or at a main tunnel shaft.

d. **Type D - CSO connection type**: where the drop shaft would be directly adjacent to the main tunnel so that no connection tunnel would be required.

e. **Type E - CSO connection type**: would be where the connection culvert would be connected directly to a shaft located on the line of a tunnel (either main tunnel or connection tunnel from another CSO).

4.16.2 The connection type proposed for each intercepted CSO is given in Table 4.5. The connection type for a site could vary depending on connection tunnel drive options. Where this was the case, Table 4.5 lists the possible types.

<table>
<thead>
<tr>
<th>CSO ref</th>
<th>CSO name</th>
<th>CSO site name</th>
<th>Connection type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS01X</td>
<td>Acton Storm Relief</td>
<td>Acton Storm Tanks</td>
<td>A</td>
<td>Connection tunnel to main tunnel shaft</td>
</tr>
<tr>
<td>CS04X</td>
<td>Hammersmith Pumping</td>
<td>Hammersmith Pumping</td>
<td>E</td>
<td>Connection culvert to main tunnel shaft</td>
</tr>
<tr>
<td></td>
<td>Station</td>
<td>Station</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS05X</td>
<td>West Putney Storm Relief</td>
<td>Barn Elms</td>
<td>E</td>
<td>Connection culvert to main tunnel shaft</td>
</tr>
<tr>
<td>CS06X</td>
<td>Putney Bridge</td>
<td>Putney Bridge Foreshore</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS07A</td>
<td>Frogmore Storm Relief-Bell Lane Creek</td>
<td>Bell Lane Creek</td>
<td>C(B), C(E)</td>
<td>Two CSOs connected via one connection tunnel (connection tunnel to main tunnel or connection tunnel driven through CSO)</td>
</tr>
</tbody>
</table>
### Phase one preferred scheme: Site selection process

<table>
<thead>
<tr>
<th>CSO ref</th>
<th>CSO name</th>
<th>CSO site name</th>
<th>Connection type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS07B</td>
<td>Frogmore Storm Relief-Buckhold Rd</td>
<td>King George’s Park</td>
<td>C(A), C(B)</td>
<td>Two CSOs connected via one connection tunnel (connection tunnel to CSO drop shaft or connection tunnel to main tunnel)</td>
</tr>
<tr>
<td>CS08A &amp; B</td>
<td>Jews Row</td>
<td>Jews Row</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS09X</td>
<td>Falconbrook Pumping Station</td>
<td>Bridges Court Car Park</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS10X</td>
<td>Lots Road Pumping Station</td>
<td>Cremorne Wharf Foreshore</td>
<td>E</td>
<td>Main tunnel driven through CSO drop shaft</td>
</tr>
<tr>
<td>CS14X</td>
<td>Ranelagh</td>
<td>Chelsea Embankment Foreshore (opposite Ranelagh Gardens)</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS16X</td>
<td>Heathwall Pumping Station</td>
<td>Tideway Walk</td>
<td>E</td>
<td>Connection culvert to main tunnel shaft</td>
</tr>
<tr>
<td>CS17X</td>
<td>South West Storm Relief</td>
<td>Tideway Walk</td>
<td>A</td>
<td>Connection culvert to main tunnel shaft</td>
</tr>
<tr>
<td>CS19X &amp; CS20X</td>
<td>Clapham Storm Relief Brixton Storm Relief</td>
<td>Albert Embankment Foreshore</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS22X</td>
<td>Regent St</td>
<td>Victoria Embankment Foreshore</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS27X</td>
<td>Fleet Main</td>
<td>Blackfriars Bridge Foreshore</td>
<td>E</td>
<td>Main tunnel driven through CSO drop shaft</td>
</tr>
<tr>
<td>CS28X</td>
<td>Shad Thames Pumping Station</td>
<td>Druid Street</td>
<td>A</td>
<td>Connection tunnel to main tunnel shaft</td>
</tr>
</tbody>
</table>

**River Thames and Rotherhithe routes**

| CS29X   | North East Storm Relief | King Edward Memorial Park | C(A), C(E) | Two CSOs connected via one connection tunnel (connection tunnel main tunnel shaft or connection tunnel driven through CSO drop shaft) |
| CS30X   | Holloway | Butcher Row | C(A) | Two CSOs connected via |
### Phase one preferred scheme: Site selection process

<table>
<thead>
<tr>
<th>CSO ref</th>
<th>CSO name</th>
<th>CSO site name</th>
<th>Connection type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS31X</td>
<td>Earl Pumping Station</td>
<td>Earl Pumping Station</td>
<td>A</td>
<td>Connection tunnel to main tunnel shaft</td>
</tr>
<tr>
<td>CS32X</td>
<td>Deptford Storm Relief</td>
<td>Borthwick Wharf Foreshore</td>
<td>C(A), C(E)</td>
<td>Two CSOs connected via one connection tunnel (connection tunnel to main tunnel shaft or connection tunnel driven through CSO drop shaft)</td>
</tr>
<tr>
<td>CS33X</td>
<td>Greenwich Pumping Station</td>
<td>Greenwich Pumping Station</td>
<td>C(A)</td>
<td>Two CSOs connected via one connection tunnel (connection tunnel to CSO drop shaft)</td>
</tr>
<tr>
<td>CS34X</td>
<td>Charlton Storm Relief</td>
<td>Herringham Road</td>
<td>E</td>
<td>Connection culvert to main tunnel shaft</td>
</tr>
</tbody>
</table>

**Abbey Mills route**

| CS29X   | North East Storm Relief | King Edward Memorial Park Foreshore | C(D) | Two CSOs connected via one connection tunnel (drop shaft adjacent to main tunnel) |
| CS30X   | Holloway Storm Relief | Butcher Row | C(A) | Two CSOs connected via one connection tunnel (connection tunnel to CSO drop shaft) |
| CS31X   | Earl Pumping Station | Earl Pumping Station | C(A), C(E) | Three CSOs connected via one connection tunnel (connection tunnel to main tunnel shaft or connection tunnel driven through CSO drop shaft) |
| CS32X   | Deptford Storm Relief | Borthwick Wharf Foreshore | C(A), C(E) | Three CSOs connected via one connection tunnel (connection tunnel to CSO drop shaft or connection tunnel driven through CSO drop shaft) |
| CS33X   | Greenwich Pumping Station | Greenwich Pumping Station | C(A) | Three CSOs connected via one connection tunnel (connection tunnel to main tunnel shaft) |
| CS34X   | Charlton Storm Relief | n/a | n/a | Flow controlled by system modifications |
CSO connection tunnel drive options

4.16.3 Not all connection types would have connection tunnels, and not all those with connection tunnels had drive options as follows:

a. No connection tunnels were associated with Type D or Type E connections.

b. All connection tunnels associated with Type B connections would be driven from the CSO site and therefore had no drive option.

c. Connection tunnels associated with Type A or Type C connections had drive options.

4.16.4 The connection tunnels and associated drive options are provided in Table 4.2 for CSO sites that are the same across all routes and in Table 4.3 for those that are not the same across all routes.
### Table 4.6 Connection tunnel drive options that are the same across all routes

<table>
<thead>
<tr>
<th>Route</th>
<th>Drive option</th>
<th>One end of connection tunnel</th>
<th>Site along connection tunnel</th>
<th>Other end of connection tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Acton Storm Tanks</td>
<td>n/a</td>
<td>Hammersmith PS</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>r</td>
<td>n/a</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>d</td>
<td>n/a</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hammersmith PS</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Barn Elms</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Putney Bridge Foreshore</td>
<td>n/a</td>
<td>Main tunnel</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>d</td>
<td>n/a</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td>King George’s Park</td>
<td>Bell Lane Creek</td>
<td>Main tunnel</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>d</td>
<td>through</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>r</td>
<td>d then d</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jews Row</td>
<td>n/a</td>
<td>Main tunnel</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>d</td>
<td>n/a</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bridges Court Car Park</td>
<td>n/a</td>
<td>Main tunnel</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>d</td>
<td>n/a</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cremorne Wharf Foreshore</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chelsea Embankment Foreshore</td>
<td>n/a</td>
<td>Main tunnel</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>d</td>
<td>n/a</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heathwall PS CSO’s site</td>
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<td>n/a</td>
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<td></td>
<td></td>
<td>South West SR CSO’s site</td>
<td>n/a</td>
<td>Tideway Walk</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>d</td>
<td>n/a</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Albert Embankment Foreshore</td>
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<td>Main tunnel</td>
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<tr>
<td></td>
<td>1</td>
<td>d</td>
<td>n/a</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Victoria Embankment Foreshore</td>
<td>n/a</td>
<td>Main tunnel</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>d</td>
<td>n/a</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blackfriars Bridge Foreshore</td>
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<td>n/a</td>
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<td></td>
<td>Druid Street</td>
<td>n/a</td>
<td>King’s Stairs Gardens</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>r</td>
<td>n/a</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>d</td>
<td>n/a</td>
<td>r</td>
</tr>
</tbody>
</table>

**Legend:** The following nomenclature/legend is used in the table to define the types of site required in the defined zones. Where ‘d’ denotes drive site, ‘r’ denotes reception site and ‘through’ denotes the tunnel driven through the site.
Table 4.7 Connection tunnel drive options – not the same across all routes

<table>
<thead>
<tr>
<th>Route</th>
<th>Drive option</th>
<th>One end of connection tunnel</th>
<th>Site along connection tunnel</th>
<th>Site along connection tunnel</th>
<th>Other end of connection tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butcher Row</td>
<td></td>
<td>King Edward Memorial Park</td>
<td>n/a</td>
<td>King's Stairs Gardens</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>r</td>
<td>through</td>
<td></td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>r</td>
<td>d-r</td>
<td></td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>Earl PS</td>
<td></td>
<td>Convoys Wharf</td>
<td>Borthwick Wharf Foreshore</td>
<td>Greenwich PS</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>r</td>
<td>d-d</td>
<td>through</td>
<td>r</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>r</td>
<td>d-d</td>
<td>r-d</td>
<td>r</td>
<td></td>
</tr>
<tr>
<td>Charlton SR CSO's site</td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

n/a - interception works included in main tunnel site works

Analysis of CSO connection tunnel drive options

4.16.5 Table 4.6 and Table 4.7 show that the interception of the following CSOs would require no connection tunnel since the interception works would be within a main tunnel site and therefore connected directly to a main tunnel shaft (Type E connection):

a. Hammersmith Pumping Station CSO (Hammersmith Pumping Station site)

b. West Putney Storm Relief CSO (Barn Elms site)

c. Heathwall Pumping Station CSO (Tideway Walk site)

d. Charlton Storm Relief CSO (Herringham Road site)
4.16.6 The interception of the following CSOs would require no connection tunnel as the main tunnel would be driven through the CSO drop shaft (Type E connection):
   a. Lots Road Pumping Station CSO (Cremorne Wharf Foreshore site)
   b. Fleet Main CSO (Blackfriars Bridge Foreshore site)

4.16.7 The interception of the following CSO would require no connection tunnel as the CSO drop shaft would be adjacent to the main tunnel (connection type D):
   a. North East Storm Relief CSO (King Edward Memorial Park Foreshore site – Abbey Mills route)

4.16.8 The interception of the following CSOs would require a connection tunnel driven from the CSO site to connect directly to the main tunnel (Type B connection):
   a. Putney Bridge CSO (Putney Bridge Foreshore site)
   b. Jews Row CSO (Jews Row site)
   c. Falconbrook Pumping Station CSO (Bridges Court Car Park site)
   d. Ranelagh CSO (Chelsea Embankment Foreshore site)
   e. Clapham Storm Relief CSO/Brixton Storm Relief CSO (Albert Embankment Foreshore site)
   f. Regent Street CSO (Victoria Embankment Foreshore site)

4.16.9 The interception of the following CSOs would require a connection tunnel driven from the CSO site to connect directly to the main tunnel shaft (Type A connection):
   a. South West Storm Relief CSO (Tideway Walk site)

4.16.10 The remaining CSOs have connection tunnel drive options:
   a. Acton Storm Relief CSO (Acton Storm Tanks site)
   b. Frogmore Storm Relief CSO - Bell Lane Creek (Bell Lane Creek site)
   c. Frogmore Storm Relief CSO - Buckhold Road (King George’s Park site)
   d. Shad Thames Pumping Station CSO (Druid Street site)
   e. Holloway Storm Relief CSO (Butcher Row site)
   f. North East Storm Relief CSO (King Edward Memorial Park site – River Thames and Rotherhithe routes)
   g. Earl Pumping Station CSO (Earl Pumping Station site)
   h. Deptford Storm Relief CSO (Borthwick Wharf site)
   i. Greenwich Storm Relief CSO (Greenwich Pumping Station site)

4.16.11 The connection tunnel drive options are discussed below and the preferred option selected.
4.16.12 The Acton connection tunnel drive options were the same across all routes.

4.16.13 The Acton Storm Tanks site was selected as the preferred CSO site and would need to be connected to the main tunnel at the Hammersmith Pumping Station site, which was selected as a preferred main tunnel reception site.

4.16.14 Two tunnel drive options were considered:
   a. Firstly a TBM would be driven from the Hammersmith Pumping Station site to the Acton Storm Tanks site
   b. Secondly, the drive direction would be reversed, see Figure 4.19 Acton connection tunnel drive options.

   **Figure 4.19 Acton connection tunnel drive options**

4.16.15 The following issues were identified and influenced the preferred drive option:
   a. A significant worksite area would be required at the Hammersmith Pumping Station site in order to construct the main tunnel reception works. This site would not have to be enlarged to support driving the connection tunnel.
   b. Driving from the main tunnel site would potentially be cheaper due to the existing work set-up.
   c. Driving the connection tunnel from the Hammersmith Pumping Station site would impact on fewer residences, as there is a greater number of residential properties surrounding the Acton Storm Tanks site.

4.16.16 For these reasons, we preferred the first drive option with a TBM from the Hammersmith Pumping Station site to the Acton Storm Tanks site.
Frogmore connection tunnel

4.16.17 The Frogmore connection tunnel drive options were the same across all routes.

4.16.18 The King George’s Park site was selected as the preferred CSO site for the Frogmore Storm Relief – Buckhold Road CSO and the Bell Lane Creek site was selected as the preferred CSO site for Frogmore Storm Relief – Bell Lane Creek CSO.

4.16.19 Two tunnel drive options were considered:

a. Firstly, a TBM would be driven from the King George’s Park site through the drop shaft at the Bell Lane Creek site and form a junction with the main tunnel under the River Thames

b. Secondly, a TBM would be driven from the Bell Lane Creek site to the King George’s Park site and then be dismantled and brought back to the Bell Lane Creek site to be driven to the main tunnel under the River Thames, see Figure 4.20.

Figure 4.20 Frogmore connection tunnel drive options

4.16.20 The following issues identified and influenced the preferred drive option:

a. The King George’s Park site was considered to be a valuable public open space. The option to drive the connection tunnel from the Bell Lane Creek site would minimise the area required for the King George’s Park site.

b. There would be an additional environmental impact on the trees and wildlife if we used the King George’s Park site as a drive site, compared to using it as a reception site.

c. Driving from the Bell Lane Creek site in two separate drives would provide an opportunity to reduce the depth of the drive towards the King George’s Park site.

d. We recognised that driving two separate drives from the Bell Lane Creek site would probably be more costly than a single drive from the King George’s Park site.
4.16.21 Taking these issues into account, we preferred the second drive option to drive both connection tunnels from the Bell Lane Creek site.

**Shad Thames connection tunnel**

4.16.22 The Shad Thames connection tunnel drive options were the same across all routes.

4.16.23 The Druid Street site was selected as the preferred CSO site and would need to be connected to the main tunnel at the King’s Stairs Gardens site, which was selected as a preferred main tunnel reception site.

4.16.24 Two tunnel drive options were considered:

a. Firstly, a TBM would be driven from the King’s Stairs Gardens site to the Druid Street site, where it would be removed

b. Secondly, the drive direction would be reversed, see Figure 4.21.

**Figure 4.21 Shad Thames connection tunnel drive options**

4.16.25 The following issues were identified and influenced the preferred drive option:

a. The size of the Druid Street site would limit the set-up of tunnel drive worksite facilities. Specifically, it would limit the scope to design the construction phase layout in order to locate the most disruptive construction works away from residential properties to minimise potential impacts.

b. Disruption to the local residents near the Druid Street site would continue for a longer period during the tunnel drive.

c. The King’s Stairs Gardens site was considered more suitable than Druid Street for 24-hour working, it could more easily accommodate tunnelling works and could share facilities with other connection tunnel drives from the same site.
4.16.26 For these reasons, we preferred the first drive option to drive the connection tunnel from the King’s Stairs Gardens site to the Druid Street site.

**Holloway connection tunnel: River Thames and Rotherhithe route**

4.16.27 The Holloway connection tunnel drive options were not the same across all routes. We have described the options associated with the River Thames and Rotherhithe routes first.

4.16.28 For the River Thames and Rotherhithe routes, the King Edward Memorial Park site and the Butcher Row site were selected as preferred CSO sites, and needed to be connected to the main tunnel at the King’s Stairs Gardens site, which was selected as a preferred main tunnel reception site.

4.16.29 Two drive options were considered:
   a. Firstly, a TBM would be driven from the King’s Stairs Gardens site through the drop shaft at the King Edward Memorial Park site and on to the Butcher Row site
   b. Secondly, a TBM would be driven from the King’s Stairs Gardens site to the King Edward Memorial Park site and another TBM would be driven from the King Edward Memorial Park site to the Butcher Row site, see Figure 4.22.

**Figure 4.22 Holloway connection tunnel drive options: River Thames and Rotherhithe routes**
The following issues were identified that influenced the preferred drive option:

a. The working area of the Butcher Row site would limit the set-up of a tunnel drive site and it would not be possible to move materials by barge.

b. The King’s Stairs Gardens site would not have to be enlarged significantly to drive the connection tunnel.

c. The first drive option (one TBM) would be the cheapest connection tunnel option due to the lower site set up cost and lower TBM costs, and would also be completed more quickly.

d. The King Edward Memorial Park site is within an area identified as deficient in open space, therefore construction impacts needed to be minimised wherever possible.

e. Alternative open space in Southwark Park is located adjacent to the King’s Stairs Gardens site; therefore, combining main reception works and connection tunnel drive works in this location would limit works elsewhere. Community issues would need careful consideration and specific mitigation.

For these reasons, we preferred the first drive option of a TBM driven from the King’s Stairs Gardens site all the way to the Butcher Row site.

Holloway connection tunnel: Abbey Mills route

The Holloway connection tunnel drive options associated with the Abbey Mills route differed from those associated with the River Thames and Rotherhithe routes.

For the Abbey Mills route, the King Edward Memorial Park Foreshore site (not the park that was preferred for the River Thames and Rotherhithe routes) and the Butcher Row site were selected as preferred CSO sites.

The drop shaft at the King Edward Memorial Park Foreshore site would be adjacent to the main tunnel and therefore would not require a connection tunnel.

Two tunnel drive options were considered for the Holloway connection tunnel:

a. Firstly, a TBM would be driven from the King Edward Memorial Park Foreshore site to the Butcher Row site

b. Secondly, the drive direction would be reversed, see Figure 4.23.
Figure 4.23 Holloway connection tunnel drive options: Abbey Mills route

The following issues were identified and influenced the preferred drive option:

a. The size of the Butcher Row site would limit the set-up of a tunnel drive site and it would not be possible to move materials by barge.

b. Noise impacts affecting local residents near the Butcher Row site would continue for a longer period if used as a tunnel drive site.

c. The King Edward Memorial Park Foreshore site would more easily accommodate tunnelling works and would allow materials to be moved by barge.

For these reasons, we preferred the first drive option of a TBM driven from the King Edward Memorial Park Foreshore site to the Butcher Row site.

Earl and Greenwich connection tunnels: River Thames and Rotherhithe routes

The Earl and Greenwich connection tunnel drive options were not the same across all routes. We have described the options associated with the River Thames and Rotherhithe routes first.

For the River Thames and Rotherhithe routes, the Earl Pumping Station site was selected as the preferred Earl Pumping Station CSO site; the Borthwick Wharf Foreshore site was selected as the preferred Deptford SR CSO site; and Greenwich Pumping Station site was selected as the preferred Greenwich Pumping Station CSO site. All three sites needed to be connected to the main tunnel at the Convoys Wharf site, which was selected as a preferred main tunnel drive site.

Two drive options were considered:

a. Firstly, one TBM would be driven from the Convoys Wharf site to the Earl Pumping Station site and another TBM would be driven from Convoys Wharf through the drop shaft at the Borthwick Wharf Foreshore site to the Greenwich Pumping Station site. This drive option would require an additional shaft and a short connection tunnel at the Convoys Wharf site because the main tunnel shaft would be used to drive the main tunnel throughout the period of drive for these
connection tunnels. It would not be possible to drive the connection
tunnels after the main tunnel drive and meet the programme.

b. Secondly, one TBM would be driven from the Convoys Wharf site to
the Earl Pumping Station site, a second TBM would be driven from the
Convoys Wharf site to the Borthwick Wharf Foreshore site and a third
TBM would be driven from the Borthwick Wharf Foreshore site to the
Greenwich Pumping Station site. This would also require an additional
shaft at Convoys Wharf for the reasons set out above. See Figure
4.24.

**Figure 4.24 Earl and Greenwich connection tunnel drive options: **
**River Thames and Rotherhithe routes**

![Diagram of connection tunnel drive options]

4.16.41 The following issues were identified and influenced the preferred drive
option:

a. The Earl Pumping Station and Greenwich Pumping Station sites are
owned by Thames Water but are not large enough on their own to be
used as connection tunnel drive sites.

b. The first option would be the cheapest connection tunnel option due to
lower site set up and TBM costs.

c. The increased environmental impact associated with driving from the
Borthwick Wharf foreshore site should be avoided.

4.16.42 Although there was a preference to maximise use of Thames Water-
owned land, for the reasons given, we preferred the first drive option using
two TBMs.
4.16.43 The Greenwich connection tunnel drive options associated with the Abbey Mills route differ from those associated with the River Thames and Rotherhithe routes.

4.16.44 For the Abbey Mills route, the same CSO sites were selected as preferred sites as for the River Thames and Rotherhithe routes; however, they needed to be connected to the main tunnel at the King’s Stairs Gardens site, which was selected as a preferred main tunnel reception site.

4.16.45 Three drive options were considered:
   a. Firstly, one TBM would be driven from the King’s Stairs Gardens site through the drop shaft at the Earl Pumping Station site, through the drop shaft at the Borthwick Wharf Foreshore site, and then on to the Greenwich Pumping Station (i.e. using one TBM).
   b. Secondly, one TBM would be driven from the King’s Stairs Gardens site through the drop shaft at the Earl Pumping Station site and then on to the Borthwick Wharf Foreshore site. A second TBM would be driven from the Borthwick Wharf Foreshore site to the Greenwich Pumping Station site (i.e., using two TBMs). For this option, the Borthwick Wharf foreshore site would need to be larger than the first option.
   c. Thirdly, one TBM would be driven from the King’s Stairs Gardens site to the Earl Pumping Station site. A second TBM would be driven from the Borthwick Wharf Foreshore site to the Earl Pumping Station site. A third TBM would be driven from the Borthwick Wharf Foreshore site to the Greenwich Pumping Station site (i.e. using three TBMs). See Figure 4.25.
The following issues were identified and influenced the preferred drive option:

a. The Earl Pumping Station and Greenwich Pumping Station sites are owned by Thames Water but were not large enough on their own to be used as connection tunnel drive sites.

b. The first option would be the cheapest due to the lower site set-up and TBM costs.

c. The increased environmental impact associated with driving the tunnel from a larger site at Borthwick Wharf Foreshore should be avoided.

Although there was a preference to maximise use of Thames Water-owned land, for the reasons given we preferred the first drive option using one TBM.
4.16.48 It was noted that the cumulative impact of the main tunnel reception site at King’s Stairs Gardens, combined with the need to drive a number of CSO connection tunnels, may be of concern to the immediately neighbouring residential community and suitable mitigation measures would need to be explored.

**Preferred connection tunnel drive options**

4.16.49 The selection of the preferred connection tunnel drive options described above are summarised in Table 4.8 for the options that are the same across all routes and in Table 4.5 for those that are not the same across all routes.

**Table 4.8 Preferred connection tunnel drive options that are the same across all routes**

<table>
<thead>
<tr>
<th>Route</th>
<th>Drive option</th>
<th>One end of connection tunnel</th>
<th>Site along connection tunnel</th>
<th>Other end of connection tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acton Storm Tanks</td>
<td>r (type A)</td>
<td>n/a</td>
<td>Hammersmith PS</td>
<td></td>
</tr>
<tr>
<td>Barn Elms</td>
<td>type E n/a</td>
<td>type E n/a</td>
<td></td>
<td></td>
</tr>
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<td>Putney Bridge Foreshore</td>
<td>n/a</td>
<td>Main tunnel</td>
<td></td>
<td></td>
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<tr>
<td>King George’s Park</td>
<td>Bell Lane Creek</td>
<td>Main tunnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jews Row</td>
<td>d then d (type C(B))</td>
<td>r</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridges Court Car Park</td>
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<td>Main tunnel</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Heathwall PS CSO’s site</td>
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<td>type E n/a</td>
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<td>Tideway Walk</td>
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<td></td>
<td></td>
</tr>
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<td>Victoria Embankment Foreshore</td>
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</tr>
<tr>
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<td></td>
</tr>
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<td>King’s Stairs Gardens</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td></td>
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</tr>
</tbody>
</table>
### Identification of the preferred route

#### 4.17.1
Sections 4.10 to 4.14 above describe the preferred main tunnel sites and CSO sites and the associated drive options for each route alignment, as identified prior to phase one consultation. This section sets out the balance of considerations that we used in assessing the routes in order to determine a preferred route for the main tunnel. The three routes were compared against each other using a range of criteria from the five disciplines (engineering, planning, environment, community and property) and exercising professional judgement to balance the issues and compare the impacts of the routes.

#### 4.17.2
The overall conclusions from each discipline’s assessment of the three routes are provided below. More detailed information is provided in the *Preferred Scheme Report*.

#### Engineering

The conclusions of the engineering assessment of the three routes are provided below.

The Abbey Mills route would be 9km and 6.7km shorter than the River Thames and Rotherhithe routes respectively and the cost of the scheme would be approximately £700m less. Despite a reduced internal volume,
the hydraulic performance of the Abbey Mills route would still comply with the requirements of the EU Urban Waste Water Treatment Directive.

4.17.5 From an overall health and safety hazard perspective, the reduction in length of the Abbey Mills route would reduce the likelihood of construction related risks. In addition, the River Thames and Rotherhithe routes would drive through water-bearing Chalk with much higher ground water pressures, which would increase wear on the TBM and the risks to personnel carrying out TBM maintenance. Other greater tunnelling risks associated with the River Thames and Rotherhithe routes included driving through a much greater length of flint-bearing Chalk, a greater number of fault zones and the construction of more deep shafts and CSO connections. However, the Abbey Mills route would follow an alignment at the top of the Chalk, close to the underside of the Thanet Sand Formation along the Limehouse Cut, which could make TBM face interventions hazardous and complex.

4.17.6 The substantial reduction in construction scope associated with a shorter main tunnel length and fewer main construction sites, coupled with tunnelling through less hazardous ground make the Abbey Mills route a safer construction choice. The reduced scope was also considered to reduce the overall procurement risk by placing less stress on the procurement chain. All of these engineering reasons, together with a lower cost solution that would comply with the requirements of the Urban Waste Water Treatment Directive, were all the reasons why the engineering assessment preferred the Abbey Mills route for the main tunnel.

Planning

4.17.7 The conclusions of the planning assessment of the three routes are set out below.

4.17.8 Our strategic comparison of the three alternative tunnel route options focussed on a number of recurring cumulative planning considerations. These considerations comprised the nature of the affected land (greenfield, previously developed and foreshore); the impact on safeguarded wharves and the River Thames; and the prospects for enacting current planning permissions and emerging proposals.

4.17.9 These considerations affected all three routes, but the Abbey Mills route would incorporate comparatively fewer greenfield and previously developed sites than either the River Thames or Rotherhithe routes. As a result, there would be fewer sites overall that would affect public open space, employment, regeneration and safeguarded wharf designations. There would also be fewer sites that would require mitigation of potential policy conflicts.

4.17.10 The level of impact on sites with extant permission or forthcoming proposals was also considered to be less for the Abbey Mills route than the other routes.

4.17.11 We noted that the Abbey Mills route would increase the relative number of foreshore sites, although compared to the other routes it would also reduce the effects on the use of King Edward Memorial Park.
4.17.12 We recognised that, in any event, the loss and replacement of public open space, particularly within areas of deficiency, and the potential for conflict with regeneration proposals are significant issues that required further investigation and on-going monitoring.

4.17.13 The potential for a reduced cumulative impact on these planning considerations was the main reason why the planning assessment preferred the Abbey Mills route for the main tunnel.

**Environment**

4.17.14 The environment assessment conclusions of the three routes are set out below.

4.17.15 The Abbey Mills Route would be 9km and 6.7km shorter than the River Thames and Rotherhithe routes respectively. This means that the Abbey Mills Route would generate less waste, require less material and need energy for construction. The Abbey Mills route would therefore have a smaller 'carbon footprint' than the two other routes, in view of these factors.

4.17.16 The Abbey Mills route would require fewer main tunnel sites than either the River Thames route or Rotherhithe route, and would therefore generate the least site-related cumulative environmental effects.

4.17.17 Our preliminary assessment of cumulative effects of the main tunnel sites across the three routes suggested that this would be the case. The main tunnel sites required for the Abbey Mills route would require fewer jetty structures to be built in the river and so minimize foreshore ecological impacts. It is also likely that the main tunnel sites required for the Abbey Mills route would impact on fewer built heritage receptors. The lower number of main tunnel sites required for the Abbey Mills route would lead to less disturbance of contaminated ground and result in adverse air quality impacts at fewer sites than the other two routes.

4.17.18 We therefore considered the Abbey Mills route to be our preferred main tunnel route from an environmental perspective.

**Community**

4.17.19 The conclusions of the community assessment of the three routes are set out below.

4.17.20 From a community impacts perspective, all three of the route options have the potential to impact on a number of sensitive receptors.

4.17.21 Although it is not possible to estimate the exact numbers of people or households affected, the Abbey Mills route would cumulatively impact on fewer residential neighbourhoods due to the shorter tunnel length and a lower number of sites.

4.17.22 None of the route options appeared likely to result in significant impacts on properties that provide health or educational services. All three routes have the potential to impact on the church and chapel located adjacent to the King's Stairs Garden's site, while the River Thames and Rotherhithe
routes could also impact on community worship events taking place in a warehouse opposite the proposed Charlton site.

4.17.23 Community cohesion and the health and well-being of local people may be impacted on by the use of a number of sites required to construct all three routes. A maximum of seven of the shared River Thames and Rotherhithe route sites would affect open space or parkland. None of the route options reduces this number. The cumulative impact is likely to be relatively small since the open space sites are not geographically close to each other and serve communities at different sides of the river.

4.17.24 Of particular importance was the amount of public open space likely to be temporarily lost at Barn Elms and King’s Stairs Gardens. For the River Thames and Rotherhithe routes, there would also be a temporary loss of public space at King George’s Park and King Edward Memorial Park. It is also likely that Pepys Park (adjacent the Convoys Wharf site on the River Thames and Rotherhithe routes) and Frank Banfield Park (opposite Hammersmith Pumping Station site) would face some disruption due to their proximity to significant construction works.

4.17.25 All three route options would require the use of sites that might impact on the local economy through the displacement of active businesses. On balance, the Abbey Mills route was considered preferable as it would not use the Charlton site and would therefore require the relocation of fewer businesses.

4.17.26 Overall, from a community impacts perspective, there are advantages and disadvantages to all three route alignments. King’s Stairs Gardens was considered at this stage of the project to be a particularly critical site as its use was vital to all three route options and the proposed construction works would likely have a number of significant impacts on the local community. None of the routes would avoid significant likely community impacts, but the cumulative socio-economic impacts were likely to be slightly fewer with the Abbey Mills route. The Abbey Mills route would require fewer main tunnel sites than either the River Thames or Rotherhithe routes, and should therefore generate less site-related cumulative impact on the community.

Property

4.17.27 The conclusions of the property assessment of the three routes are provided below.

4.17.28 All three route options would give rise to property issues, and the preferred sites fall within the following categories: development sites, parks owned by local authorities, occupied industrial estates, Thames Water property and foreshore sites.

4.17.29 In terms of main tunnel sites, the River Thames and Rotherhithe routes would require three development sites, two parks owned by local authorities, part of an industrial estate and an existing Thames Water operational site.

4.17.30 The considerations for the Abbey Mills route were the same as for the River Thames route, except that the number of main tunnel sites was
reduced to five, removing one development site and the industrial estate at Charlton from consideration. Beckton STW was also replaced by Abbey Mills Pumping Station, which is owned by Thames Water.

4.17.31 Therefore, there were fewer cumulative property issues associated with the Abbey Mills route, although a number of issues remained to be addressed for all three routes, particularly in terms of potentially high acquisition costs of development sites, establishing the ability to secure the rights required to public parks, and the need to provide compensation for relocated businesses.

4.17.32 From a property perspective, considered the Abbey Mills route to be the preferred main tunnel route.

**Summary of the preferred route analysis**

4.17.33 The comparison of the three routes by the five disciplines (engineering, planning, environment, community and property) concluded that the Abbey Mills route was the preferred route and it was presented at phase one consultation. In summary, the Abbey Mills route has a number of advantages:

a. It would be the shortest route.

b. It would be the least disruptive and most cost-effective option, delivering 20 per cent savings compared to the other two options, while still meeting all our environmental objectives.

c. It would require the lowest number of sites.

d. It would require less tunnelling at depth through Chalk in the east, which is more difficult and would entail greater health and safety issues.

4.18 **Phase one preferred scheme and consultation**

4.18.1 The results of the assessments and analysis set out above resulted in the phase one preferred scheme as presented at phase one consultation. This scheme is illustrated in Figure 4.26 and comprised:

a. The Abbey Mills route as the preferred route for the main tunnel

b. The selection of 22 preferred sites (Beckton STW is not counted as a site here) out of 123 shortlisted sites, made up of one main tunnel drive site, two main tunnel reception sites, two combined (main tunnel drive and CSO) sites and 17 CSO sites.

4.18.2 The route would terminate at Abbey Mills Pumping Station, where flows would continue via the Lee Tunnel for treatment at Beckton STW. The preferred scheme was subject to further on-going engagement at phase one consultation. Consultees also had the opportunity at phase one consultation to comment on the shortlisted sites and tunnel routes that were not selected as preferred, but were considered as potential alternatives.

4.18.3 Stage 2 of the Site selection methodology paper stated that on-going engagement and consultation activities should be carried out in relation to
our identified preferred sites and their uses, as defined by the drive strategy, which related to how sites link together to form the project. Some high level considerations are outlined at Stage 2, and further details on our approach to consultation are provided in our Community consultation strategy and Statement of community consultation.

4.18.4 During phase one consultation, we consulted on the need for the project; the alternatives to a tunnel; our work up to that point to establish our preferred scheme (including other shortlisted sites and routes considered); engineering, planning, environmental, community and property issues raised and considered during our site selection work; and our initial ideas on the permanent structures once work is complete.
4 Phase one preferred scheme: Site selection process

Figure 4.26 Phase one preferred scheme
5 Between phase one and phase two consultation: Scheme development

5.1 Introduction

5.1.1 This section describes how the scheme evolved following phase one consultation. It also explains the back-checking exercise described in our *Site selection methodology paper* and how and why we used this process to search for new sites where necessary for scheme development work.

5.1.2 Scheme development work was generally undertaken for one of three reasons (or a combination of these reasons):
   a. on-going engineering developments and scheme design
   b. phase one and interim consultation feedback
   c. changes in circumstances.

5.1.3 In particular, this section focuses on the scheme development work as it related to the preferred sites and the tunnelling drive strategy (ie, tunnelling directions and how the main tunnel sites connect to one another) presented at phase one consultation and potential changes thereto.

5.1.4 The details of the site selection work carried out between phase one and phase two consultation is presented in Section 6 and in the site appendices (see Volumes 3 to 5, Section 3 of each site appendix), which explain how we arrived at the scheme presented at phase two consultation.

5.2 On-going engineering developments and scheme design

5.2.1 Throughout the development of the project, engineering design has proceeded in parallel with the site selection process. The methodology recognises that there is an iterative relationship between engineering design and site selection (see Volume 2, Appendix 1, paragraph 1.7.5). As part of this iterative process, we had regard to phase one consultation feedback and, wherever possible, we sought to take account of feedback relevant to site selection considerations and identify improved means of implementing the project in our on-going engineering scheme design.

5.2.2 Design development activities that took place following phase one consultation included:
   a. architectural and landscape design work for above-ground features
   b. engineering designs and studies of various components of the scheme (for example, means of CSO interception, site size requirements, hydraulic studies, etc)
c. ‘system master planning’ to define changes to sewerage system operations, consider the facilities needed to control and limit overflows from the project and address ventilation and odour design

d. other work examining construction, transportation and river navigation logistics issues

e. field investigations, including ground investigations and surveys.

5.2.3 In particular, the following design development work influenced the sites and tunnelling strategy that made up the phase two preferred scheme:

a. Developments in the design reduced the number of the 34 CSOs that would be controlled by the project by means of direct interception from 21 at phase one consultation to 18 at phase two consultation. The remaining 16 CSOs can be controlled by other indirect measures, as described in the Site selection background technical paper. This is described in more detail in relation to particular sites in Section 6.7.

b. In terms of marine transport, we considered that operations between Putney Bridge and Hammersmith Bridge would be challenging, especially when servicing the peak tunnelling rates. In the upper reaches of the river beyond Putney Bridge, the presence of recreational users, such as rowers and small boats, presented a major hazard and risk to be considered when evaluating sites. Sites along this part of the Thames could be accessed and serviced but would require careful planning to mitigate the problems associated with navigational constraints. This is discussed in relation to the suitability of sites in Zone S2 (Barn Elms) and Zone S3 (Wandsworth Bridge) in Section 6.6.

c. At phase one consultation, the minimum size for a main tunnel drive site in areas where the geology is London Clay (the western section of the scheme) was assumed to be 18,000m$^2$. Further investigations determined that could be reduced to approximately 15,000m$^2$ by constraining certain activities and facilities.

d. Further work was undertaken to investigate the hydraulic requirements of the western end of the tunnel. We found that a larger diameter tunnel than initially proposed is required at the western end in order to meet flow and storage requirements.

e. Use of the River Lee for barge transportation was studied further. Considering all currently available information, we found that it would be unlikely to provide a reliable day-in, day-out means of barging throughout a sustained main tunnel construction period at the Abbey Mills Pumping Station site.

f. Further work was undertaken to determine the method and strategy for providing for odour and air management.

g. We studied system hydraulics in relation to the storage volume of the Greenwich connection tunnel.

h. Further studies enabled a better understanding of fluvial impacts, currents and sensitivities of construction in the river.
5.2.4 The above list, although not exhaustive, sets out some of the engineering design factors that influenced site selection and tunnelling strategy for the phase two preferred scheme. These factors were taken into account in the back-checking process summarised in Section 5.5 and reported in Section 6 (also see Volumes 3 to 5, site appendices, Section 3).

5.3 **Phase one consultation and interim consultation feedback**

5.3.1 Full details of consultation responses are contained in the *Report on phase one consultation*. We received feedback from 2,869 unique consultees, including 2,815 community respondents, 30 technical consultees and 24 landowners. There was greater support for the Abbey Mills route than the other two route options that we consulted on.

5.3.2 The *Report on phase one consultation* includes our responses to the issues raised by respondents during phase one consultation. It explains the process for analysing and identifying key themes that arose. We also undertook further analysis to identify how the themes might influence the development of the proposed scheme. The five disciplines (engineering, planning, environment, community and property) reviewed the key themes and issues, and evaluated their impact on our proposals and how we could respond to them.

5.3.3 Feedback from phase one consultation was one of many factors we considered in reviewing the scheme against defined site selection considerations. We considered whether they raised any matters that were not known or would potentially alter the overall conclusions of all five disciplines in our optineering process. We took each of the issues raised by consultees into account and considered whether we could reduce the effects identified. We carefully considered the justification for keeping any of the proposals as originally presented or whether further investigation was needed (see Section 5.5 below).

5.3.4 We have always recognised the importance of introducing measures to reduce the effects of our proposals, and the feedback received, together with the more detailed environmental information that we collected, helped to guide our further work. In order to mitigate the effects of our works, we undertook further design development and environmental assessment work, and/or proposed amendments to the nature or extent of the works.

5.3.5 We gave careful consideration to the comments received on the preferred sites presented at phase one consultation and comments received on other shortlisted sites. In response to new information received through consultation, the sites fell into three categories:

- a. investigate the potential to use an alternative site
- b. investigate possible alternative technical solutions
- c. incorporate measures to address the issues raised concerning the potential effects of the project.

5.3.6 There was also a fourth category of sites for which no new information relevant to site selection had been raised and the issues had already been
considered in the site selection process. No further changes were considered for these sites. However, potential issues were addressed through detailed design and/or mitigation measures.

5.3.7 Section 5.5 below provides a summary of the sites within these categories and more detailed in relation to each site is reported in Section 6 (also see Volumes 3 to 5, site appendices, Section 3).

Interim engagement between phases one and phase two consultation

5.3.8 As a result of comments received during phase one consultation, (which ended in January 2011), further technical work subsequently undertaken, and the availability of new, alternative sites that were not previously available to us, we identified:

a. several sites where we considered works of a different nature or intensity than consulted on at phase one consultation

b. a number of sites that were potentially suitable alternatives to those consulted on at phase one consultation.

5.3.9 These changes were the subject of our interim engagement. In total, we consulted on 11 sites as part of our interim engagement, which are listed below. The site presented at phase one consultation is referenced in brackets for information.

a. Acton Storm Tanks
b. Carnwath Road Riverside (Barn Elms)
c. Chambers Wharf (King’s Stairs Gardens)
d. Cremorne Wharf Depot (Cremorne Wharf Foreshore)
e. Deptford Church Street (Borthwick Wharf Foreshore)
f. Dormay Street (Bell Lane Creek)
g. Falconbrook Pumping Station (Bridges Court Car Park)
h. Greenwich Pumping Station
i. Heckford Street Industrial Area (King Edward Memorial Park Foreshore)
j. Kirtling Street (Tideway Walk)
k. Shad Thames Pumping Station (Druid Street).

5.3.10 This process is described in the Interim engagement report, which was made available as part of phase two consultation. This report provided a summary of the feedback received from members of the public and other stakeholders in response to the interim engagement events undertaken between 11 March 2011 and 16 August 2011.

5.3.11 Engagement with the public was coordinated through a programme of ‘drop-in sessions’ or ‘community liaison meetings’ held at venues close to the respective sites, where members of the public could review and discuss our proposals with members of the project team. Members of the
public were able to submit written feedback on our proposals via comment cards or via general correspondence, such as email or letters.

5.3.12 Feedback gathered during this period was used to review the sites prior phase two consultation and was taken into account in the back-checking process summarised in Section 5.5 and reported in Section 6 (also see Volumes 3 to 5, site appendices, Section 3).

5.4 Changes in circumstances

5.4.1 We recognised that during the course of the site selection and consultation processes circumstances relating to particular sites could change or new information on sites could become available. Our objective was to select the most suitable sites available at the time the project is to be constructed (securing them in advance, where appropriate), and we ensured that our site selection process was flexible enough to take these changes on board.

5.4.2 The scheme development work therefore had regard to new information and changes in circumstances since phase one consultation, where applicable. These changes were, in some cases, the reason or one of the reasons for triggering the back-checking process described in Section 5.5. The types of change in circumstances that we took into account can generally be grouped under the following headings:

a. Engineering: new information that has arisen through the on-going engineering work described in Section 5.2

b. Planning: granting of planning permissions for alternative schemes, lapsing of planning permissions on potential sites, site commencements, changes to planning policies and designations

c. Environment: new survey information, new information obtained for the environmental impact assessment process, changes in designated sites.

d. Community: any change in the community uses on or surrounding a site

e. Property: commencement of development, new information as a result of land acquisition investigations on site availability.

5.4.3 Particular examples included:

a. Land adjoining Hammersmith Pumping Station: submission of a new planning application for the residential development on the site and planned to change the designation from an employment zone to a residential zone in the London Borough of Hammersmith and Fulham’s emerging Local Development Framework.

b. Availability of a new, previously unconsidered site (which had not previously been included on our long list) potentially suitable for interception of the Frogmore Storm Relief – Bell Lane Creek CSO.

c. Availability of Chambers Wharf as a potential alternative main tunnel site to King’s Stairs Gardens. This site was previously discounted as
construction appeared to have commenced. However, the owner demolished the existing buildings, stopped work and put the site on the market.

5.4.4 These factors were taken into account in the back-checking process summarised in Section 5.5 and reported in Section 6 (also see Volumes 3 to 5, site appendices, Section 3).

5.5 **Back-check process**

5.5.1 As discussed in the previous sections, scheme development review work was generally undertaken for one of three reasons (or a combination of these reasons):

a. on-going engineering developments and scheme design

b. phase one and interim consultation feedback

c. changes in circumstances.

5.5.2 Where these factors applied to a site, we needed to reconsider the suitability of particular sites identified as preferred sites for phase one consultation.

5.5.3 Part 3B of the *Site selection methodology paper* explains how the methodology allowed us to revisit the site selection process and undertake a back-check if a site was eliminated for any reason, if there was a significant change in circumstances or due to development in the engineering design.

5.5.4 The site selection process prior to back-checking and the steps in the back-check process are illustrated in Figure 5.1.
The process and how it was applied can be summarised as follows:

a. Step 1 requires a decision to be made on whether there is a need to trigger the back-check process (for example this could be for any of the reasons set out in Sections 5.2 to 5.4 above, or a combination of those reasons). This process was undertaken for each of the sites identified at phase one consultation, including the alternative sites suggested in phase one consultation.

b. Step 2 requires the back-check process to be scoped (ie, availability of potential sites to be determined) and at the end of Step 2, the project group need to agree if there is sufficient scope (sites) and, if so, which 'pool', or group of sites, is to be reassessed in Step 3.

c. Step 3 requires the five disciplines to reassess the site under consideration by following Stage 1 of the Site selection methodology paper. The findings of the reassessment were discussed at an optioneering workshop and recommendations were made on any new replacement sites and any necessary changes to the scheme, including any alterations to the main tunnel and connection tunnel strategy. The recommendations from step three were fed into Step 4.

d. In Step 4, the workshop recommendations were considered and approved by the management team. This resulted in further targeted consultation (interim engagement) with relevant stakeholders, as discussed in paragraphs 5.3.5 to 5.3.7).

5.5.6 We used the back-check process in relation to the following phase one preferred sites (NB: for information, the interim consultation sites or
description of issue are provided in brackets. References are provided to Section 3 of the relevant volume and appendix for more details):

a. Acton Storm Tanks (use of site) – Volume 3, Appendix A
b. Hammersmith Pumping Station (location within a wider site) – Volume 3, Appendix B
c. Barn Elms (Carnwath Road Riverside) – Volume 3, Appendix G
d. Bell Lane Creek (Dormay Street) – Volume 3, Appendix E
e. Bridges Court Car Park (Falconbrook Pumping Station) – Volume 3, Appendix H
f. Cremorne Wharf Foreshore (Cremorne Wharf Depot) – Volume 4, Appendix J
g. Chelsea Embankment Foreshore (location within the foreshore) – Volume 4, Appendix K
h. Tideway Walk (Kirtling Street) – Volume 4, Appendix L
i. King’s Stairs Gardens (Chamber Wharf) – Volume 5, Appendix R,
j. King Edward Memorial Park Foreshore (Heckford Street) – Volume 5, Appendix S
k. Borthwick Wharf Foreshore (Deptford Street) – Volume 5, Appendix U
l. Greenwich Pumping Station (use of site) – Volume 5, Appendix V.

5.5.7 The conclusions of the back-check process are summarised in Section 6.

5.6 Summary of scheme development process

5.6.1 Table 5.1 below summarises the implications of our scheme development work, as described in this section, for each of the phase one consultation preferred sites. It should be noted that for each site we considered whether or not there was any additional information that would potentially trigger a back-check. Where there was no substantive new information or any design changes to take into account, we did not proceed with the back-check. Table 5.1 also provides the relevant volume and appendix that details the reasons and outcomes of all the reviews and back-checks carried out for each site.

The implications for each site, following further site selection work and consideration of drive options, and in relation to the development of the phase two preferred scheme are presented in Section 6 below. (NB: for information, the relevant interim consultation site name/site issue is provided in brackets in Table 5.1).

Section 48: Report on site selection process
Volume 1: Main report
### Table 5.1 Phase one preferred sites: Summary of implications of scheme development work for each phase one consultation site

<table>
<thead>
<tr>
<th>Site</th>
<th>Implications for the phase one preferred site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acton Storm Tanks (use of site)</td>
<td><strong>Back-check required.</strong> We identified a need to consider whether the main tunnel should be extended to Acton Storm Tanks and whether this, or another site, would be suitable as a main tunnel reception site. However, it should be noted that we still believed that this would be the most appropriate site to intercept the local CSO, which would still need to be connected to the main tunnel at the most suitable back-checked main tunnel site near to this site. Details of this back-check are provided in Volume 3, Appendix A, Section 3.</td>
</tr>
<tr>
<td>Hammersmith Pumping Station (alternative location within a wider site and use)</td>
<td><strong>Back-check required.</strong> We still believed this to be the most appropriate site to connect the local CSO to the main tunnel. However, instead of ending the main tunnel at Hammersmith Pumping Station, we identified a need to look at whether the main tunnel should be extended to Acton Storm Tanks. This would mean that a smaller CSO site would be required at Hammersmith Pumping Station for a shorter period of time (approximately three years), with potentially fewer effects and fewer permanent structures. Details of this back-check are provided in Volume 3, Appendix B, Section 3.</td>
</tr>
<tr>
<td>Barn Elms (Carnwath Road Riverside)</td>
<td><strong>Back-check required.</strong> We still believed this to be the most appropriate site to connect the local CSO to the main tunnel. We identified a need to review alternative sites from Hammersmith Bridge to Albert Bridge that could be used to construct the main tunnel. One site that we decided to explore further was the Carnwath Road Riverside area. This would mean that a smaller CSO site would be required at Barn Elms for a shorter period of time (approximately two and half years), with potentially fewer effects and fewer permanent structures. Details of this back-check are provided in Volume 3, Appendix G, Section 3 (also for the CSO see Volume 3, Appendix C).</td>
</tr>
<tr>
<td>Putney Bridge Foreshore</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. We still believed this to be the most appropriate site to connect the local CSO to the main tunnel. Details of the review are provided in Volume 3, Appendix D, Section 3.</td>
</tr>
<tr>
<td>Bell Lane Creek (Dormay Street)</td>
<td><strong>Back-check required.</strong> A site in close proximity to the existing local CSO was put up for sale and could be used to intercept this CSO. Further work was identified as required in order to understand whether this site would be an appropriate alternative to our preferred site at phase one consultation. Details of this back-check are provided in Volume 3, Appendix E, Section 3.</td>
</tr>
</tbody>
</table>
### Between phase one and phase two consultation: Scheme development

<table>
<thead>
<tr>
<th>Site</th>
<th>Implications for the phase one preferred site</th>
</tr>
</thead>
<tbody>
<tr>
<td>King George’s Park</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. We still believed this to be the most appropriate site to connect the local CSO to the main tunnel. Details of the review are provided in Volume 3, Appendix F, Section 3.</td>
</tr>
<tr>
<td>Jews Row</td>
<td>We looked at alternatives to control flows in order to remove the requirement for a CSO site to intercept flows at this location (see Section 6.7).</td>
</tr>
<tr>
<td>Bridges Court Car Park</td>
<td><strong>Back-check required.</strong> We identified a need to look at alternative sites for CSO interception, including Falconbrook Pumping Station, which is owned by Thames Water. Details of this back-check are provided in Volume 3, Appendix H, Section 3.</td>
</tr>
<tr>
<td>(Falconbrook Pumping Station)</td>
<td></td>
</tr>
<tr>
<td>Cremorne Wharf Foreshore</td>
<td><strong>Back-check required.</strong> We identified a need for further work to investigate the potential to locate the access to our proposed works through the waste transfer facility rather than Cremorne Gardens, or to use an alternative site. Details of this back-check are provided in Volume 4, Appendix J, Section 3.</td>
</tr>
<tr>
<td>(Cremorne Wharf Depot)</td>
<td></td>
</tr>
<tr>
<td>Chelsea Embankment Foreshore</td>
<td><strong>Back-check required.</strong> We identified a need to undertake further work to investigate the potential to use a land-based site rather than a foreshore site to intercept the existing local CSO and connect the northern Low Level Sewer No.1 to the main tunnel. Details of this back-check are provided in Volume 4, Appendix K, Section 3.</td>
</tr>
<tr>
<td>(alternative location in foreshore)</td>
<td></td>
</tr>
<tr>
<td>Tideway Walk</td>
<td><strong>Back-check required.</strong> We still believed that the Battersea area was the most appropriate for connecting the local CSOs to the main tunnel. We explored splitting the CSO and main tunnel sites and the CSO site could be smaller, with fewer permanent structures. We still required a main tunnel site in the Tideway Walk area and identified a need to explore alternative options for this site. Details of this back-check are provided in Volume 4, Appendix L, Section 3.</td>
</tr>
<tr>
<td>(Kirtling Street)</td>
<td></td>
</tr>
<tr>
<td>Albert Embankment Foreshore</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. We still believed this to be the most appropriate site to connect the existing local CSOs to the main tunnel. We explored whether an alternative access via Lacks Dock would be possible. Details of the review are provided in Volume 4, Appendix N, Section 3.</td>
</tr>
<tr>
<td>Victoria Embankment Foreshore</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered.</td>
</tr>
</tbody>
</table>
### Between phase one and phase two consultation: Scheme development

<table>
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<tr>
<th>Site</th>
<th>Implications for the phase one preferred site</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>We still believed this to be the most appropriate site to intercept the existing local CSO and connect the northern Low Level Sewer No.1 to the main tunnel. Details of the review are provided in Volume 4, Appendix P, Section 3.</td>
</tr>
<tr>
<td>Blackfriars Bridge Foreshore</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. We still believed this to be the most appropriate site to intercept the existing local CSO and connect the northern Low Level Sewer No.1 to the main tunnel. Details of the review are provided in Volume 4, Appendix Q, Section 3.</td>
</tr>
<tr>
<td>Druid Street</td>
<td>We looked at alternatives to control flows in order to remove the requirement for a CSO site to intercept flows at this location (see Section 6.7).</td>
</tr>
<tr>
<td>King’s Stairs Gardens (Chambers Wharf)</td>
<td><strong>Back-check required.</strong> We remained of the view that we needed a site in this general area. We identified a need to review whether there was an alternative site that could be used to construct the main tunnel. An opportunity arose for us to purchase Chambers Wharf, a previously shortlisted site, which we did in conjunction with the property developers St James Group Limited. Details of this back-check are provided in Volume 5, Appendix R, Section 3.</td>
</tr>
<tr>
<td>King Edward Memorial Park Foreshore</td>
<td><strong>Back-check required.</strong> We considered that there was a need to review the site layout, access arrangements and investigate potential options to connect the CSO to the main tunnel. Details of this back-check are provided in Volume 5, Appendix S, Section 3.</td>
</tr>
<tr>
<td>Butcher Row</td>
<td>We looked at alternatives to control flows in order to remove the requirement for a CSO site to intercept flows at this location (see Section 6.7).</td>
</tr>
<tr>
<td>Abbey Mills Pumping Station (use of site)</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. We still believed this to be the most appropriate site as it is located within an existing Thames Water operational site. Details of the review are provided in Volume 5, Appendix W, Section 3.</td>
</tr>
<tr>
<td>Earl Pumping Station</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. We still believed this to be the most appropriate site to connect the existing local CSO to the main tunnel. Details of the review are provided in Volume 5, Appendix T, Section 3.</td>
</tr>
</tbody>
</table>
Between phase one and phase two consultation: Scheme development

<table>
<thead>
<tr>
<th>Site</th>
<th>Implications for the phase one preferred site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borthwick Wharf Foreshore (Deptford Church Street)</td>
<td>Back-check required. We identified a need to look at alternative sites for CSO interception and investigated accordingly. Details of this back-check are provided in Volume 5, Appendix U, Section 3.</td>
</tr>
<tr>
<td>Greenwich Pumping Station (use of site and connection tunnel)</td>
<td>Back-check required. We still believed this to be the most appropriate site to connect the local CSO to the main tunnel. We also considered ways in which the connection tunnel could be constructed and identified that a larger construction site might be required at this location. Details of this back-check are provided in Volume 5, Appendix V, Section 3.</td>
</tr>
</tbody>
</table>

5.6.2 Section 6 below sets out the conclusions reached in respect of each of the above sites following scheme development work, which informed the preferred phase two scheme (see for more details the site appendices referred to in Table 5.1).
6 Phase two preferred scheme: Site selection process

6.1 Introduction

6.1.1 The purpose of this section describes how we arrived at the preferred scheme presented at phase two consultation as a consequence of the scheme development work that took place following phase one consultation. In particular, it sets out how we identified our preferred sites and the tunnel drive strategy that links them.

6.1.2 Prior to phase one consultation, we produced the Preferred Scheme Report (Autumn 2010). Its purpose was to recommend the preferred sites, associated tunnel drives and main tunnel route for the project for phase one consultation. Prior to phase two consultation, we produced the Phase two scheme development report (Winter 2011) which served a similar purpose in setting out the preferred sites and tunnel drive option identified as a result of scheme development since phase one consultation.

6.1.3 It should be noted that scheme development did not affect the preferred main tunnel route, which remained the Abbey Mills route (see the Phase one consultation report, March 2011).

6.1.4 In order to explain how we identified the preferred scheme put forward at phase two consultation, we have split the remainder of this section into the following sections:

a. Review and assessment of long list, draft short list and short list of sites (Section 6.2): this section summarises how individual sites were assessed in order to arrive at a short list. The same process was followed as outlined in full in Section 4.

b. Main tunnel site zones (Section 6.3): this section sets out which zone each shortlisted site was assigned to.

c. Main tunnel drive options (Section 6.4): this section details the various possible drive options to construct the tunnel by linking a combination of available main tunnel zones to create a scheme that meets the project’s objectives.

d. Main tunnel sites (Section 6.5): this section identifies the main tunnel sites put forward as most suitable for each identified zone and summarises the rationale for their selection. Further details of the sites are provided in Sections 3 to 6 of Volume 3, Appendices A and G, H; Volume 4, Appendix L; and Volume 5, Appendices R and W.

e. Analysis of main tunnel drive options (Section 6.6): this section describes how the various tunnelling drive options were evaluated, in terms of comparing suitability of sites used by different drive options in order to arrive at the preferred drive option and hence the preferred main tunnel sites.

f. CSO sites (Section 6.7): this section summarises the assessment of the preferred sites for connecting each CSO to the main tunnel.
Further details of the sites are provided in Section 3 in Volume 3, Appendices A to F, H; Volume 4, Appendices J, K, M, N, P, Q; and Volume 5, Appendices S to V.

g. **CSO connection tunnel drive options** (Section 6.8): this section explains the considerations taken into account for drive options associated with the long CSO connection tunnels.

h. **Phase two preferred consultation scheme** (Section 6.9): this section describes the sites, tunnelling drive option and route that made up the preferred scheme for phase two consultation.

6.1.5 Further information about the project’s background and engineering requirements can be found in the *Site selection background technical paper* (Summer 2011) (see Volume 2, Appendix 2).

6.1.6 All the information and assessments contained in Section 6 are related to this stage in the project’s development based on the information available at the time.

6.2 **Review and assessment of long list, draft short list and short list of sites**

6.2.1 As explained in Section 5, we revisited the site selection process and reassessed sites in certain areas through our back-check process. This assessment involved repeating the relevant stages of the site selection process described in full in Section 4. The site appendices for main tunnel and CSO sites, as noted in paragraph 6.1.4 above, provide details of the relevant long and draft short list assessments.

6.2.2 In order to be able to undertake a back-check for a specific site, it was necessary to revisit both the previous long list assessments: firstly at Table 2.2 of the *Site selection methodology paper* (May 2009 and Summer 2011) (earlier version is available on Thames Water website and for the latest version see Volume 2, Appendix 1), note that the later version did not change the site selection assessment process, but merely added a second round of consultation and therefore only the later date will be used in this section; and secondly the previous draft short list assessments at Table 2.3 of the *Site selection methodology paper* (Summer 2011). In addition to revisiting the previous assessments and verifying the findings against any new information received, any new sites not previously considered were assessed in accordance with the considerations set out in Tables 2.2 and 2.3.

6.2.3 Sites were included on the post phase one consultation long list and were assessed to provide a post phase one consultation draft short list. A short list of potential sites was then confirmed for each of the back-check sites. The site appendices for main tunnel and CSO sites, as noted in paragraph 6.1.4 above, provide details of the relevant long and draft short list assessments.

6.2.4 For each shortlisted site, a site suitability report was prepared, as described in Section 4, and the recommendations within the reports were
Phase two preferred scheme: Site selection process

considered at a series of workshops alongside the drive options set out in the *Engineering options report – Abbey Mills route* (Summer 2011).

6.2.5 Following the back-check process, the number of sites on the various lists were:

a. long list: 770 main tunnel sites and 367 CSO sites
b. draft short list: 120 list main tunnel sites and 148 CSO sites
c. final short list: 53 main tunnel sites and 57 CSO sites.

6.3 Main tunnel site zones

6.3.1 Prior to phase one consultation, an engineering options report was prepared in accordance with the *Site selection methodology paper* (Summer 2011). It considered how sites worked in combination and options for main tunnel alignments and CSO connections.

6.3.2 The Abbey Mills route was identified as the preferred route in the *Preferred Scheme Report* (Autumn 2010), which was prepared prior to phase one consultation and remained the preferred route following phase one consultation.

6.3.3 A second engineering options report, the *Engineering options report – Abbey Mills route* (Summer 2011), was prepared as part of the scheme development process following phase one consultation in order to consider the engineering drive options available to construct the main tunnel on the Abbey Mills route in light of the potential changes to main tunnel sites.

6.3.4 These ‘drive options’ were considered, having regard to the shortlisted sites available following the back-checking process.

6.3.5 The *Engineering options report – Abbey Mills route* (Autumn 2010) considered:

a. system design and engineering requirements
b. main tunnel and connection tunnel drive options.

6.3.6 The *Engineering options report – Abbey Mills route* (Summer 2011) described the control and interception of CSO flows, tunnel hydraulic requirements and system functional and operational requirements. It describes the geology along the route and the implications for the construction of the tunnel, and the tunnel engineering and construction requirements and methods. Of particular importance, it clearly states that the spacing of main tunnel sites, and therefore the number of main tunnel sites required, was influenced by:

a. the TBM types, which must be appropriate to the geological conditions expected
b. the need to deliver the project efficiently and on time
c. the risk of TBM breakdowns/servicing requirements and their severity and frequency, which increase with the length of the drive
d. the emergency egress of the construction workforce, which becomes more difficult the longer the length of the drive.

6.3.7 As a result of these considerations, we identified a number of concurrent main tunnel drives required to construct the main tunnel. The final decision on the number of TBMAs, and hence the number of main tunnel sites, was based on a balance between the type of TBM appropriate to the ground, the available locations of main tunnel sites, geology, programme, environment, amenity, health and safety, risk, cost and procurement considerations.

6.3.8 The 53 main tunnel sites on the short list fell principally into two types of site required to construct the main tunnel:

a. main tunnel reception/intermediate sites only
b. main tunnel drive sites (also suitable as reception/intermediate sites).

6.3.9 The characteristics of these types of site are described in the Site selection background technical paper (Summer 2011, see Volume 2). Furthermore, each shortlisted site was described in detail, and its suitability for the proposed usage was assessed and documented in its own site suitability report.

6.3.10 In order to assess the total number of combinations of tunnel drive options, the shortlisted sites were grouped into a number of zones (as done prior to phase one consultation and reported in the previous Engineering options report, Spring 2010). This was based on the geographical proximity of sites. Figure 6.1 shows the main tunnel site zones identified. It should be noted that Zones S8, S9 and S10 were not relevant to the Abbey Mills route, as they applied to the other two alternative routes previously under consideration and are not discussed further in this section.
6.3.11 Table 6.1 below identifies the shortlisted main tunnel sites within each zone and identifies the type of use for which they were assessed for suitability. For each of these sites, the specific site suitability report contains a more detailed assessment.

**Table 6.1 Grouping of shortlisted main tunnel sites for the Abbey Mills route**

<table>
<thead>
<tr>
<th>Site zone</th>
<th>Site ID</th>
<th>Site name</th>
<th>Local authority</th>
<th>Site usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>S01EG</td>
<td>Acton Storm Tanks</td>
<td>Ealing</td>
<td>• reception</td>
</tr>
<tr>
<td></td>
<td>S02EG</td>
<td>Commercial units, Stanley Gardens</td>
<td>Ealing</td>
<td>• reception</td>
</tr>
<tr>
<td></td>
<td>S03EG</td>
<td>Acton Park Industrial Estate</td>
<td>Ealing</td>
<td>• reception</td>
</tr>
<tr>
<td></td>
<td>S04EG</td>
<td>Industrial units, Allied Way</td>
<td>Ealing</td>
<td>• reception</td>
</tr>
<tr>
<td>S1</td>
<td>No shortlisted sites</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td>S17RD</td>
<td>Barn Elms</td>
<td>Richmond</td>
<td>• double drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• single drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S3</td>
<td>S18WH</td>
<td>Feathers Wharf</td>
<td>Wandsworth</td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td></td>
<td>S72HF</td>
<td>Fulham Depot, next to Wandsworth Bridge</td>
<td>Hammersmith and Fulham</td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td></td>
<td>S87HF</td>
<td>Carnwath Road</td>
<td>Hammersmith</td>
<td>• single drive</td>
</tr>
<tr>
<td>Site zone</td>
<td>Site ID</td>
<td>Site name</td>
<td>Local authority</td>
<td>Site usage</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>----------------------------</td>
<td>-----------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Riverside and Fulham</td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S4</td>
<td></td>
<td>No shortlisted sites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S5</td>
<td>S61WH</td>
<td>Battersea Park</td>
<td>Wandsworth</td>
<td>• double drive with S92WH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• single drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S68WH</td>
<td></td>
<td>Battersea Power Station</td>
<td>Wandsworth</td>
<td>• double drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• single drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S72WH</td>
<td></td>
<td>Kirtling Street with</td>
<td>Wandsworth</td>
<td>• split double drive with S93WH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cringle Street</td>
<td></td>
<td>• split single drive with S93WH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• split reception/intermediate with S93WH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S86WH</td>
<td></td>
<td>Post Office</td>
<td>Wandsworth</td>
<td>• split double drive with S80WH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• split single drive with S80WH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S92WH</td>
<td></td>
<td>Part of Battersea</td>
<td>Wandsworth</td>
<td>• double drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power Station</td>
<td></td>
<td>• single drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S93WH</td>
<td></td>
<td>Kirtling Street</td>
<td>Wandsworth</td>
<td>• double drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• single drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S94WH</td>
<td></td>
<td>Post Office Way</td>
<td>Wandsworth</td>
<td>• split single drive with S80WH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S95WH</td>
<td></td>
<td>Depots, Ponton Road</td>
<td>Wandsworth</td>
<td>• double drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• single drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S6</td>
<td>S54SK</td>
<td>King’s Stairs Gardens</td>
<td>Southwark</td>
<td>• single drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S76SK</td>
<td></td>
<td>Chambers Wharf</td>
<td>Southwark</td>
<td>• single drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S7</td>
<td>S020T</td>
<td>Shadwell Basin</td>
<td>Tower Hamlets</td>
<td>• single drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S021T</td>
<td></td>
<td>King Edward Memorial Park</td>
<td>Tower Hamlets</td>
<td>• single drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• reception/intermediate</td>
</tr>
<tr>
<td>S024T/</td>
<td></td>
<td>Heckford Street</td>
<td>Tower Hamlets</td>
<td>• split reception/split</td>
</tr>
</tbody>
</table>
### Site selection process

**6.4 Main tunnel drive options**

6.4.1 This section outlines the drive options identified as available, based on the potential site uses within each main tunnel zone, as described above in table 6.1.

6.4.2 Section 6.5 (Main tunnel sites) takes into account the suitability of potential sites within each drive option in order to evaluate the relative merits of each potential drive option and arrive at a preferred scheme. The sequence of decisions made in order to arrive at a preferred scheme was as follows:

a. Nine zones were identified along the length of the Abbey Mills route.

b. A series of potential drive options (as set out in this section) were identified based on the nine zones (drive options needed to have regard to zones where a main tunnel site was an absolute requirement for example, at the start (Zone S0) and end (Zone S11) of the main tunnel).

c. The most suitable main tunnel drive and reception sites within each zone were identified. It was possible for no suitable sites to be identified in a zone. This could be acceptable if it was not an absolute requirement to have a site in that zone.

d. The drive options were evaluated using a series of comparisons, taking into account the relative suitability of one site compared to one in a neighbouring or alternative zone.

e. The preferred drive option and preferred sites were identified.

6.4.3 All the feasible drive options were identified based on the potential number of TBMs required and the sites that they could be driven from and to. Based on the site zone grouping and the maximum and minimum drive lengths defined below, and for the reasons explained at paragraphs 6.3.10 and 6.3.11 above, either three or four TBMs would be needed to construct the main tunnel.
6 Phase two preferred scheme: Site selection process

6.4.4 The list of feasible drive options was developed based on the following considerations, which are similar to those used to determine the drive options for the phase one preferred scheme:

a. a construction period of six years
b. the theoretical maximum practical drive length, estimated to be 12km
c. the minimum economic drive length, which is 3km due to the time and effort required to install and remove the TBM
d. the types of site available in each zone (ie, whether they were suitable for a drive or reception site)
e. the length of tunnel drives through different geological strata
f. length of time to construct the very deep shafts required in the Lambeth Group, Thanet Sand Formation or Chalk ground conditions, which is longer than in the London Clay at the western section of the tunnel. A diaphragm wall shaft would be required in these areas (Zones S5 Battersea to S11 Abbey Mills). London Clay is found in Zones S0 Acton to S4 Lots Road.
g. the distance between access points for the operation and maintenance of the permanent works
h. the vertical alignment and gradient constraints for the tunnel.

6.4.5 The list of main tunnel drive options was considered in a series of preferred scheme optioneering workshops, which brought together representatives of the engineering, planning, environment, community and property teams to consider the merits and demerits of potential options. These workshops were based on the drive options established in the Engineering options report – Abbey Mills route (Summer 2011). The list of potential main tunnel drive options presented to the optioneering workshops is provided at Table 6.2 below.
Table 6.2 Main tunnel: Summary of drive options

<table>
<thead>
<tr>
<th>Drive option</th>
<th>S0</th>
<th>S2</th>
<th>S3</th>
<th>S5</th>
<th>S6</th>
<th>S7</th>
<th>S11</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1/E1</td>
<td>r</td>
<td>d-r</td>
<td>-</td>
<td>d</td>
<td>d</td>
<td>r-r</td>
<td>d</td>
</tr>
<tr>
<td>W1/E2</td>
<td>r</td>
<td>d-r</td>
<td>-</td>
<td>d</td>
<td>d</td>
<td>r-d</td>
<td>d</td>
</tr>
<tr>
<td>W1/E3</td>
<td>r</td>
<td>d-r</td>
<td>-</td>
<td>d</td>
<td>d</td>
<td>r-r</td>
<td>d</td>
</tr>
<tr>
<td>W1/E4</td>
<td>r</td>
<td>d-r</td>
<td>-</td>
<td>d</td>
<td>d</td>
<td>r-d</td>
<td>d</td>
</tr>
<tr>
<td>W1/E5</td>
<td>r</td>
<td>d-r</td>
<td>-</td>
<td>d</td>
<td>r</td>
<td>d-r</td>
<td>d</td>
</tr>
<tr>
<td>W1/E6</td>
<td>r</td>
<td>d-r</td>
<td>-</td>
<td>d</td>
<td>r</td>
<td>d-r</td>
<td>d</td>
</tr>
<tr>
<td>W2/E1</td>
<td>r</td>
<td>d-d</td>
<td>-</td>
<td>d</td>
<td>r</td>
<td>r-r</td>
<td>d</td>
</tr>
<tr>
<td>W2/E2</td>
<td>r</td>
<td>d-d</td>
<td>-</td>
<td>d</td>
<td>r</td>
<td>r-d</td>
<td>d</td>
</tr>
<tr>
<td>W2/E3</td>
<td>r</td>
<td>d-d</td>
<td>-</td>
<td>d</td>
<td>r</td>
<td>r-r</td>
<td>d</td>
</tr>
<tr>
<td>W2/E4</td>
<td>r</td>
<td>d-d</td>
<td>-</td>
<td>d</td>
<td>r</td>
<td>r-d</td>
<td>d</td>
</tr>
<tr>
<td>W2/E5</td>
<td>r</td>
<td>d-d</td>
<td>-</td>
<td>d</td>
<td>r</td>
<td>d-r</td>
<td>d</td>
</tr>
<tr>
<td>W2/E6</td>
<td>r</td>
<td>d-d</td>
<td>-</td>
<td>d</td>
<td>r</td>
<td>d-r</td>
<td>d</td>
</tr>
<tr>
<td>W3/E1</td>
<td>r</td>
<td>-</td>
<td>d-r</td>
<td>d</td>
<td>d</td>
<td>r-f</td>
<td>d</td>
</tr>
<tr>
<td>W3/E2</td>
<td>r</td>
<td>-</td>
<td>d-r</td>
<td>d</td>
<td>d</td>
<td>r-f</td>
<td>d</td>
</tr>
<tr>
<td>W3/E3</td>
<td>r</td>
<td>-</td>
<td>d-r</td>
<td>d</td>
<td>d</td>
<td>r-f</td>
<td>d</td>
</tr>
<tr>
<td>W3/E4</td>
<td>r</td>
<td>-</td>
<td>d-r</td>
<td>d</td>
<td>d</td>
<td>r-f</td>
<td>d</td>
</tr>
<tr>
<td>W3/E5</td>
<td>r</td>
<td>-</td>
<td>d-r</td>
<td>d</td>
<td>d</td>
<td>r-f</td>
<td>d</td>
</tr>
<tr>
<td>W3/E6</td>
<td>r</td>
<td>-</td>
<td>d-r</td>
<td>d</td>
<td>d</td>
<td>r-f</td>
<td>d</td>
</tr>
</tbody>
</table>

**Legend:** The following nomenclature/legend is used in the table to define the types of site required in the defined zones. Where ‘d’ denotes drive site, ‘r’ denotes reception site and ‘i’ denotes intermediate site. The tunnel is driven from a ‘d’ drive location to a ‘r’ reception location.

<table>
<thead>
<tr>
<th>No site required</th>
<th>Single Reception</th>
<th>Double Reception</th>
<th>Drive and Reception</th>
<th>Single Drive</th>
<th>Double Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>r</td>
<td>r-r</td>
<td>r-d</td>
<td>d</td>
<td>d-d</td>
</tr>
</tbody>
</table>

6.4.6 In order to interpret the various drive options set out in Table 6.2, it may be helpful to consider the following description of the final option above, W3/E6:

a. A site in Zone S0 Acton would be used to receive a TBM from a site in Zone S3 Wandsworth Bridge.

b. A site in Zone S3 Wandsworth Bridge would be used to drive a TBM to a site in Zone S0 Acton.

c. The same site at S3 Wandsworth Bridge would also be used to receive a TBM from the other direction, from a drive site in Zone S5 Battersea.

d. A site in Zone S5 Battersea would be used to drive a TBM to Zone S3 Wandsworth Bridge.
e. The same site in Zone S5 Battersea would also be used to receive a TBM from the other direction, from a drive site at Zone S7 Limehouse.

f. A site in Zone S7 Limehouse would be used drive a TBM to a site in Zone S5 Battersea.

g. The same site in Zone S7 Limehouse would also be used to receive a TBM from the other direction, from a drive site in Zone S11 Abbey Mills.

h. A site in Zone S11 Abbey Mills would be used to drive a TBM to a site in Zone S7 Limehouse.

6.4.7 Table 6.2 lists the 18 potentially feasible drive options and demonstrates that:

a. All 18 options would use four TBM.

b. Four options would use four drive sites and one reception site, while 14 options would use three drive sites and two reception sites.

c. All options would require a main tunnel site in Zone S0 Acton, Zone S5 Battersea and Zone S11 Abbey Mills.

d. All options would require a main tunnel site in either Zone S2 Barn Elms or Zone S3 Wandsworth Bridge.

e. All options would require a main tunnel site in either Zone S6 Shad or Zone S7 Limehouse.

6.4.8 The potential requirement for a drive site or reception site in each zone was linked to the direction in which each section of the tunnel was to be constructed, i.e., the direction in which the TBM would ‘drive’ the tunnel from one site (a drive site) to another (a reception site) and the maximum lengths of tunnel drive that could be achieved.

6.5 Main tunnel sites

6.5.1 Section 6.6 explains why it was necessary to consider how the potential main tunnel sites would link together to form possible drive options for construction of the main tunnel. It describes how shortlisted main tunnel sites were assigned to particular zones, and how various combinations of zones and types of main tunnel site (drive or reception) were identified as possible drive options, taking into account the system design and engineering requirements for the project. The most suitable site within each zone was then identified. This process is summarised in this section, and described in more detail in Section 3 of Volume 3, Appendices A and G, H; Volume 4, Appendix L; and Volume 5, Appendices R and W.

6.5.2 However, it should be noted that the scheme would not require sites within all nine zones. It would require a site in certain zones, some of which were fixed (i.e., the zones at the beginning and end) and some of which could be compared against neighbouring zones, in order to choose the most suitable site within that broad location.

6.5.3 Each sub section below outlines the most suitable site within each of the different site zones for the phase two scheme. It should be noted that
these did not represent the final preferred sites selected for phase two consultation, but simply the most suitable site within that zone for the purpose of comparing drive options. In order to identify the most favourable means of constructing the main tunnel, the starting point was to choose a site within each zone so as to compare drive options based on these zones and choose a workable and affordable scheme (drive option) with the lowest impact on the community and environment, and thus least conflict with planning policy.

6.5.4 Preferred sites could only be identified once the drive options had been evaluated in the context of available sites, as described in Section 6.6 below.

**Zone S0 Acton**

6.5.5 At phase one consultation, there was no Zone S0 Acton and therefore no preferred main tunnel site in this zone. We had proposed a CSO site at Acton Storm Tanks, which would have been connected to the main tunnel via a connection tunnel driven from the Hammersmith Pumping Station site. During scheme development work, we found that the Hammersmith Pumping Station site was no longer available (refer also to Zone S1 Hammersmith below). For this reason (and the reasons explained in Volume 3, Appendix A), we reviewed the tunnelling strategy for the western end of the tunnel, which lead to a need to consider potential main tunnel sites at the western end of the tunnel.

6.5.6 C01YC: Acton Storm Tanks (smaller CSO site) remained our preferred site to intercept the Acton Storm Tanks CSO.

6.5.7 In order to identify a potential main tunnel site, we defined a 500m area around the CSO site in order to create the new main tunnel Zone S0 Acton to ensure that any potential site would be close enough to our preferred CSO site. We then commenced the back-check process for Zone S0 in order to determine whether there were any potential sites and, if so, how suitable they were. Based on the available information, no shortlisted main tunnel drive sites were identified.

6.5.8 We shortlisted four main tunnel reception/intermediate sites: S01EG/C01YC Acton Storm Tanks (an extension of our preferred CSO site), S02EG/C01YC Commercial units, Stanley Gardens, S03EG/C01YC Acton Park Industrial Estate and S04EG/C01YC Industrial units, Allied Way.

6.5.9 S01EG/C01YC Acton Storm Tanks was identified as the most suitable main tunnel reception site within Zone S0 Acton because it was a brownfield site and was already used and owned by Thames Water to temporarily store storm water flows in tanks when there is not enough capacity in the sewerage system. The site is large enough to intercept the CSO and receive the main tunnel from Carnwath Road Riverside.

6.5.10 Volume 3, Appendix A, Section 3 gives further details of the identification of the Acton sites at this stage.
Zone S1 Hammersmith

6.5.11 At phase one consultation, we identified S33HF Hammersmith Pumping Station and surrounding land as our preferred site for a main tunnel reception site in Zone S1 Hammersmith. We also proposed to use this site to connect the local CSO to the main tunnel and drive a connection tunnel to Acton Storm Tanks.

6.5.12 However, during scheme development work, we identified that most of the area around the Hammersmith Pumping Station site was no longer available due to the submission of a new planning application for residential development on the site and the reallocation of the site from employment use to residential use in the London Borough of Hammersmith and Fulham’s emerging Local Development Framework.

6.5.13 We held discussions with the landowner of the site which concluded that the only viable option would be to use part of the site for a CSO connection only and not as a main tunnel reception or drive site for the connection tunnel to Acton Storm Tanks.

6.5.14 The possibility of extending the main tunnel to Acton Storm Tanks (see Zone S0 Acton above) opened up the option of using this site only to intercept the local Hammersmith Pumping Station CSO.

6.5.15 As a result of the new planning application and the change to the site allocation policy, we began a back-check to review the availability of a main tunnel drive site that could be used to drive the tunnel to Acton Storm Tanks from a location further east. Further engineering work determined that the size of a main tunnel drive site in areas of clay geology could be reduced from 18,000m$^2$ to 15,000m$^2$ by constraining certain activities and facilities. This allowed us to reconsider sites that had previously been dismissed because they were slightly too small.

6.5.16 We concluded that there was no site available to be used as a main tunnel site (drive or reception) in Zone S1 Hammersmith.

Zone S2 Barn Elms

6.5.17 At phase one consultation, S17RD Barn Elms was identified as the most suitable site in this zone (it was the only shortlisted site in this zone) and it was subsequently identified as a preferred site once the phase one drive options had been evaluated.

6.5.18 S17RD Barn Elms remained the most suitable site for this zone for the reasons previously identified, which included the opportunity to combine the main tunnel worksite with the CSO connection worksite, river access for transportation of materials, distance from residential properties and vehicular access to the local road network.

6.5.19 Further technical work meant that the tunnelling strategy for the western end of the tunnel had to be reviewed. This led to a need to reconsider potential main tunnel sites in Zones S1 Hammersmith to S4 Lots Road and to trigger the back-check process. Further engineering work also determined that the size of a main tunnel drive site in areas of clay geology could be reduced from 18,000m$^2$ to 15,000m$^2$ by constraining
certain activities and facilities. This allowed us to reconsider sites that had previously been dismissed because they were slightly too small.

6.5.20 The suitability of drive options that relied on this site is discussed further in Section 6.6. Not all drive options utilised a site in Zone S2 Barn Elms.

6.5.21 Volume 3, Appendix G, Section 3 gives further details of the identification of the Barn Elms site (alongside other potential sites in Zones S1 Hammersmith to S4 Lots Road).

**Zone S3 Wandsworth Bridge**

6.5.22 At phase one consultation, no were sites identified as suitable for use as a main tunnel drive site in Zone S3 Wandsworth Bridge. We identified two sites that would be suitable as main tunnel reception sites, but the phase one preferred tunnelling strategy meant that this type of site was not required in this locality.

6.5.23 Further technical work meant that the tunnelling strategy for the western end of the tunnel had to be reviewed. This led to a need to reconsider potential main tunnel sites in Zones S1 Hammersmith to S4 Lots Road and to trigger the back-check process. Further engineering work also determined that the size of a main tunnel drive site in areas of clay geology could be reduced from 18,000m$^2$ to 15,000m$^2$ by constraining certain activities and facilities. This allowed us to reconsider sites that had previously been dismissed because they were slightly too small.

6.5.24 Through the back-check process, three sites were shortlisted: two main tunnel reception sites and one single main tunnel drive site in this zone. (The single main tunnel drive was previously two intermediate/sites that were combined to form one larger site.)

6.5.25 The shortlisted sites were: S87HF Carnwath Road Riverside (which combines previous sites S69HF Trinidad Wharf and Industrial site, Carnwath Road and S70HF Industrial site, Carnwath Road), which was assessed as a potential main tunnel drive or reception site; S18WH Feathers Wharf, which was assessed as a potential main tunnel reception site; and S72HF Fulham Depot, which was also assessed as a potential main tunnel reception site.

6.5.26 S18WH Feathers Wharf was identified as the most suitable main tunnel reception site in Zone S3 Wandsworth Bridge. In summary, this was because it is a brownfield site in an industrial area.

6.5.27 However, S18WH Feathers Wharf would not be large enough for a main tunnel drive site; therefore S87HF Carnwath Road Riverside was identified as the most suitable main tunnel drive site in Zone S3 Wandsworth Bridge. In summary, this was because it is a brownfield site with river access and it is a safeguarded wharf.

6.5.28 The suitability of drive options that relied on these sites is discussed further in Section 6.6. Not all drive options utilised a site in Zone S3 Wandsworth Bridge.
6.5.29 Volume 3, Appendix G, Section 3 gives further details of the identification of the Carnwath Road Riverside site (alongside other potential sites in Zones S1 Hammersmith to S4 Lots Road).

**Zone S4 Lots Road**

6.5.30 At phase one consultation, no sites were identified as suitable for use as a main tunnel drive site in Zone S4 Lots Road. We identified two main tunnel reception/sites, but the phase one preferred tunnelling strategy meant that a main tunnel site was not needed in this locality.

6.5.31 Further technical work meant that the tunnelling strategy for the western end of the tunnel had to be reviewed. This led to a need to reconsider potential main tunnel sites in Zones S1 Hammersmith to S4 Lots Road and to trigger the back-check process. Further engineering work also determined that the size of a main tunnel drive site in areas of clay geology could be reduced from 18,000m² to 15,000m² by constraining certain activities and facilities. This allowed us to reconsider sites that had previously been dismissed because they were slightly too small.

6.5.32 Through the back-check process, no sites were shortlisted in Zone S4 Lots Road. Therefore, no suitable sites for further consideration were identified in this zone. For this reason, none of the drive options utilised a site within this zone.

**Zone S5 Battersea**

6.5.33 At phase one consultation, the most suitable site in this zone was S79WH/S80WH Tideway Walk and this was taken forward to consultation as a preferred site. This site was also to be used to connect two local CSOs to the main tunnel.

6.5.34 A main tunnel site was required in this zone to suit all of the drive options identified in Section 6.4. The distance between potential sites in this zone and the next set of potential sites to the east (Zone S6 Shad) was such that a main tunnel site in this zone was required so as not to exceed maximum recommended tunnelling distances.

6.5.35 At phase one consultation, further information on the preferred site (S79WH/S80WH) was obtained. In particular, we were informed that planning permission for housing on the site had been granted and that work had commenced on the site, so it would not be available to the project.

6.5.36 The back-check process for this zone was triggered on the basis that the site was no longer available, and we assessed seven potential main tunnel drive (single and/or double) sites and three potential reception only sites. All of these sites progressed from the long list to the short list. Of these sites, S72WH/S93WH Kirtling Street was identified as the most suitable site in this zone. In summary, this was because it is a brownfield site in an industrial area with direct river access and good road access, and would be suitable for use as a double drive site if required.

6.5.37 The suitability of drive options that relied on this site is discussed further in Section 6.6. All drive options utilised a site in Zone S5 Battersea.
Volume 4, Appendix L, Section 3 gives further details of the identification of the Kirtling Street site (alongside other potential sites in Zone 5 Battersea).

Zone S6 Shad

At phase one consultation, the most suitable site in this zone (the only shortlisted site in this zone) was S54SK King’s Stairs Gardens and this was taken forward to consultation as a preferred main tunnel reception site. This site was also preferred as a site to drive two connection tunnels to connect four surrounding CSOs to the main tunnel.

A main tunnel drive or reception site was required in this zone for some, but not all, of the drive options identified in Section 6.4. There are risks associated with tunnelling through different types of geology. There is a change in geology from the Lambeth Group and Thanet Sand Formation (Zone S5 Battersea) to Chalk (Zone S6 Shad – approximately 500m to the east of Tower Bridge) and therefore, based on engineering risks, drive options from Zones S5 (Battersea) to S7 (Limehouse) are less desirable.

The S76SK Chambers Wharf site had been on our draft short list but did not proceed to the final short list prior to phase one consultation. We were aware that a developer had secured planning approval for housing on this site and appeared to have started work on this permission (demolition and site clearance had commenced). Since then, the site was put up for sale and, in conjunction with the property developers St James Group Limited (part of the Berkley Group), we purchased the site as a possible alternative to King’s Stairs Gardens.

This new information relating to the availability of Chambers Wharf, the feedback received during phase one consultation in relation to our proposed use of King’s Stairs Gardens, and engineering design developments combined to trigger the back-check process.

Potential sites within this zone were therefore reconsidered through the back-check assessment process. While a number of sites were included on the long list and draft short list, the only sites included on the short list in this zone that were assessed in further detail were S76SK Chambers Wharf (for a drive or reception site) and S54SK King’s Stairs Gardens (for a drive or reception site).

The assessment led to the conclusion that S76SK Chambers Wharf should be identified as the most suitable site within this zone. In summary, this was because it is a brownfield site with river access and it would provide sufficient space to be used as either a main tunnel drive or reception site.

The suitability of drive options that relied on this site is discussed further in Section 6.6. Not all drive options utilised a site in this Zone S6 Shad.

Volume 5, Appendix R, Section 3 gives further details of the identification of the Chambers Wharf site (alongside other potential sites in Zones S6 Shad and S7 Limehouse).
Zone S7 Limehouse

6.5.47 A main tunnel drive or reception site in this zone was required for one or more of the drive options described in Section 6.4.

6.5.48 At phase one, the most suitable drive or reception site in this zone was S021T King Edward Memorial Park. However, following a comparison of available drive options, it was not identified as a preferred drive or reception site. However, the adjoining foreshore site was identified as a preferred site for CSO connection.

6.5.49 As described in relation to Zone S6 above, a back-check was triggered in respect of S54SK King’s Stairs Gardens. This required us to reconsider potential sites (and related drive options) in Zone S7 Limehouse as sites in this zone could be used as a potential alternative to a site in Zone S6 Shad.

6.5.50 For the reasons discussed in Appendix R (Chambers Wharf), S021T King Edward Memorial Park remained the most suitable site in Zone S7 Limehouse. In summary, this was because when compared to other sites in this zone, it was less constrained and offered the opportunity to combine a main tunnel site with a CSO site. It also has river access.

6.5.51 The suitability of drive options that relied on this site is discussed further in Section 6.6. Not all drive options utilised a site in Zone S7 Limehouse.

6.5.52 Volume 5, Appendix R, Section 3 gives further details of consideration of this site as an alternative to S54SK King’s Stairs Gardens (alongside other potential sites in Zones S6 Shad and S7 Limehouse).

Zone S8 Deptford, Zone S9 Charlton and Zone S10 Beckton

6.5.53 At phase one, we identified the most suitable drive and/or reception site in each of these zones. Drive options for the River Thames route and Rotherhithe route utilised the sites in these zones.

6.5.54 Following phase one consultation, we decided to proceed with Abbey Mills as our preferred route, and the two alternative routes were not considered further. The Abbey Mills route would directly connect Zone S7 Limehouse to Zone S11 Abbey Mills and would not require sites in Zones S8 Deptford, S9 Charlton or S10 Beckton. Sites in these zones are not therefore considered further as main tunnel sites in this section. Sites in Zone S8 Deptford are, however, considered further in relation to the Greenwich connection tunnel, as described in Volume 5, Appendix V, Section 3. It should be noted that the Lee Tunnel would transfer flows from Abbey Mills to Beckton STW for treatment.

Zone S11 Abbey Mills

6.5.55 A main tunnel drive or reception site was required in this zone for all of the drive options described in Section 6.4.

6.5.56 The most suitable site identified in this zone at phase one was S84NM Abbey Mills Pumping Station. Scheme development work since phase one consultation confirmed that this site remained the most suitable site. The suitability of drive options that relied on this site is discussed further in Section 6.6.
6.5.57 Volume 5, Appendix W, Section 3 gives further details of the identification of this site.

**Summary of main tunnel sites by zone**

6.5.58 Table 6.3 below summarises the conclusions of our assessment of the most appropriate sites in each main tunnel zone for the phase two scheme. In some instances, the sites remain the same as identified in our phase one consultation, and in other instances the sites were not previously identified as the most suitable site in the zone. Full details are provided in Section 3 of Volume 3, Appendices A and G, H; Volume 4, Appendix L; and Volume 5, Appendices R and W.

**Table 6.3 Summary of main tunnel sites in each zone**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Zone name</th>
<th>Single drive site</th>
<th>Double drive site</th>
<th>Reception site</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>Acton</td>
<td>No shortlisted sites</td>
<td>Not required</td>
<td>S01EG Acton Storm Tanks</td>
</tr>
<tr>
<td>S1</td>
<td>Hammersmith</td>
<td>No shortlisted sites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td>Barn Elms</td>
<td>S17RD Barn Elms</td>
<td>S17RD Barn Elms (one shaft, to be used sequentially for two drives)</td>
<td>S17RD Barn Elms</td>
</tr>
<tr>
<td>S3</td>
<td>Wandsworth</td>
<td>S87HF Carnwath Road Riverside</td>
<td>No shortlisted sites</td>
<td>S18WH Feathers Wharf</td>
</tr>
<tr>
<td>S4</td>
<td>Lots Road</td>
<td>No shortlisted sites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S5</td>
<td>Battersea</td>
<td>S72WH/S93WH Kirtling Street with Cringle Street</td>
<td>S72WH/S93WH Kirtling Street with Cringle Street</td>
<td>S72WH/S93WH Kirtling Street with Cringle Street</td>
</tr>
<tr>
<td>S6</td>
<td>Shad</td>
<td>S76SK Chambers Wharf</td>
<td>No shortlisted sites</td>
<td>S76SK Chambers Wharf</td>
</tr>
<tr>
<td>S7</td>
<td>Limehouse</td>
<td>S021T King Edward Memorial Park</td>
<td>No shortlisted sites</td>
<td>S021T King Edward Memorial Park</td>
</tr>
<tr>
<td>S8</td>
<td>Deptford</td>
<td>Not required for Abbey Mills route</td>
<td>Not required for Abbey Mills route</td>
<td>Not required for Abbey Mills route</td>
</tr>
<tr>
<td>S9</td>
<td>Charlton</td>
<td>Not required for Abbey Mills route</td>
<td>Not required for Abbey Mills route</td>
<td>Not required for Abbey Mills route</td>
</tr>
<tr>
<td>S10</td>
<td>Beckton</td>
<td>Not required for Abbey Mills route</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NB: Flows would reach Beckton STW from Abbey Mills Pumping Station via the Lee Tunnel for the Abbey Mills route.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S11</td>
<td>Abbey Mills</td>
<td>S84NM Abbey Mills Pumping Station</td>
<td>Not required</td>
<td>S84NM Abbey Mills Pumping Station</td>
</tr>
</tbody>
</table>
6.6 Analysis of main tunnel drive options

6.6.1 This section explains how the available drive options and most suitable sites identified for each zone, as described in Sections 6.4 and 6.5 above, were considered, compared and evaluated in order to arrive at the phase two preferred scheme. The evaluation took account of engineering, planning, environment, community, and property considerations. Decisions were made collectively by representatives of all five disciplines on the basis of the balance of merits and demerits.

6.6.2 As explained above, we needed to identify a series of sites that would work together to enable construction of the project. The drive options did not rely on the availability a drive or reception site in every zone (and, as detailed above, some zones had now been excluded altogether). The choices between drive options therefore tended to reflect the suitability of the identified site in one zone, as compared to the identified sites in the neighbouring zones.

6.6.3 Sites in certain zones were essential to completion of the scheme, either because they were at the start or end of the route, or because maximum tunnel drive lengths or a change in geology necessitated a shaft in that location. For these zones, choices tended to reflect whether the site was more or less suitable for a drive shaft (which would generally have a greater impact than a reception shaft) when compared to other potential options. It should also be noted that all options also required a double drive, double reception or combined drive and reception site at Zone S5 Battersea.

6.6.4 Preferred main tunnel drive options

6.6.5 In order to assess the suitability of the main tunnel drive options identified, we used a series of comparisons to make choices between drive options with regard to the comparative advantages and disadvantages of the most appropriate site in each zone. Having regard to the possible options outlined in table 6.2, we identified these comparisons as the key differences between the options and the only comparisons that needed to be made in order to choose between options.

6.6.6 Having made each comparison, it was possible to eliminate a number of drive options until the list was reduced to the preferred tunnel drive option. The comparisons that were made to arrive at a preferred option included:

a. Comparison 1: Comparing the use of Chambers Wharf (the most suitable site in Zone S6 Shad) to the use of King Edward Memorial Park (the most suitable site in Zone S7 Limehouse) as a main tunnel site.

b. Comparison 2: Comparing the use of Barn Elms (the most suitable site in Zone S2 Barn Elms) to the use of Carnwath Road Riverside (the most suitable site in Zone S3 Wandsworth) as a main tunnel drive site.

c. Comparison 3: Comparing the use of Abbey Mills Pumping Station (the most suitable site in Zone S11 Abbey Mills) as main tunnel drive
6.6.6 Each of these comparisons and the conclusions reached at the preferred scheme workshops by the engineering, planning, environment, community and property disciplines are discussed in turn below. It should be noted that, in many instances, the advantages and disadvantages of options were finely balanced and discipline representatives took a collective view in order to identify the preferred options.

**Comparison 1: Chambers Wharf (Zone S6 Shad) compared to King Edward Memorial Park (Zone S7 Limehouse) as a main tunnel site (drive or reception)**

6.6.7 This choice compared options that included a main tunnel site in Zone S6 Shad with those that relied on a main tunnel site in Zone S7 Limehouse. There were no options that required a main tunnel site in both zones. We compared the nine drive options that included a main tunnel site in Zone S6 Shad to the nine drive options that included a main tunnel site in Zone S7 Limehouse.

**Figure 6.2 Comparison 1: Option with a main tunnel site in Zone S6 Shad**

6.6.8 Key considerations taken into account in assessing this option, as shown in Figure 6.2, included the following:

a. It was important to select the least risky and most predictable TBM for the expected geological conditions. The increased length of the tunnel drive between Zone S5 Battersea and King Edward Memorial Park would increase the risks associated with tunnelling due to the longer tunnel drive and the change in ground conditions just east of Tower Bridge. A tunnel drive between Zone S5 Battersea and Chambers Wharf would be shorter and present less risk.
b. Chambers Wharf is a brownfield site and subject to fewer policy restrictions than King Edward Memorial Park, which is a designated public open space in an area with an identified deficiency of open space.

c. Overall, it is likely that there would be fewer environmental impacts at Chambers Wharf. Mitigation measures would, however, be required for Chambers Wharf and we acknowledge that both sites are in the vicinity of residential properties.

d. There is no acquisition risk for Chambers Wharf as it is owned by Thames Water (having been acquired to ensure the opportunity to consider this site). Discretionary purchase costs would be likely.

**Figure 6.3 Comparison 1: Option with a main tunnel site in Zone S7 Limehouse**

6.6.9 Key considerations taken into account in assessing this option, as shown in Figure 6.3, included:

a. King Edward Memorial Park would be large enough to contain the full temporary construction area required without extending into the foreshore as would be needed at Chambers Wharf.

b. A main tunnel site at King Edward Memorial Park could be combined with the site required to intercept the CSO at this location, and would avoid the need for an additional site.

c. In planning and community terms, no specific advantages of using King Edward Memorial Park were identified compared to Chambers Wharf. It was recognised that King Edward Memorial Park, which is a designated public open space, is in an area with an identified deficiency of open space. The park is also in a conservation area.

d. The use of King Edward Memorial Park would introduce acquisition risks due to the possible need for a special parliamentary procedure.
6.6.10 Based on the above considerations, on balance, we would prefer to use Chambers Wharf as a main tunnel drive site and eliminate options that use King Edward Memorial Park for this purpose. In summary, Chambers Wharf was preferred as it is a brownfield site, the length of the tunnel drive would be shorter and present less risk, the environmental impacts would be lower and it would conflict less with planning policy than Chambers Wharf.

6.6.11 As a result of this comparison, the nine options that would require a main tunnel drive site in King Edward Memorial Park (Zone S7 Limehouse) were eliminated.
Comparison 2: Barn Elms (Zone S2 Barn Elms) compared to Carnwath Road Riverside (Zone S3 Wandsworth Bridge) as a main tunnel drive site

6.6.12 This choice compared options that included a main tunnel drive site in Zone S2 Barn Elms with those that relied on a main tunnel drive site in Zone S3 Wandsworth Bridge. No options required a main tunnel drive site in both zones. This site comparison allowed us to compare the nine remaining drive options, six of which included a main tunnel site in Zone S2 Barn Elms and three included a main tunnel site in Zone S3 Wandsworth Bridge.

Figure 6.4 Comparison 2: Option with a main tunnel site in Zone S3 Wandsworth Bridge

6.6.13 Key considerations taken into account in assessing this option, as shown in Figure 6.4, included the following:

a. Carnwath Road Riverside includes a safeguarded wharf and has much better river access for transportation of construction materials, and could use significantly larger barges than Barn Elms. The need for new jetty and wharf facilities would be reduced compared to Barn Elms.

b. Health and safety issues associated with using the river and, in particular, the dangers of interfacing with pleasure boat users would be reduced at Carnwath Road Riverside, as well as interfaces with people using the Thames Path.

c. Carnwath Road Riverside would require relocation of existing retail/businesses.
d. Carnwath Road Riverside is a brownfield site that is partly vacant, whereas Barn Elms is a greenfield site. Use of Carnwath Road Riverside is supported in policy terms by its brownfield and safeguarded wharf status, although the area of Carnwath Road Riverside and beyond is currently proposed for regeneration in the draft South Fulham Riverside Supplementary Planning Document.

e. The Thames Path at Carnwath Road Riverside is already diverted around part of the proposed site, and a further diversion is considered more acceptable than at Barn Elms on the basis that it is less well used and a diversion island around the worksite at Barn Elms would be too long and not be as feasible.

f. In environmental terms, the use of a brownfield site would have fewer environmental impacts than the greenfield site at Barn Elms. However, mitigation measures would still be required at Carnwath Road Riverside.

g. Use of Carnwath Road Riverside would avoid the potential impact on the users of Barn Elms sports fields and the loss of two to three sports pitches, and possible relocation of the scout hut and boathouse.

h. Acquisition of Carnwath Road Riverside would not require a special parliamentary procedure. Discretionary purchase costs are, however, to be expected.

**Figure 6.5 Comparison 2: Option with a main tunnel site in Zone S2 Barn Elms**
6.6.14 Key considerations taken into account in assessing this option, as shown in Figure 6.5, included the following:

a. Barn Elms is a large open area with the potential for sufficient space for construction operations. No major building demolition would be required and the site could be combined with the West Putney CSO interception site, which would avoid the need to acquire an extra site.

b. Health and safety issues associated with using the river and in particular the dangers of interfacing with pleasure boat users and people using the Thames Path would be greater at Barn Elms.

c. Barn Elms is subject to policy constraints, including Metropolitan Open Land and public open space.

d. In environmental terms, the use of Barn Elms might impact on nearby ecological sites, including the London Wetland Centre site of special scientific interest (SSSI) and the River Thames and Beverley Brook sites of nature conservation importance (SINCs).

e. There would potentially be impacts on users of the Barn Elms sports fields, including the loss of two to three sports pitches and the possible relocation of the scout hut and boathouse.

f. There are potentially fewer residential properties in the nearby area and therefore there would be less impact on community in the immediate vicinity. However, the impact of construction works may be more difficult to mitigate at this more tranquil site.

g. Lower acquisition costs are expected at Barn Elms than at Carnwath Road Riverside. However, the use of open space at Barn Elms, which is owned and operated by a local authority, might be subject to special parliamentary procedure. Discretionary purchase costs are to be expected.

6.6.15 Based on the above considerations, on balance, we preferred to use Carnwath Road Riverside as a main tunnel drive site and eliminate options that use Barn Elms for this purpose. In summary, this was because Carnwath Road Riverside is a brownfield site and would avoid the loss of designated public open space. It is also an existing safeguarded wharf and has much better river access, which would enable the use of significantly larger barges and reduce the dangers of interfacing with pleasure boat users.

6.6.16 As a result of this comparison, the six options that use a main tunnel site in Zone S2 Barn Elms were eliminated.
6.6.17 The final comparisons between the three remaining drive options involved making choices between the use of Abbey Mills Pumping Station or Chambers Wharf as a main tunnel drive site or reception site (with the associated implications for the connection tunnel to Greenwich Pumping Station, which are described further in paragraphs 6.8.24 to 6.8.31). The three options included:

a. Option A (Option W3/E3 in Table 6.2): Abbey Mills would be used as a drive site to drive the tunnel to Chambers Wharf. Chambers Wharf would be used a reception site to receive the TBM from Abbey Mills and the TBM from the drive site in Zone S5 Battersea. Chambers Wharf would also be used to either drive (Option A1) or receive (Option A2) the connection tunnel to/from Greenwich Pumping Station (identified in figure 6.6 and 6.7 as sub-options A1 and A2).

b. Option B (Option W3/E5 in Table 6.2): Abbey Mills would be used as a drive site to drive the tunnel to Chambers Wharf. Chambers Wharf would be used to receive the TBM from Abbey Mills. Chambers Wharf would also be used as a drive site to drive the main tunnel to Zone S5 Battersea and receive the connection tunnel from Greenwich Pumping Station. It would not be possible to drive the connection tunnel from Chambers Wharf as the site is not big enough to support concurrent drive operations and there would be insufficient time to build one tunnel and then the other.

c. Option C (Option W3/E4 in Table 6.2): Abbey Mills Pumping Station would be used as a reception site to receive the TBM from Chambers Wharf. Chambers Wharf would be used as a drive site to drive the tunnel to Abbey Mills. Chambers Wharf would also be used to receive the TBM from Zone S5 Battersea and receive the connection tunnel from Greenwich Pumping Station. It would not be possible to drive the connection tunnel from Chambers Wharf since the site is not big enough to support concurrent drive operations and because there is insufficient time to build one tunnel and then the other.

6.6.18 The three options are illustrated and discussed below.
Option A (A1 and A2)

**Figure 6.6 Comparison 3: Option A1 (Greenwich connection tunnel driven from Zone S6 Shad)**

**Figure 6.7 Comparison 3: Option A2 (Greenwich connection tunnel received in Zone S6 Shad)**
6.6.19 Key considerations taken into account in assessing Option A1/A2, as shown in Figure 6.6 and Figure 6.7, included the following:

a. Using Chambers Wharf to receive the main TBMs would avoid the need for temporary river reclamation and demolition of the existing jetty to form the site. It would be possible to drive or receive the Greenwich connection tunnel from Chambers Wharf on a smaller site without demolishing the jetty.

b. There would be less impact on residential amenity at Chambers Wharf and this option would avoid additional temporary encroachment into the river (a strategic policy area) at the site.

c. There would potentially be a significant increase in the amount of material required to be transported from Abbey Mills by road (assuming that transport by barge would be limited), and consequently an increased impact on residential amenity there.

d. This option would have greater impact on residents at Abbey Mills but it would reduce the impact on those at Chambers Wharf as, although the site could still be used to drive the smaller connection tunnel (Option A1), it would not be required for a main tunnel drive.

e. Use of Abbey Mills as a drive site would reduce the potential for discretionary purchase costs at Chambers Wharf (which are likely to be significantly higher than discretionary purchase costs for an Abbey Mills drive site). This option would avoid partial construction in the foreshore and associated acquisition risks. Sub-option A1 reduces the need for additional land to be temporarily acquired at Greenwich to drive the connection tunnel.

6.6.20 The drive options for the Greenwich connection tunnel are evaluated in Section 6.8 below.
### Option B

**Figure 6.8 Comparison 3: Option B**

Key considerations taken into account in assessing Option B, as shown in Figure 6.8, included the following:

- **a.** This option would result in reduced construction risks associated with the concentrated tunnelling operations that would otherwise be required at the double drive site in Zone S5 Battersea. However, Chambers Wharf could not be used as both a main tunnel drive site and to drive a connection tunnel to Greenwich Pumping Station.

- **b.** In environmental terms, on balance we slightly preferred Abbey Mills Pumping Station as a drive site to Chambers Wharf if materials could be transported by barge. However, if this would not be feasible, it would be preferable to drive from Chambers Wharf, where the river could reliably be used to remove excavated materials, which would result in fewer road vehicles having to travel past sensitive residential receptors near Abbey Mills.

- **c.** From a planning, property and community perspective, no particular advantages of this option were identified.
6.6.22 Key considerations taken into account in assessing Option C, as shown in Figure 6.9, included the following:

a. There would be significantly better river access for removal of excavated materials at Chambers Wharf than Abbey Mills. Further technical studies have shown that transporting material to or from the Abbey Mills site by the River Lee is highly undesirable given that materials would need to be reliably transported daily over a two- to three-year period. This level of barge movements would be required if Abbey Mills Pumping Station were used as a main tunnel drive site, given the volume of excavated material that would be produced.

b. As this option would offer a potential reduction in the amount of material required to be transported from Abbey Mills by road (assuming that transport by barge would be limited), it would reduce the impact on amenity and communities in the vicinity of Abbey Mills.

c. This option would avoid the need for works to create significant wharfage in the Channelsea River and the potential impact on the road network at Abbey Mills in the event that barge movements from Abbey Mills are limited, which would avoid related environmental impacts.

d. The potential for discretionary purchase costs at Abbey Mills would be minimised if it is used as a reception site rather than a drive site.
Based on the above considerations, on balance, we concluded that ‘Option C (drive option W3/E4)’, ie, driving the main tunnel from Chambers Wharf to Abbey Mills (and using Chambers Wharf to receive the TBM from Zone S5), should be selected. One of the main factors that influenced this decision was that further technical studies showed that restrictions in barge size, reliance on high tides to move barges to and from the site, and other navigational risks and constraints would make it very difficult to transport material reliably over a sustained period of several years in order to service a main tunnel drive site from the Abbey Mills site using the River Lee. It was also highly undesirable in terms of delivering the project in a timely and efficient manner. Therefore, the use of Chambers Wharf as a main tunnel drive site, with the ability to transport material by barge, was considered more acceptable than using Abbey Mills as a drive site with reliance on road transport to remove materials.

Preferred drive options

In summary, nine zones were identified along the length of the Abbey Mills route. We identified a series of potential drive options using the most suitable site in each zone. All drive options required a main tunnel site in Zone S0 Acton, Zone S5 Battersea and Zone S11 Abbey Mills. All options also required a double drive, double reception or combined drive and reception site at Zone S5 Battersea. No suitable main tunnel sites were available in Zone S1 Hammersmith or Zone S4 Lots Road.

This meant that the series of comparisons outlined above were based on using a site either in Zone S2 Barn Elms or Zone S3 Wandsworth Bridge, and a site either in Zone S6 Shad or Zone S7 Limehouse (in each case, there was no requirement for a site in both pairs of zones as they are too close together), and deciding whether each of the required main tunnel sites should be a drive site or reception site.

Based on the above comparisons and conclusions reached by all disciplines at the preferred scheme workshops, we identified Option W3/E4 as the preferred drive option for connecting the main tunnel sites, as shown in table 6.2 above and described at paragraph 6.9.2 below.

6.7 CSO sites

Introduction

This section provides an overview of each CSO and how the preferred CSO sites were identified. A detailed account of the site selection process for each CSO site is included in the appendices to this report for further information.

Each site was considered, in view of our professional judgment and in comparison to the alternatives for the CSO. Preferred sites were not necessarily free from constraint. Rather, they were identified because they were considered the most suitable, or least constrained, site in a required location.
Acton Storm Relief CSO

6.7.3 Three sites were shortlisted for the interception of this CSO, although Chiswick Maternity Hospital was later discounted as development on site meant that it was no longer available.

6.7.4 At phase one consultation, C01YC Acton Storm Tanks was our preferred site for CSO interception and it remained our preferred site at phase two consultation for this use. In summary, this site was selected because it is an existing Thames Water site and it would have fewer impacts on residential amenity than the other potential site (C01XT Welstead Way car park).

6.7.5 At phase two consultation, we also proposed to extend the main tunnel to Acton Storm Tanks. This site would therefore intercept the Acton Storm Relief CSO and also serve as a main tunnel reception site. The position of the shaft was moved to the northern part of the site to minimise the potential impact on residents of Warple Way. At phase one consultation, it was proposed that a connection tunnel would transfer flows from Acton to the main tunnel in the Hammersmith area. Refer to Section 6.5, which discusses the requirements for a main tunnel site at Zone S0 Acton.

6.7.6 Further details on the selection of this site, including the requirement to use this site as a main tunnel site as well as a CSO site, are provided in Volume 3, Appendix A, Section 3.

Hammersmith Pumping Station CSO

6.7.7 At phase one consultation, Hammersmith Pumping Station was a preferred main tunnel reception site and was also the preferred site for the CSO interception.

6.7.8 At phase two consultation, it was no longer a main tunnel reception site, but it was still necessary to intercept the CSO in this location (see Zone S2 at paragraphs 6.5.11 to 6.5.16).

6.7.9 Five sites were shortlisted for the interception of this CSO.

6.7.10 At phase one consultation, C04XJ Hammersmith Pumping Station (off Chancellors Road) was selected as the preferred site and was to be used as part of the preferred main tunnel site (S33HF Vacant Industrial land by Hammersmith Pumping Station) for construction purposes. In summary, C04XJ was selected due to its proximity to the existing pumping station, the potential to combine work with main tunnel shaft works, and the reduced impact on the local community.

6.7.11 Scheme development work and the submission of a new planning application for the land adjacent to the pumping station since phase one consultation (as well as indications that this development will commence shortly) eliminated the possibility of using S33HF Vacant Industrial land by Hammersmith Pumping Station as a main tunnel reception site. The smaller, adjacent site C04XN Hammersmith Pumping Station (off Distillery Road), which was still part of S33HF, but in a slightly different location in the north-eastern corner, was the preferred site for CSO interception at phase two consultation as it could be utilised in conjunction with the development of the surrounding site (the remainder of S33HF). The site is
6 Phase two preferred scheme: Site selection process

also in close proximity to our existing pumping station. The drop shaft is located further away from existing residential dwellings than the other shortlisted sites, which means that construction effects could be more effectively managed. The site is also brownfield land and has good access.

6.7.12 Further details of the selection of this site are provided in Volume 3, Appendix B, Section 3.

West Putney Storm Relief CSO

6.7.13 At phase one consultation, S17RD Barn Elms was a preferred main tunnel drive site and the preferred site for CSO interception.

6.7.14 At phase two consultation, it was no longer a main tunnel site, but it was still necessary to intercept the CSO in this location.

6.7.15 Four sites were shortlisted for interception of the West Putney Storm Relief CSO.

6.7.16 At phase one consultation, C05XQ Southeast corner of Barn Elms sports fields was our preferred site for the CSO interception (and was sited alongside the main tunnel site S17RD Barn Elms). In summary, this site was chosen for the CSO interception as it would be possible to combine works with a main tunnel site and allow for efficient working; it has good access and would require fewer enabling works than other options.

6.7.17 As a result of scheme development work, we preferred S87HF Carnwath Road Riverside to S17RD Barn Elms for use as a main tunnel drive site. However, C05XQ remained the preferred site for the CSO interception at phase two consultation. This was because it would avoid the need to relocate an existing business and community facilities, the ecological impact of working in the foreshore and would have less impact on the local community than other shortlisted sites.

6.7.18 Further details of selection of this site are provided in Volume 3, Appendix C, Section 3.

Putney Bridge CSO

6.7.19 The existing sewerage system is configured so that two large sewers join together beneath the main road junction at the southern end of Putney Bridge, just upstream of the CSO discharge point. Both branches of the sewerage network need to be intercepted. Consequently, the only viable location to intercept all flows for the Putney Bridge CSO is below the point where the two sewers meet. Therefore, all shortlisted sites were located in the foreshore.

6.7.20 Four CSO sites were shortlisted for the interception of this CSO. All four were located in the foreshore, two to the west (upstream) and two to the east (downstream) of Putney Bridge. It should be noted that foreshore sites can be flexible, so in effect the choice was either to the west or east of Putney Bridge.

6.7.21 At phase one consultation, the preferred site was identified as the foreshore west of Putney Bridge. In summary, this site was identified as we considered that, when compared to alternatives, use of this site would
minimise adverse construction effects on the multiple sensitive receptors located on the eastern side of the bridge.

6.7.22 At phase two consultation, the preferred site remained the foreshore west of Putney Bridge. The layout was further developed in response to local engagement, which resulted in the inclusion of a temporary replacement slipway and the construction site was moved slightly to the west. This would help to reduce the impact on Putney Bridge and ensure that recreational and commercial river users would not be adversely affected during construction.

6.7.23 Further details of selection of this site are provided in Volume 3, Appendix D, Section 3.

Frogmore Storm Relief – Bell Lane Creek CSO

6.7.24 Two sites were originally shortlisted for the interception of this CSO. At phase one consultation, C07AF Small Business, Bell Lane Creek, was our preferred site for the CSO interception.

6.7.25 Following phase one consultation, we received new information on the availability of a new alternative site, C07AR Dormay Street, to the north of the preferred site. This alternative site, which was vacant site, was the preferred site for phase two consultation as its use would avoid the loss of an existing business (Panorama Antennas) and it was considered suitable in all other respects.

6.7.26 Further details of selection of this site are provided in Volume 3, Appendix E, Section 3.

Frogmore Storm Relief – Buckhold Road

6.7.27 Two sites were shortlisted for the interception of this CSO. At phase one consultation, C07BF King George’s Park was our preferred site at phase one consultation and it remained our preferred site at phase two consultation. In summary, we preferred this site because it would allow efficient working and would result in fewer impacts on residential amenity than the alternative shortlisted site.

6.7.28 Further details of selection of this site are provided in Volume 3, Appendix F, Section 3.

Jews Row – Wandle Valley Storm Relief CSO and Falconbrook Storm Relief CSO

6.7.29 At phase one consultation, we identified C08AC/BD, a concrete batching plant, as our preferred site to intercept these CSOs.

6.7.30 However, further scheme development work undertaken since phase one consultation concluded that it was no longer necessary to identify a site to intercept these two CSOs. This is because modifications that were made within the sewer system sufficiently reduced the number of spills into the river without the need to carry out any further works.
Falconbrook Pumping Station CSO

6.7.31 Four sites were originally shortlisted for the interception of this CSO. At phase one consultation, our preferred site was C09XC Bridges Court Car Park.

6.7.32 Scheme development work took into account consultation feedback received at phase one consultation and further engineering design work that was undertaken. Consequently a new site, C09XH Falconbrook Pumping Station, was identified as our preferred site for phase two consultation. In summary, this site was considered most suitable as it is a Thames Water-owned site and appeared likely to have less impact on residential amenity than alternative sites. We are developing dedicated access to the site from York Road in consultation with Transport for London.

6.7.33 Further details of selection of this site are provided in Volume 3, Appendix H, Section 3.

Lots Road Pumping Station CSO

6.7.34 Only one site, C10XA Cremorne Wharf Foreshore, was originally shortlisted for the interception of this CSO. At phase one consultation, it was our preferred site.

6.7.35 Scheme development work took into account new information on the availability of the Cremorne Wharf Depot site, phase one consultation feedback and further engineering design work that was undertaken. Consequently a new site, C10XB Cremorne Wharf Depot, was identified as our preferred site for phase two consultation. In summary, this site was considered more suitable because it is on brownfield land; it would not result in disruption to the foreshore and it would have less impact on residential amenity compared to the alternatives.

6.7.36 Further details of selection of this site are provided in Volume 4, Appendix J, Section 3.

Ranelagh CSO

6.7.37 Only one site (C14XA Chelsea Embankment Foreshore (west of Chelsea Bridge) was originally shortlisted for the interception of this CSO and connection to the northern Low Level Sewer No.1.

6.7.38 At phase one consultation, it was our preferred site. At phase two consultation, our preferred site remained Chelsea Embankment foreshore; however, the location in the foreshore was moved slightly to a new site, C14XJ Chelsea Embankment Foreshore (opposite Bull Ring Gate). Although the decision was finely balanced, this site was chosen because we considered that it would give rise to fewer effects overall.

6.7.39 Further details of selection of this site are provided in Volume 4, Appendix K, Section 3.

Heathwall Pumping Station and South West Storm Relief CSO

6.7.40 At phase one consultation, we identified Tideway Walk (S79WH/S80WH/C17XB) as our preferred site for the interception of these CSOs. It was also the preferred main tunnel drive site in this location.
The site comprised Heathwall Pumping Station and land adjacent to Tideway Walk Industrial site

6.7.41 At phase two consultation, Tideway Walk was no longer a main tunnel drive site (see Zone S5 at paragraphs 6.5.33 to 6.5.38), but it was still necessary to intercept both CSOs in this location.

6.7.42 Three sites were originally shortlisted: one for Heathwall Pumping Station outfall and two for the South West Storm Relief. The sites adjoined, or were part of the main tunnel site at Tideway Walk.

6.7.43 Following scheme development work, at phase two consultation the main tunnel site changed to S72WH/S93WH Kirtling Street, which is located to the west of Tideway Walk. Therefore, the main tunnel site and CSO site could no longer be combined.

6.7.44 Scheme development work reconsidered the most appropriate site for CSO interception and for phase two consultation the CSO interception site was C16XB Heathwall Pumping Station as it comprises existing operational Thames Water land.

6.7.45 Further details of selection of this site are provided in Volume 4, Appendix M, Section 3 (also see Volume 4, Appendix L, Section 3 for Kirtling Street).

Clapham Storm Relief and Brixton Storm Relief CSO

6.7.46 In total, four sites were shortlisted for consideration. At phase one consultation, our preferred site for the interception of both CSOs was C20XS Albert Embankment Foreshore. This remained our preferred site at phase two consultation. In summary, this site was preferred because, compared to the alternatives, it would have least impact on residential amenity, allow access and minimise the impact on the flow of the river.

6.7.47 Further details of selection of this site are provided in Volume 4, Appendix N, Section 3.

Regent Street CSO

6.7.48 A site is needed to intercept the Regent Street CSO and connect the northern Low Level Sewer No.1 to the main tunnel.

6.7.49 Two sites were shortlisted for this CSO. At phase one consultation, C22XA Victoria Embankment Foreshore was our preferred site and it remained our preferred site at phase two consultation. In summary, we preferred this site because we considered that it would be less likely to conflict with planning policy, particularly in relation to heritage and open space designations, compared to the other shortlisted site. It would also reduce the risk of working alongside the District and Circle line underground tunnels.

6.7.50 Further details on the selection of this site are provided in Volume 4, Appendix P, Section 3.

Fleet Main CSO

6.7.51 A site is needed to intercept the Fleet Main CSO and to connect the northern Low Level Sewer No.1 to the main tunnel.
6.7.52 Only one site was shortlisted for the Fleet Main CSO and northern Low Level Sewer No.1. This site, C27XA Blackfriars Bridge Foreshore, was our phase one consultation preferred site and remained our preferred site at phase two consultation. Although the site would require careful mitigation, it was the only potentially suitable site.

6.7.53 Further details on the selection of this site are provided in Volume 4, Appendix Q, Section 3.

**Shad Thames Pumping Station CSO**

6.7.54 At phase one consultation, C28XE Druid Street was identified as our preferred site for the interception of this CSO. However, scheme development work undertaken since phase one consultation identified that, by carrying out modifications and upgrades within the Shad Thames Pumping Station, we would not need to intercept the storm relief sewer and connect it to the tunnel. As a consequence, there is no requirement for a site at Druid Street.

6.7.55 The works at Shad Thames Pumping Station would include modifications to the pumps and internal pipework, demolition of the existing superintendent’s building behind the pumping station, construction of a slightly larger annex to house new electrical equipment, and some modifications to the existing sewers outside the pumping station. There would be no CSO drop shaft at this site and no connection to the tunnel.

**North East Storm Relief CSO**

6.7.56 Two sites were originally shortlisted for interception of this CSO. At phase one consultation, our preferred site was C29XA King Edward Memorial Park Foreshore. A modified version of this site, which included an area of the park in order to reduce the area in the foreshore, remained our preferred site at phase two consultation. Further work to test the suitability of this site was undertaken in response to specific queries raised at phase one consultation.

6.7.57 The further work included consideration of a CSO site in C29XB King Edward Memorial Park connected by a connection tunnel to a deep intermediate main shaft in one of the Zone S7 Limehouse main tunnel sites (the options are set out in Table 6.6). This option would involve using two sites to connect the CSO to the tunnel. In summary, we considered that, compared to the alternatives, C29XA King Edward Memorial Park Foreshore would have the least cumulative impact on the local community and local businesses and avoid having concurrent work at two sites in close proximity to each other, which would put more construction traffic onto the roads in the area. Consideration was also given to the potential impact of aligning the tunnel under buildings in reaching this conclusion.

6.7.58 Further details on the selection of this site are provided in Volume 5, Appendix S, Section 3.

**Holloway Storm Relief CSO**

6.7.59 At phase one consultation, C30XG Butcher Row was identified as our preferred site for the interception of this CSO. However, scheme
development work undertaken since phase one consultation identified that, by carrying out modifications to the existing sewer, we would not need to intercept the storm relief sewer and connect it to the tunnel. Consequently, there is no requirement for a site at Butcher Row. Instead works would need to be carried out on the existing sewer in Bekesbourne Street.

6.7.60 The works in Bekesbourne Street would include construction of a chamber around the existing sewer, and installation of a new penstock and flap valve. These works would not be connected to the main tunnel.

**Earl Pumping Station CSO**

6.7.61 Six sites were shortlisted for the interception of this CSO. At phase one consultation, our preferred site was C31XY/XZ Earl Pumping Station (and adjoining industrial premises). This remained our preferred site for phase two consultation. In summary, this site was selected primarily to make some use of a Thames Water site and keep all the new CSO assets within an extended Thames Water operational site.

6.7.62 Further details on the selection of this site are provided in Volume 5, Appendix T, Section 3.

**Deptford Storm Relief CSO**

6.7.63 Three sites were originally shortlisted for this CSO and, at phase one consultation, our preferred site was C32XA Borthwick Wharf Foreshore.

6.7.64 Since phase one consultation, scheme development work has been undertaken to address matters raised at phase one consultation and engineering concerns regarding CSO interception and construction access. As a consequence of this work, at phase two consultation, our preferred site was C32XZ Deptford Church Street. In summary, we preferred this site because it is much more accessible than Borthwick Wharf Foreshore, not as close to dense residential development, would not impact on Ahoy Centre and it would not encroach into the River Thames.

6.7.65 Further details on the selection of this site are provided in Volume 5, Appendix U, Section 3.

**Greenwich Pumping Station CSO**

6.7.66 Three sites were shortlisted for the interception of this CSO and at phase one consultation our preferred site was C33XU Greenwich Pumping Station. Greenwich Pumping Station remained our preferred site at phase two. However, we then worked out an amended version of the site in terms of size and layout – C33XV. This site would incorporate land at Phoenix Wharf (CL005) in order to allow the site to be used for a long CSO connection tunnel drive site as well as a CSO interception. In summary, it was judged the most suitable site as it predominantly uses an existing Thames Water site, with the resulting operational efficiencies in a controlled environment.

6.7.67 Further details on the selection of this site are provided in Volume 5, Appendix V, Section 3.
6.8 CSO connection tunnel drive options

CSO connection types

6.8.1 The CSO connection types A to E described in Section 4.14 remained unchanged. The connection types for each CSO to be intercepted are given in Table 6.4. More than one type is listed if the connection type depended on the drive options.

Table 6.4 CSO sites and connection types

<table>
<thead>
<tr>
<th>CSO ref</th>
<th>CSO name</th>
<th>CSO site name</th>
<th>Connection type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS01X</td>
<td>Acton SR</td>
<td>Acton Storm Tanks</td>
<td>E</td>
<td>Connection culvert to main tunnel shaft</td>
</tr>
<tr>
<td>CS04X</td>
<td>Hammersmith PS</td>
<td>Hammersmith Pumping Station</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS05X</td>
<td>West Putney SR</td>
<td>Barn Elms</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS06X</td>
<td>Putney Bridge</td>
<td>Putney Bridge Foreshore</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS07A</td>
<td>Frogmore SR -</td>
<td>Dormay Street</td>
<td>C(A)</td>
<td>Two CSOs connected via one connection tunnel (connection tunnel to CSO drop shaft)</td>
</tr>
<tr>
<td></td>
<td>Bell Lane Creek</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS07B</td>
<td>Frogmore SR -</td>
<td>King George’s Park</td>
<td>C(A), C(B), C(E)</td>
<td>Two CSOs connected via one connection tunnel (connection tunnel to CSO drop shaft or connection tunnel to main tunnel or on line of Frogmore connection tunnel)</td>
</tr>
<tr>
<td></td>
<td>Buckhold Rd</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS09X</td>
<td>Falconbrook PS</td>
<td>Falconbrook Pumping Station</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS10X</td>
<td>Lots Road PS</td>
<td>Cremorne Wharf Depot</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
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<tr>
<td>CS14X</td>
<td>Ranelagh</td>
<td>Chelsea Embankment Foreshore (opposite Bull Ring Gate)</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS16X</td>
<td>Heathwall PS</td>
<td>Heathwall Pumping Station</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS17X</td>
<td>South West SR</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>CS19X</td>
<td>Clapham SR</td>
<td>Albert Embankment Foreshore</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
<tr>
<td>CS20X</td>
<td>Brixton SR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS22X</td>
<td>Regent St</td>
<td>Victoria</td>
<td>B</td>
<td>Connection tunnel to main tunnel</td>
</tr>
</tbody>
</table>
6 Phase two preferred scheme: Site selection process

<table>
<thead>
<tr>
<th>CSO ref</th>
<th>CSO name</th>
<th>CSO site name</th>
<th>Connection type</th>
<th>Description</th>
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<tr>
<td></td>
<td></td>
<td>Embankment Foreshore</td>
<td></td>
<td>main tunnel</td>
</tr>
<tr>
<td>CS27X</td>
<td>Fleet Main</td>
<td>Blackfriars Bridge Foreshore</td>
<td>E</td>
<td>Main tunnel driven through CSO drop shaft</td>
</tr>
<tr>
<td>CS29X</td>
<td>North East SR</td>
<td>King Edward Memorial Park Foreshore</td>
<td>A or E</td>
<td>Connection tunnel to main tunnel shaft or main tunnel driven through CSO drop shaft</td>
</tr>
<tr>
<td>CS31X</td>
<td>Earl PS</td>
<td>Earl Pumping Station</td>
<td>C(E)</td>
<td>On line of Greenwich connection tunnel</td>
</tr>
<tr>
<td>CS32X</td>
<td>Deptford SR</td>
<td>Deptford Church Street</td>
<td>C(E)</td>
<td>On line of Greenwich connection tunnel</td>
</tr>
<tr>
<td>CS33X</td>
<td>Greenwich PS</td>
<td>Greenwich Pumping Station</td>
<td>C(A)</td>
<td>Connection tunnel to main tunnel shaft</td>
</tr>
</tbody>
</table>

NB: Details of the various connection types A to E are provided in the *Engineering options report – Abbey Mills route* (Summer 2011).

**CSO connection tunnel drive options**

6.8.2 The Acton Storm Relief CSO (Acton Storm Tanks site) CSO would not require a connection tunnel as the interception works would be within a main tunnel site and therefore connected directly to a main tunnel shaft (Type E connection):

6.8.3 The interception of the Fleet Main CSO (Blackfriars Bridge Foreshore site) CSO would not require a connection tunnel as the main tunnel would be driven through the CSO drop shaft (Type E connection):

6.8.4 The interception of the following CSOs would require a connection tunnel driven from the CSO site to connect directly with the main tunnel (Type B connection):

   a. Hammersmith Pumping Station CSO (Hammersmith Pumping Station site)
   b. West Putney Storm Relief CSO (Barn Elms site)
   c. Putney Bridge CSO (Putney Bridge Foreshore site)
   d. Falconbrook Pumping Station CSO (Falconbrook Pumping Station site)
   e. Heathwall Pumping Station CSO/Charlton Storm Relief CSO (Heathwall Pumping Station site)
   f. Lots Road Pumping Station CSO (Cremorne Wharf Depot site)
   g. Ranelagh CSO (Chelsea Embankment Foreshore site)
   h. Clapham Storm Relief CSO/Brixton Storm Relief CSO (Albert Embankment Foreshore site)
   i. Regent Street CSO (Victoria Embankment Foreshore site)
6.8.5 The remaining CSOs and associated connection tunnels had drive options:

a. Frogmore connection tunnel:
   i. Frogmore Storm Relief CSO - Bell Lane Creek (Dormay Street site)
   ii. Frogmore Storm Relief CSO - Buckhold Road (King George’s Park site)

b. Greenwich connection tunnel:
   i. Earl Pumping Station CSO (Earl Pumping Station site)
   ii. Deptford Storm Relief CSO (Deptford Church Street site)
   iii. Greenwich Storm Relief CSO (Greenwich Pumping Station site)

c. North East Storm Relief CSO connection options (King Edward Memorial Park Foreshore site)

6.8.6 The connection tunnel drive options for these six CSO sites are discussed and the preferred option described below.

Frogmore connection tunnel

6.8.7 Table 6.5 presents the list of Frogmore connection tunnel drive options that were taken forward to the next stage of the site selection process for multidisciplinary consideration.

Table 6.5 Frogmore connection tunnel: Drive options

<table>
<thead>
<tr>
<th>Connection tunnel drive option</th>
<th>Frogmore SR - Buckhold Road</th>
<th>Frogmore SR - Bell Lane Creek</th>
<th>Main tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>FA</td>
<td>d</td>
<td>r-d</td>
<td>r</td>
</tr>
<tr>
<td>FB</td>
<td>r</td>
<td>d then d</td>
<td>r</td>
</tr>
<tr>
<td>FC</td>
<td>d</td>
<td>r-r</td>
<td>d</td>
</tr>
<tr>
<td>FD</td>
<td>r</td>
<td>d-r</td>
<td>d</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connected to the Zone S3 main tunnel shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSO</td>
</tr>
<tr>
<td>Frogmore SR - Buckhold Road</td>
</tr>
<tr>
<td>--------------------------------</td>
</tr>
<tr>
<td>Connection tunnel drive option</td>
</tr>
<tr>
<td>FF</td>
</tr>
<tr>
<td>FG</td>
</tr>
<tr>
<td>FH</td>
</tr>
<tr>
<td>FI</td>
</tr>
<tr>
<td>FJ</td>
</tr>
</tbody>
</table>
6.8.8 The site selection back-checking associated with sites for the North East Storm Relief CSO identified two feasible CSO connection types as follows:

a. The King Edward Memorial Park Foreshore (C29XA) and King Edward Memorial Park (C29XB) shortlisted sites could be connected to the main tunnel via a CSO drop shaft constructed on the line of the main tunnel. This would be a Type E CSO connection and no connection tunnel would be required.

b. The King Edward Memorial Park Foreshore (C29XA) and King Edward Memorial Park (C29XB) shortlisted sites could be connected to the main tunnel via a connection tunnel and an intermediate shaft could be located on one of the main tunnel site Zone S7 Limehouse shortlisted sites. This would be a Type A CSO connection.

6.8.9 Table 6.6 presents the two North East Storm Relief connection tunnel drive options associated with the Type A CSO connection that were taken forward to the next stage of the site selection process for multidisciplinary consideration.

### North East Storm Relief connection options

<table>
<thead>
<tr>
<th>Single reception</th>
<th>Single drive</th>
<th>Intermediate</th>
<th>Sequential double drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>r</td>
<td>d</td>
<td>i</td>
<td>d then d</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Double reception</th>
<th>Drive and reception</th>
<th>Tunnel drive through CSO drop</th>
<th>Consecutive double drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>r-r</td>
<td>r-d</td>
<td>through</td>
<td>d-d</td>
</tr>
</tbody>
</table>

#### Table 6.6 North East Storm Relief Type A CSO connection tunnel: Drive options

<table>
<thead>
<tr>
<th>CSO site/Zone</th>
<th>Connection tunnel drive option</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEMP (C29XB)/KEMP Foreshore (C29XA)</td>
<td>NA d r</td>
</tr>
<tr>
<td>S7 Limehouse</td>
<td>NB r d</td>
</tr>
</tbody>
</table>

#### Greenwich connection tunnel

6.8.10 The potentially feasible drive options for the Greenwich connection tunnel are presented in table 6.7 below. All of the Greenwich connection tunnel drive options connected to the main tunnel via a main tunnel shaft in Zone S6 Shad.
6.8.11 Table 6.7 also shows which main tunnel drive options were associated with each of the connection tunnel drive options, as they must be able to work in combination (these are explained in more detail in Volume 5, Appendix V, Section 3).

Table 6.7 Greenwich connection tunnel: Drive options

<table>
<thead>
<tr>
<th>Connection tunnel drive option</th>
<th>Main tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone G3 Greenwich PS</td>
<td>CSO or Zone</td>
</tr>
<tr>
<td>Zone G2 Deptford Storm Relief</td>
<td></td>
</tr>
<tr>
<td>Zone G1 Zone S6 Shad</td>
<td></td>
</tr>
<tr>
<td>Zone S11 Abbey Mills</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend: The following nomenclature/legend is used to define the types of site required. Where 'd' denotes drive site, 'r' denotes reception site and 'through' denotes the tunnel drives through a CSO drop shaft.

Analysis of CSO connection tunnel drive options

Frogmore connection tunnel

6.8.12 The Frogmore connection tunnel would bring together flows from the Frogmore Storm Relief – Bell Lane Creek (CS07A) CSO and the Frogmore Storm Relief – Buckhold Road (CS07B) CSO before connecting to the main tunnel.

6.8.13 To meet the hydraulic flow requirements and maintain suitable access for operation and maintenance, a 2.2m internal diameter connection tunnel would be required. The horizontal and vertical alignment of the connection tunnel would be selected to avoid the existing power supply cable tunnels and the foundations of existing and proposed buildings. The tunnel would also need to pass under the River Thames with sufficient ground cover. The ground conditions in this area are London Clay.

6.8.14 The first four options for the Frogmore connection tunnel (explained in Table 6.5, references FA to FD) could be to drive or receive the connection tunnel from King George’s Park or Dormay Street, and then connect to the main tunnel. These four options were discounted because a direct connection into the main tunnel would be unnecessarily complex and would create greater health and safety risks.
6.8.15 The next six options for the Frogmore connection tunnel (Table 6.5, references FE to FJ) were to either drive or receive the connection from either King George’s Park or Dormay Street, and then connect to the main tunnel site at Carnwath Road Riverside (main tunnel site Zone S3).

6.8.16 There were three options (Table 6.5, references FE, FF and FG) that would have required a TBM to be driven from King George’s Park but they were discounted as it is a valuable public open space and these options would create greater disruption.

6.8.17 The three remaining options, which were assessed in more detail, can be summarised as follows:

**Option FH for the Frogmore connection tunnel**

6.8.18 Drive the TBM from Dormay Street to King George’s Park, then dismantle it and bring it back to Dormay Street in order to drive it under the River Thames to Carnwath Road Riverside; or use a second machine (if ground conditions dictated that a different type of machine should be used) for the drive from Dormay Street to Carnwath Road Riverside. All construction materials would enter and leave the tunnel at Dormay Street for this option as illustrated at Figure 6.10.

**Figure 6.10 Option FH for the Frogmore connection tunnel**
Option FI for the Frogmore connection tunnel:

6.8.19 Drive the TBM from Carnwath Road Riverside to Dormay Street, then drive the TBM (or use a second machine if ground condition dictated that a different type of machine should be used) from Dormay Street to King George’s Park. Construction materials would enter and leave the tunnel at both Carnwath Road Riverside and Dormay Street for this option. Refer to Figure 6.11.

Figure 6.11 Option FI for the Frogmore connection tunnel
Option FJ for the Frogmore connection tunnel:

6.8.20 Drive the TBM from Carnwath Road Riverside through to Dormay Street and on to King George’s Park (or use a second machine if ground conditions dictated that a different type of machine should be used) from Dormay Street to Carnwath Road Riverside with service provided from Carnwath Road. All construction materials would enter and leave the tunnel at Carnwath Road Riverside for this option. Refer to Figure 6.12.

Figure 6.12 Option FJ for the Frogmore connection tunnel

6.8.21 The main considerations in comparing the three options were as follows:

a. The tunnel alignment between King George’s Park and Dormay Street must avoid a cable tunnel, and the tunnel between Dormay Street and Carnwath Road Riverside must pass safely under the river. To achieve these requirements, the tunnel must follow a tighter horizontal radius in one part and be deeper in the other when crossing the river, and this means that different tunnelling machines are preferred for each reach. This also means that there would be a tunnel level change at Dormay Street. Therefore to minimise the need to duplicate construction facilities, and minimise health and safety risks and possible delay risks to the main tunnelling works at Carnwath Road Riverside, the engineering preference is Option FG.

b. Use of King George’s Park should be kept to the minimum, given that it is designated as open space. Dormay Street and Carnwath Road Riverside are more suitable as drive sites, given their brownfield status.

c. Using King George’s Park as a reception site would reduce the environmental effects, particularly in respect of townscape and ecology.

d. It would be preferable to minimise disruption in King George’s Park by using this as a reception site only, and to drive from either Dormay Street or Carnwath Road Riverside as both are brownfield sites.
e. King George’s Park is not suitable as a drive site as it is green space and has associated special parliamentary procedure acquisition risks. In property terms, there is little difference between Dormay Street and Carnwath Road Riverside as connection tunnel drive sites.

6.8.22 The five discipline teams considered the suitability of each option in light of the key issues set out above. They concluded that Option FH, which would involve a sequential drive strategy for the connection tunnel at Dormay Street (ie, drive the connection tunnel to King George’s Park, take the TBM out and bring it back to Dormay Street, then drive the connection tunnel to Carnwath Road Riverside, which is how both these CSOs would be connected to the main tunnel). The Frogmore connection tunnel drive strategy would mean that King George’s Park and Carnwath Road Riverside would both act as reception sites for this tunnel, which was the preferred option as it would minimise the impact on King George’s Park, make best use of the available space at Dormay Street, reduce further impacts to Carnwath Road Riverside, and decrease programme risk.

6.8.23 Option FH was therefore identified as the preferred drive option for the Frogmore connection tunnel (see figure 6.10 and figure 6.18).

**Greenwich connection tunnel**

6.8.24 The Greenwich connection tunnel would connect CSOs at Greenwich Pumping Station (CS33X), Deptford Storm Relief (CS32X) and Earl Pumping Station (CS31X) to the main tunnel. The possible options for the associated tunnelling strategy are set out in Table 6.6 above. These options are linked to the wider main tunnel drive options described in paragraphs 6.6.21 to 6.6.26 above and the preferred option was identified as Option C, as set out in paragraph 6.6.23. Option C precluded Greenwich connection tunnel options GA, GB, GC and GD.

6.8.25 A back-check exercise was undertaken to determine acceptability of Greenwich Pumping Station as a connection tunnel drive site and this is reported in Volume 5, Appendix V. We concluded that, by combining Greenwich Pumping Station with adjoining land at Phoenix Wharf, the site was suitable for use as a connection tunnel drive site. We also decided that Chambers Wharf was not large enough or otherwise suitable to accommodate both a drive site for the main tunnel to Abbey Mills and a connection tunnel drive site to Greenwich Pumping Station. Given the requirement to drive the main tunnel to Abbey Mills from Chambers Wharf, the Greenwich connection tunnel drive strategy GF(con) had to be discounted, leaving three options GH, GI and GJ which used drive sites in zones G1, G2 or G3. Zone G1 includes the Boat yard, Calypso Way (S74SK), Zone G2 includes Convoys Wharf (S01LM) and Zone G3 includes two scenarios: Greenwich Pumping Station (C33XV) as a CSO and connection tunnel reception tunnel site, and Greenwich Pumping Station plus Phoenix Wharf (C33XV + CL005) as a CSO and long connection tunnel drive site.

6.8.26 These three options, which were assessed in more detail, can be summarised as follows:
Option GH Greenwich connection tunnel

6.8.27 This would require the TBM to be driven north from the Boatyard, Calypso Way to Chambers Wharf through Earl Pumping Station. The TBM would then be dismantled and brought back to the Boatyard, Calypso Way so that it could be driven to Greenwich Pumping Station through Deptford Church Street. Alternatively, a second machine could be used (if ground conditions dictated that a different type of machine should be used) for the drive from the Boatyard, Calypso Way to Greenwich Pumping Station. All construction materials would enter and leave the tunnel at the Boatyard, Calypso Way for this option. Refer to Figure 6.13.

Figure 6.13 Option GH for Greenwich connection tunnel
Option GI for Greenwich connection tunnel

6.8.28 This option would require the TBM to be driven north from Convoys Wharf to Chambers Wharf through Earl Pumping Station. The TBM would then be dismantled and brought back to Convoys Wharf so it could be driven to Greenwich Pumping Station through Deptford Church Street. Alternatively, a second machine could be used (if ground conditions dictated that a different type of machine should be used) for the drive from Convoys Wharf to Greenwich Pumping Station. All construction materials would enter and leave the tunnel at Convoys Wharf for this option. Refer to Figure 6.14.

Figure 6.14 Option GI for Greenwich connection tunnel
**Option GJ for Greenwich connection tunnel**

6.8.29 This option would require the TBM to be driven north from the Greenwich Pumping Station to Chambers Wharf through Earl Pumping Station and Deptford Church Street. All construction materials would enter and leave the tunnel at Greenwich Pumping Station for this option. Refer to Figure 6.15.

*Figure 6.15 Option GJ for Greenwich connection tunnel*

6.8.30 The five discipline teams considered the suitability of each tunnel strategy in the light of the key issues set out above. The main considerations for each discipline in comparing the three options were that Options GI and GJ involved setting up an additional site and sinking a temporary shaft with the associated increased costs and health and safety risks.

6.8.31 It was concluded that Option GH, which involved a connection tunnel driven from Greenwich Pumping Station and received at Chambers Wharf was the preferred option because it would avoid the need to obtain an additional site and build an additional temporary shaft (see Figure 6.13, Figure 6.17 and Figure 6.18).

**6.9 Phase two preferred scheme**

6.9.1 The preceding sections explain how the potential drive options for the main tunnel and connection tunnels were considered alongside potential main tunnel sites and CSO sites to arrive at a phase two preferred scheme.

6.9.2 To summarise, the phase two preferred scheme was drive option W3/E4 and included the preferred sites listed in Table 6.2. For completeness, Table 6.8 shows the phase one preferred scheme and associated sites alongside the phase two preferred scheme and associated sites.
### Table 6.8 Summary of preferred sites

<table>
<thead>
<tr>
<th>Phase one preferred scheme</th>
<th>Site type</th>
<th>Phase two preferred scheme</th>
<th>Site type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preferred site name</strong></td>
<td><strong>Site type</strong></td>
<td><strong>Preferred site name</strong></td>
<td><strong>Site type</strong></td>
</tr>
<tr>
<td>Acton Storm Tanks</td>
<td>CSO site; connection tunnel reception</td>
<td>Acton Storm Tanks</td>
<td>Main tunnel single reception site; CSO site</td>
</tr>
<tr>
<td>Hammersmith Pumping Station</td>
<td>Main tunnel reception site; CSO site; connection tunnel drive</td>
<td>Hammersmith Pumping Station</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
</tr>
<tr>
<td>Barn Elms</td>
<td>Sequential main tunnel double drive site; CSO site</td>
<td>Barn Elms</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
</tr>
<tr>
<td>Putney Bridge Foreshore</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
<td>Putney Bridge Foreshore</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
</tr>
<tr>
<td>Bell Lane Creek</td>
<td>CSO site; connection tunnel drive to main tunnel; connection tunnel drive to King George's Park</td>
<td>Dormay Street</td>
<td>CSO site; connection tunnel drive to Carnwath Road Riverside; connection tunnel drive to King George's Park</td>
</tr>
<tr>
<td>King George’s Park</td>
<td>CSO site; connection tunnel reception</td>
<td>King George’s Park</td>
<td>CSO site; connection tunnel reception</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>Carnwath Road Riverside</td>
<td>Main tunnel single drive/single reception site; connection tunnel reception</td>
</tr>
<tr>
<td>Jews Row</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
<td>-</td>
<td>Technical solutions have removed the requirement for a CSO site at this location</td>
</tr>
<tr>
<td>Bridges Court Car Park</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
<td>Falconbrook Pumping Station</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
</tr>
<tr>
<td>Cremorne Wharf Foreshore</td>
<td>CSO site; drop shaft on line of main tunnel</td>
<td>Cremorne Wharf Depot</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
</tr>
<tr>
<td>Chelsea Embankment Foreshore (west of Chelsea Bridge)</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
<td>Chelsea Embankment Foreshore (opposite Bull ring Gate)</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
</tr>
<tr>
<td>Preferred site name</td>
<td>Site type</td>
<td>Preferred site name</td>
<td>Site type</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Tideway Walk</td>
<td>Main tunnel single drive/single reception site; CSO site (two CSO interceptions)</td>
<td>Kirtling Street</td>
<td>Main tunnel concurrent double drive site</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heathwall Pumping Station</td>
<td>CSO site (two CSO interceptions); connection tunnel drive to main tunnel</td>
</tr>
<tr>
<td>Albert Embankment Foreshore</td>
<td>CSO site (two CSO interceptions); access along the foreshore; connection tunnel drive to main tunnel</td>
<td>Albert Embankment Foreshore</td>
<td>CSO site (two CSO interceptions); access via Lacks Dock; connection tunnel drive to main tunnel</td>
</tr>
<tr>
<td>Victoria Embankment Foreshore</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
<td>Victoria Embankment Foreshore</td>
<td>CSO site; connection tunnel drive to main tunnel</td>
</tr>
<tr>
<td>Blackfriars Bridge Foreshore</td>
<td>CSO site; drop shaft on line of main tunnel</td>
<td>Blackfriars Bridge Foreshore</td>
<td>CSO site; drop shaft on line of main tunnel</td>
</tr>
<tr>
<td>Druid Street</td>
<td>CSO site; connection tunnel reception</td>
<td>-</td>
<td>Technical solutions have removed the requirement for a CSO site at this location</td>
</tr>
<tr>
<td>King’s Stairs Gardens</td>
<td>Main tunnel double reception site; two connection tunnel drives</td>
<td>Chambers Wharf</td>
<td>Main tunnel single drive/single reception site; one connection tunnel reception</td>
</tr>
<tr>
<td>King Edward Memorial Park Foreshore</td>
<td>CSO site; connection tunnel drive to Butcher Row; all facilities in the foreshore; drop shaft on line of main tunnel</td>
<td>King Edward Memorial Park Foreshore</td>
<td>CSO site; no connection tunnel drive to Butcher Row; some facilities in the park; drop shaft on line of main tunnel</td>
</tr>
<tr>
<td>Butcher Row</td>
<td>CSO site; connection tunnel reception</td>
<td>-</td>
<td>Technical solutions have removed the requirement for a CSO site at this location</td>
</tr>
<tr>
<td>Earl Pumping Station</td>
<td>CSO site; drop shaft on line of connection tunnel</td>
<td>Earl Pumping Station</td>
<td>CSO site; drop shaft on line of connection tunnel</td>
</tr>
<tr>
<td>Borthwick Wharf Foreshore</td>
<td>CSO site; drop shaft on line of connection tunnel</td>
<td>Deptford Church Street</td>
<td>CSO site; drop shaft on line of connection tunnel</td>
</tr>
</tbody>
</table>
6.10 Preferred route

6.10.1 At phase one consultation, the Abbey Mills route was our preferred route and this remains our preferred – and only – route at phase two consultation as illustrated in Figure 6.16 below.

Figure 6.16 Abbey Mills route
6.11 Preferred tunnelling drive strategy

6.11.1 The phase two preferred drive option was W3/E4, which is illustrated in Figure 6.17 below.

**Figure 6.17 Preferred drive option**

6.12 Preferred sites

6.12.1 This report explains how we identified the preferred sites for phase two consultation. To summarise, the phase two preferred sites are set out in Figure 6.16 above and include:

a. 16 sites identified for CSO interception (plus connection tunnel drive for some sites)

b. two main tunnel reception sites (Acton Storm Tanks and Abbey Mills Pumping Station)

c. three main tunnel drive sites (Carnwath Road Riverside, Kirtling Street and Chambers Wharf).

6.12.2 The locations of the preferred sites and their proposed uses are illustrated in Figure 6.18 below.
Figure 6.18 Preferred sites and proposed uses

- Acton Storm Tanks
- Hammersmith Pumping Station
- Barn Elms
- Putney Bridge Foreshore
- Dornay Street
- King George's Park
- Carnewas Road Riverside
- Falconbrook Pumping Station
- Cremorne Wharf Depot
- Chelsea Embankment Foreshore
- Kitting Street
- Heathrow Pumping Station
- Albert Embankment Foreshore
- Victoria Embankment Foreshore
- Blackfriars Bridge Foreshore
- Chambers Wharf
- King Edward Memorial Park Foreshore
- Abbey Mills Pumping Station

Site types:
- Main tunnel drive site
- Main tunnel reception site
- CSO site
- Short connection tunnel drive site
- Long connection tunnel drive site
After phase two consultation: Review prior to Section 48 publicity

7.1 Introduction

7.1.1 This section describes how the scheme was reviewed following phase two consultation in order to arrive at the proposed application that is to be publicised under Section 48 of the Planning Act 2008. The proposed sites reported in this section of the report are subject to consideration of the responses received during the publicity period. Those responses will be taken into account in accordance with Section 48 of the Planning Act 2008.

7.1.2 This section considers: on-going engineering development; comments received during phase two consultation and targeted consultation; and any new information and changes in circumstances that are relevant to site selection.

7.1.3 This section is split into the following sections:

a. **On-going engineering developments** (Section 7.2). This section describes any on-going engineering developments and project design relevant to site selection.

b. **Phase two consultation feedback** (Section 7.3). This section describes the feedback from phase two consultation on site selection themes and how this was taken into consideration when reviewing the phase two preferred scheme.

c. **Any changes in circumstances and new information** (Section 7.4). This section describes any new information and changes in circumstances following phase two and how these relate to site selection.

d. **Back-check and targeted review process** (Section 7.5). This section describes whether any of the above would trigger a back-check in respect of the preferred sites from phase two consultation, review process for certain detailed aspects of sites and targeted consultation feedback.

e. **Tunnel drive options review** (Section 7.6). This section describes the preparation of *Engineering options report – Abbey Mills route* (Spring 2012) and consideration of phase two consultation suggested alternative drives; review of the main tunnel drive options and sites.

f. **Summary of scheme review process** (Section 7.7). This section describes the implications of the review for each phase two preferred site.

g. **Proposed project for Section 48 publicity** (Section 7.8). This section records the proposed project comprising the proposed route, sites and drive strategy for Section 48 publicity.
7.1.4 All site selection matters related to points a. to e. above were taken into account when we reviewed the preferred and shortlisted sites presented at phase two consultation. The salient outcomes are drawn together in Section 7.7. The details of the site selection work carried out post phase two consultation in relation to each individual site, are contained within the site appendices (see Volumes 3 to 5, Section 4 in each site appendix). These site details are not repeated in the rest of Section 7 instead the main themes are described.

7.1.5 There are a number of other documents to be published as part of Section 48 publicity that cover more detailed matters and may aid the understanding of the proposed project: pre-application publicity, description of development, transport strategy, construction practice and plans.

7.2 On-going engineering consideration and scheme design

7.2.1 Throughout the development of the project, the engineering design has proceeded in parallel with the site selection process. It has always been recognised (see Volume 2, Appendix 1, Site selection methodology paper, paragraph 1.7.5) that there is an iterative relationship between engineering design and site selection.

7.2.2 As part of this iterative process, we had regard to ongoing engineering design developments and phase two consultation feedback relevant to site selection considerations (as defined in the Site selection methodology paper) and whether we could make improvements to sites. Detailed design improvements follow on from the site selection process, which includes considerations like detailed site layouts, mitigation measures such as repositioning ventilation columns, increased use of the river, boundary treatment, and junction improvements.

7.2.3 Design development and engineering considerations following phase two consultation included:

a. a review of suggested alternative tunnelling options, as set out in the Engineering options report – Abbey Mills route (Spring 2012) and summarised in Section 7.6 below

b. further engineering designs and studies of various components of the scheme (for example, means of CSO interception, site size requirements, hydraulic studies, tunnel alignment, etc)

c. ‘system master planning’ to define changes to sewerage system operations and consider the facilities needed to control and limit overflows and air management

d. other work examining construction, transportation and river navigational logistics issues

e. field investigations, including ground investigations and surveys

f. architectural and landscape design work for above-ground features.
7.2.4 The above list, although not exhaustive, covers the main factors considered in the post phase two consultation project review and the points related to the site selection process are described in Section 7.7 (also see Volumes 3 to 5, Appendices, Section 4 in each appendix).

7.3 Phase two consultation feedback

7.3.1 Full details of consultation responses and how we have taken them into account are contained within the Main report on phase two consultation and Supplementary report on phase two consultation (May 2012) (both these reports are available on Thames Water website). A total of 6,019 respondents provided feedback to our phase two consultation with a total of 6,553 responses received:

- **a. Statutory consultees:** 21
- **b. Local authorities:** 17
- **c. Landowners:** 131
- **d. Community consultees:** 5,841
- **e. Petitions:** 9

7.3.2 Both of the reports on phase two consultation included Thames Water’s responses to the issues raised by respondents. The main issues related to site selection included: the main tunnel route; preferred, shortlisted and suggested alternative sites and alternative tunnelling drive options. We undertook a further analysis to identify how these issues might influence the site selection process and the detailed development of the project. The site selection review of feedback involved the five disciplines – engineering, planning, environment, community and property considerations and the exercise of professional judgement. This approach was used to identify potential site selection issues and impact they might have on our phase two consultation preferred scheme.

7.3.3 In this review we considered whether the phase two consultation feedback raised any new information or matters that could potentially alter the overall conclusions we had reached in identifying our proposed project. Taking each of the issues raised by consultees into account, we also considered whether we could reduce the likely effects of our proposed development, or whether we should prefer any of the alternative sites identified by consultees, or use any of the sites for a different purpose (e.g., main tunnel drive or reception site).

7.3.4 Where there was no new information relevant to the site selection process or potential issues identified by respondees had already previously been considered in the site selection process then no further changes were considered for that site, except for the sites listed in Section 7.5.

7.3.5 We received a range of feedback on our proposals for our preferred sites, including supportive and neutral comments and objections, issues and concerns. We took all comments received into account in accordance with the requirements of the Planning Act 2008.
We recognise that some respondents had concerns about our preferred tunnel route (Abbey Mills) and its alignment, but after considering all the comments we received, there was greater support for the Abbey Mills route compared to the other two route options we consulted on at phase two consultation and nothing which we considered to justify choosing a different site.

We gave careful consideration to the comments received on the preferred sites presented at phase two consultation and also comments received on other shortlisted sites. In light of the feedback that we received, we believe that no new information was brought to our attention that would change the conclusions of our site selection process to date.

However we have always recognised the importance of introducing measures to reduce the effects of our proposals. The feedback received, together with the environmental information that we have collected, has helped to guide our further work. In order to mitigate the effects of our works, we have undertaken further design development and environmental assessment work, and for certain sites we have proposed amendments to the nature or extent of the works (see Section 48: Pre-application publicity report).

Any changes in circumstances and new information

We recognised that, during the course of the site selection process, circumstances relating to particular sites could change or new information on sites could become available. Our objective has always been to select the most suitable sites available at the time the project is to be constructed (securing them in advance, where appropriate). We have ensured that our site selection process is flexible enough to take any changes in circumstances or new information on board.

The site selection review therefore had regard to new information and changes in circumstances since phase two consultation, where applicable. The information we took into account can generally be grouped under the following headings:

a. Engineering: new information that has arisen through the on-going engineering work described in Section 7.2 and detailed design work.

b. Planning: granting of planning permissions for alternative schemes, lapsing of planning permissions on potential sites, commencement of development work on sites, changes to planning policies and designations.

c. Environment: new survey information, new information obtained for the environmental impact assessment process, changes in site designations.

d. Community: any change in the community uses on or surrounding a site.

e. Property: commencement of development work on sites, new information as a result of land acquisition investigations on availability of sites.
7.4.3 Particular examples included:

a. River transport - our revised transport strategy will enable us to make more use of the river on our main tunnel drive sites and a number of foreshore sites in order to reduce the number of lorries on the local road network.

b. Hammersmith Pumping Station – planning permission has been granted and work has commenced on site for a major residential development. We will therefore continue to consult with the developers of the Hammersmith Embankment/Fulham Reach site to ensure that our proposed CSO site will be integrated into their development site.

c. King Edward Memorial Park Foreshore - at phase two consultation we showed support construction site facilities in the western end of the park, but we now intend to locate these off-site to reduce effects on the park’s recreational facilities; introduce additional noise attenuation measures to address noise generated during construction; provide open mesh fence along the full extent of our proposed access route off Glamis Road to allow views through to the river and foreshore; junction improvements at Glamis Road and The Highway to facilitate safer access for vehicles; extend the site boundary around the playground in order to create a larger usable space during construction and to provide a new relocated playground.

d. Greenwich Pumping Station - we amended our proposals to avoid the need to demolish the Listed Coal Shed structure and hence reduce the impact on historic assets.

7.4.4 The information described above was taken into account in the review, in considering whether further site investigations were needed or to consider whether the detailed design development could address concerns about potential impact on sites.

7.5 Back-check and targeted review process

7.5.1 As discussed in the previous sections, project review work was generally undertaken to consider the impact of the following upon site selection (or a combination of these reasons):

a. on-going engineering developments and scheme design

b. feedback from phase two consultation and targeted consultation

c. new information and changes in circumstances.

7.5.2 Where these factors applied to a site, we potentially needed to reconsider the suitability of our phase two consultation preferred sites via a back-check process. In reviewing sites, we also considered whether or not the information would alter our overall conclusions on a site, if not, then a back-check would not be triggered.

7.5.3 Part 3B of the Site selection methodology paper explains how the methodology allows us to revisit the site selection process and undertake a back-check if a site is eliminated for any reason, or if there is significant change in circumstance or development in the engineering design (see Volume 2, Appendix 1).
7.5.4 The site selection process prior to back-checking and the steps in the back-check process are illustrated in Figure 7.1.

**Figure 7.7.1 Overview of the back-check process**

Site selection
- Longlist of sites
- Draft shortlist of sites
- Final shortlist of sites
- Preferred list of sites
- Monitor sites

Back-check process
- Step 1 – Trigger for back-check process
- Step 2 – Scoping the back-check process
- Step 3 – Undertaking the back-check
- Step 4 – Review site and scheme and approval

No – Stop
Return to monitor sites

Yes
No – Stop
Return to monitor sites

Yes – scope and identify group of sites

Yes – disciplines assess and recommend replacement sites

7.5.5 Following the phase two consultation we carried out Step 1 of the back-check process to review if there were any ongoing engineering and project design developments; feedback from consultation or new information or changes in circumstances related to any of the phase two consultation preferred sites which would alter our overall conclusions for a site and/or use of the site (see Section 7.6).

7.5.6 While we recognise that a number of sites remain challenging and require further work on detailed design and/or mitigation measures to reduce their impact, none of the information reviewed and summarised in Sections 7.2 to 7.6 necessitated the need to trigger a back-check in relation to any of the phase two consultation preferred sites, except where noted below. Whilst for other sites we did not believe there was any information that would trigger a back-check, we concluded potential effects on sites could be addressed through detailed design and/or mitigation measures instead of changing to another site.

7.5.7 We did, however, consider that there was a requirement to carry a targeted back-check for sites a. and b. listed below, and a review of specific elements for sites c. and d. listed below:

a. Putney Embankment Foreshore: location and layout of the of the temporary works and permanent structure

b. Barn Elms: access route to the site
c. Albert Embankment Foreshore: alternative construction access between Camelford House and Tintagel House

d. Victoria Embankment Foreshore: amend the layout and shape of the permanent structure.

7.5.8 We also carried out further targeted consultation for the four sites listed above, and the feedback is briefly summarised in the relevant appendices identified in Table 7.1 below.

7.5.9 The outcomes of the targeted consultation have resulted in the following changes listed in Table 7.1.

Table 7.1 Changes as a result of targeted consultation

<table>
<thead>
<tr>
<th>Site</th>
<th>Changes since targeted consultation</th>
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<tbody>
<tr>
<td><strong>Barn Elms</strong></td>
<td>As a result of phase two and targeted consultation feedback, we intend to change the construction and operational access arrangements so that construction traffic accesses the site from Upper Richmond Road (A205), travels along Rocks Lane (A306) before turning right into Queen Elizabeth Walk. We also intend to reduce the scale and design of the permanent above-ground structures on this site. Back-check details are provided in Volume 3, Appendix D.</td>
</tr>
<tr>
<td><strong>Putney Embankment Foreshore</strong></td>
<td>We intend to modify the location and layout of the temporary works and our permanent design, in response to comments received on the permanent design of the works and its relationship to the public slipway. We also intend to change the nature and location of the temporary replacement slipway. These changes would require adjustments to the site boundary. We have revised our transport strategy to make further use of the river for transporting excavated materials from the shaft and the short connection tunnel to the main tunnel away from the site in order to reduce the number of lorries on local roads. Back-check details are provided in Volume 3, Appendix C.</td>
</tr>
<tr>
<td><strong>Albert Embankment Foreshore</strong></td>
<td>We are considering an alternative construction access between Camelford and Tintagel Houses in response to security concerns raised by the occupants of Vauxhall Cross. We intend to make minor amendments to the design of permanent works including the shape of the foreshore structure to address navigational safety issues and as a result of ongoing design development. We have revised our transport strategy to make further use of the river for transporting excavated materials from the shaft and the short connection tunnel to the main tunnel away from the site in order to reduce the number of lorries on local roads. Review details are provided in Volume 4, Appendix N.</td>
</tr>
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</table>
### Site Changes since targeted consultation

<table>
<thead>
<tr>
<th>Site</th>
<th>Changes since targeted consultation</th>
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<tbody>
<tr>
<td>Victoria Embankment Foreshore</td>
<td>We intend to amend the layout and shape of our permanent design. The layout we propose is more formal and symmetrical than that presented during phase two and targeted consultations, and projects less far into the river. It combines elements of the engineering design from targeted consultations with the architectural designs presented at phase two consultation. We have also reviewed the method for constructing the cofferdam as well as orientating the moored barge to address navigational safety. Review details are provided in Volume 4, Appendix P.</td>
</tr>
</tbody>
</table>

### 7.6 Tunnelling drive options review

#### 7.6.1 Following phase two consultation, we prepared *Engineering options report – Abbey Mills route* (Spring 2012). Section 7.6 summarises the additional information from this report and the conclusions of the review of the drive options. This report covers the following:

a. System design and engineering requirements: This part sets out at high level; the system, geological, tunnelling and CSO engineering requirements to be considered as part of the development of engineering options, and subsequent selection of a proposed drive strategy and its associated proposed list of main tunnel sites for the Abbey Mills route. As such, this largely states and summarises requirements without providing an in-depth justification for the system and engineering requirements.

b. Main tunnel and connection tunnel drive options: This part summarises the tunnel options considered and the analysis and refinement of these options. Included in the analysis is consideration of the relationship of the tunnel options to the available groups of shortlisted sites.

#### 7.6.2 This report was prepared to evaluate and consider phase two consultation suggested alternative tunnelling drive options, which are discussed below.

**Definition of drive options**

#### 7.6.3 Before considering the alternative drive options, the definition of drive options is presented as contextual information. The overall development of options and selection of sites includes consideration of the following:

a. Main tunnel drive options – a number of drive options exists where the number of TBM s, numbers of sites and length of drives would vary.

b. Main tunnel site options – for each drive option, there are a number of sites that could be used where the space, tunnel alignment, and other factors would vary.
c. CSO connection options – the type of CSO connection would depend on the flow, the geology, the proximity of the main tunnel or one of its sites, and a number of other factors.

d. CSO site options – a number of CSO sites could be available for each CSO drop shaft, and the type of connection may vary according to a number of factors, including proximity of the main tunnel or one of its sites.

7.6.4 A number of drive options exist and are based on the number of TBMs used and the number of main tunnel sites that they can be driven from. The approach to identifying drive options differentiates between main tunnel sites from which tunnels can be driven in either one or both directions.

7.6.5 To establish the range of drive options, each drive is considered between two zones, with a drive site within one zone and a reception site within another zone. By combining different zones together, a number of drive options can be established. By also applying the following two basic constraints, the initial number of drive options can be established:

a. drive lengths (maximum and minimum)

b. site type (potential to be a double drive, single drive or intermediate/reception site).

Suggested alternative drive options

7.6.6 Other more unconventional drive options have been considered, such as the use of convertible TBMs, TBMs docking underground, or TBM abandonment as a means of either extending drive lengths or avoiding the need for a main tunnel site. However, these were not taken forward in the selection of the tunnel drive strategy for a range of reasons.

7.6.7 One such option might be to convert a TBM from EPB to slurry (or vice versa) mid-drive as would be required at the eastern end of the project (just east of Tower Bridge) when traversing the chalk to sand/gravel interface. However, there is no comparable precedent for full conversion of a large diameter high pressure TBM from earth pressure balance mode, with conveyor muck handling, to slurry pressure balance, with slurry pipe muck handling. Such a change, if it were feasible, would require major structural rebuilding more suitable for a fabrication factory, not in hazardous confined space conditions under the river with limited access and lifting facilities. Compromises in the TBM design including increased use of bolted connections would be required to allow the conversion, but they would make the TBM inherently more flexible and would affect efficiency and threaten the ability of the TBM to get through the flint bearing Chalk especially given the longer total drive length. The excavated material handling and disposal systems would also need to be changed. In addition, since these sections of tunnel would be excavated sequentially as opposed to in parallel, and would require a period of downtime for TBM conversion, the programme would increase beyond the 6-year total construction period for the project.
Another option might be driving two TBMs to meet at a ‘docking point’ underground where the internal mechanical equipment from within the TBM would be removed leaving the shell in the ground. This has been done in Tokyo at a much smaller scale, and also on the Storebælt Tunnel in Denmark. However, the Storebælt Tunnel is under the sea, which prevented any other lower risk options from being adopted. There are significant health and safety risks in stabilising the ground to allow dismantling of the cutterheads as well as higher risk due to heavy lifting and flame cutting underground without the support available above ground or in a shaft.

Bearing in mind the large internal diameter of the main tunnel, the drive alternatives discussed above have a number of disadvantages such as:

a. the health and safety risks involved in construction of a cavern through the body of the TBM within which to dismantle the cutterhead

b. the difficulties associated with stabilising the ground to facilitate construction of the “docking cavern” in poor saturated ground using ground treatment such as freezing. This would likely involve the use of jack up barges in the River Thames to drill holes to allow liquid nitrogen/super cooled brine to be pumped into the ground for a prolonged period to produce a stable section of ground within which to excavate the cavern

c. the need to convert the excavated material handling and processing facilities for the paste extracted by an EPBM, which is handled by screw and conveyor, to the slurry pipes and liquid separation plant of a SPBM. There is no comparable precedent for this.

d. the need to dismantle two TBMs using flame cutting in hazardous confined conditions leaving the TBM skins in place. The risks cannot be over emphasised as the components can weigh up to 100 tonnes

e. the need for unusual heavy lifting operations underground in confined conditions

The clear outcome from study of these alternatives was that they represent unacceptably high health and safety risks to workers and an unacceptable project risk.

The project from a health and safety point of view has adopted a goal of zero accidents, zero harm and zero compromise. These alternatives are not compatible with the aspirations of the project.

We reviewed the drive options in relation to our phase two consultation main tunnel sites:

a. Acton Storm Tanks (see Volume 3, Appendix A)
b. Carnwath Road Riverside (see Volume 3, Appendix G)
c. Kirtling Street (see Volume 4, Appendix L)
d. Chambers Wharf (see Volume 5, Appendix R)
e. Abbey Mills Pumping Station (see Volume 5, Appendix W).
7.6.13 The conclusion of the review did not result in any new options. The drive options in the *Engineering options report – Abbey Mills route* (Spring 2012) remain the same as the ones proposed at *Engineering options report – Abbey Mills route* (Summer 2011).

7.6.14 As there was no new information or circumstances, the review of the drive options did not alter our phase two consultation main tunnel sites or drive strategy (see Figure 7.2 below). We do appreciate the challenges we faced at the main tunnel drive sites at Carnwath Road Riverside, Kirtling Street and Chambers Wharf. We believe we can mitigate the impacts. For example at Carnwath Road Riverside and Chambers Wharf: we have revised our transport strategy to make further use of the river for transporting shaft, other excavated materials and sand and aggregates for secondary tunnel linings to reduce the number of lorries on local roads. Whilst at Kirtling Street we propose to make these changes to river use and to retain the operations at the concrete batching plant in order to reduce the number of lorries on the local road network.

7.6.15 There are further detailed responses to alternative drive options in relation to the above sites in the *Supplementary phase two consultation report* (May 2012, see Chapter 2 and particular site chapters).

7.7 Summary of review prior to Section 48 publicity

7.7.1 Taking into account all the matters discussed above, Table 7.2 below summarises the site selection review for each of the phase two consultation preferred sites and provides the relevant volume and specific site appendix reference. Overall we concluded there was no substantive information that would necessitate a back-check or change any sites, except for Barn Elms and Putney Embankment Foreshore (see Table 7.2). Whilst we have not made any site changes, we have continued to develop detailed design improvements and mitigation measures for all the sites listed in Table 7.2. There is also more site specific responses in the *Supplementary phase two consultation report*.

Table 7.2 Summary of post phase two consultation project review work for each phase two preferred site and drive options

<table>
<thead>
<tr>
<th>Site</th>
<th>Implications for the phase two preferred site</th>
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<tbody>
<tr>
<td>Acton Storm Tanks</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. There was no new information or change of circumstances that would have altered our assessment of this site. We also reviewed drive options for the western section of the main tunnel, but there was no information that would alter our drive strategy. We consider this to be the most appropriate site to intercept the Acton Storm Relief CSO and to receive the western end of the main tunnel. Details of the review are provided in Volume 3, Appendix</td>
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<tr>
<td>Site</td>
<td>Implications for the phase two preferred site</td>
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<tr>
<td>Hammersmith Pumping Station</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. Whilst planning permission has been granted the Hammersmith Embankment/Fulham Reach development, we continued to work with the developer to ensure that our proposed CSO site will be integrated into their development site. We still consider this to be the most appropriate site to intercept the Hammersmith Pumping Station CSO. Details of the review are provided in Volume 3, Appendix B, Section 4.</td>
</tr>
<tr>
<td>Barn Elms</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered for the CSO site. However we did carry out a targeted back-check to address concerns on the potential access routes to the site, which was then subject to targeted consultation. This resulted in a change to the construction and operational access would be via Queen Elizabeth Walk instead of the construction access via Rocks Lane presented at phase two consultation. We still consider this to be the most appropriate site to intercept the West Putney CSO with the new site access route via Queen Elizabeth Walk. Details of the review are provided in Volume 3, Appendix C, Section 4.</td>
</tr>
<tr>
<td>Putney Embankment Foreshore (formerly Putney Bridge Foreshore)</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should be triggered to address concerns about the location of the worksite and permanent structure. We reviewed all potential sites to intercept the Putney Bridge CSO (located under the Putney Bridge) and to connect it to the main tunnel. The back-check resulted in a modified foreshore site that moved the phase two consultation site approximately 30 meters to the west, so it will be further from the Grade II listed Putney Bridge. We changed the site name from Putney Bridge Foreshore to Putney Embankment Foreshore and carried out targeted consultation. We consider Putney Embankment Foreshore to be the most appropriate site to intercept the Putney Bridge CSO. Details of the review are provided in Volume 3, Appendix D, Section 4.</td>
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<td>Site</td>
<td>Implications for the phase two preferred site</td>
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<tr>
<td>Dormay Street</td>
<td>After phase two consultation: Review prior to Section 48 publicity</td>
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<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. There was no new information or change of circumstances that would have altered our assessment of this site.</td>
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<td></td>
<td>We still consider this to be the most appropriate site to intercept Frogmore Storm Relief – Bell Lane Creek CSO and to drive the Frogmore connection tunnel to King George’s Park and Carnwath Road Riverside in order to connect both part of these CSOs to the main tunnel. Details of the review are provided in Volume 3, Appendix E, Section 4.</td>
</tr>
<tr>
<td>King George’s Park</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. There was no new information or change of circumstances that would have altered our assessment of this site.</td>
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<td></td>
<td>We still consider this to be the most appropriate site to intercept Frogmore Storm Relief – Buckhold Road CSO and to receive the Frogmore connection tunnel from Dormay Street. Details of the review are provided in Volume 3, Appendix F, Section 4.</td>
</tr>
<tr>
<td>Carnwath Road Riverside</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered.</td>
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<td>We recognise that, given the locations where we are seeking to construct and operate the tunnel, many of the sites are constrained. However there were no factors that we had previously had not considered, and instead, we believe we can address the site effects through increased river use and other mitigation measures. We also reviewed drive options for the western section of the main tunnel, but there was no information that would alter our drive strategy.</td>
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<td></td>
<td>We still believe this to be the most appropriate site to drive the main tunnel to Acton Storm Tanks, to receive the main tunnel from Kirtling Street and to receive the Frogmore connection tunnel from Dormay Street. Details of the review are provided in Volume 3, Appendix G, Section 4.</td>
</tr>
<tr>
<td>Falconbrook Pumping Station</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. There was no information that would have altered our assessment of this site.</td>
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<td>Site</td>
<td>Implications for the phase two preferred site</td>
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<tr>
<td>Cremorne Wharf Depot</td>
<td>We still believe this to be the most appropriate site to intercept the Falconbrook Pumping Station CSO and connect it to the main tunnel. Details of the review are provided in Volume 3, Appendix H, Section 4.</td>
</tr>
<tr>
<td></td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. The site is a safeguarded wharf but the owner intends to submit a planning application to redevelop the depot site, but the project team is working with the owner to ensure that its proposals and our project objectives can both be achieved on this site. We also intend to make more use of the river to reduce the numbers of lorries on local roads. After considering this information we still believe this to be the most appropriate site to intercept Lots Road Pumping Station CSO and connect it to the main tunnel. We continued to work on the detailed design and mitigation measures for this site. Details of the review are provided in Volume 4, Appendix J, Section 4.</td>
</tr>
<tr>
<td>Chelsea Embankment Foreshore (opposite Bull Ring Gate)</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. A review of engineering construction risks associated with constructing connection tunnels in the Lambeth Group and additional geotechnical information from borehole investigations found that the connection tunnel should be as short as possible in order to minimise health and safety risks during construction. We also intend to make more use of the river to reduce the numbers of lorries on local roads. We still believe this to be the most appropriate site to intercept Ranelagh CSO and the northern Low Level Sewer No. 1 to the main tunnel. We continue to work on the detailed design and mitigation measures for this site. Details of the review are provided in Volume 4, Appendix K, Section 4.</td>
</tr>
<tr>
<td>Kirtling Street</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. There was more planning and property information related to the site and the surrounding area, but this did not alter our previous conclusions. We believe we can address the site effects through increased river use, retain the operation of the concrete batching plant and</td>
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After phase two consultation: Review prior to Section 48 publicity

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<thead>
<tr>
<th>Site</th>
<th>Implications for the phase two preferred site</th>
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<tr>
<td>Site Implications for the phase two preferred site</td>
<td>other mitigation measures. We reviewed drive options for the western/central sections of the main tunnel, but there was no information that would alter our drive strategy. We still believe this to be the most appropriate site to drive the central section of the main tunnel to Carnwath Road Riverside and Chambers Wharf. Details of the review are provided in Volume 4, Appendix L, Section 4.</td>
</tr>
<tr>
<td>Heathwall Pumping Station</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. There was no new information or change of circumstances that would have altered our assessment of this site. We also intend to make more use of the river to reduce the numbers of lorries on local roads. We still believe this to be the most appropriate site to intercept Heathwall Pumping Station and South West Storm Relief CSOs and connect them to the main tunnel. Details of the review are provided in Volume 4, Appendix M, Section 4.</td>
</tr>
<tr>
<td>Albert Embankment Foreshore</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. The feedback showed that access to the site remained a concern. We have carried out targeted consultation on alternative access to the site in response to security concerns raised by the occupants of Vauxhall Cross. We also intend to make more use of the river to reduce the numbers of lorries on local roads. We still consider this to be the most appropriate site to intercept Clapham Storm Relief and Brixton Storm Relief CSOs and connect them to the main tunnel. Details of the review are provided in Volume 4, Appendix N, Section 4.</td>
</tr>
<tr>
<td>Victoria Embankment Foreshore</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. In response to phase two consultation feedback we developed the design of the permanent structure and carried out targeted consultation on it. This resulted in no change to the site location, but the detailed design of the permanent structure has been revised to meet design concerns. We now propose a more formal and symmetrical layout than were presented at phase two.</td>
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<tr>
<td>Site</td>
<td>Implications for the phase two preferred site</td>
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<tr>
<td>Blackfriars Bridge Foreshore</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. There are no feasible alternative sites. We intend to make more use of the river to reduce the numbers of lorries on local roads. We still consider this to be the most appropriate site to intercept Fleet Main CSO and northern Low Level Sewer No.1 to the main tunnel. Details of the review are provided in Volume 4, Appendix Q, Section 4.</td>
</tr>
<tr>
<td>Chambers Wharf</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. We recognise that, given the locations where we are seeking to construct and operate the tunnel, many of the sites are constrained. However there were no factors that we had previously had not considered, and instead, we believe we can address the site effects through increased river use and other mitigation measures. We reviewed the drive options for the eastern section of the main tunnel and Greenwich connection tunnel, but there was no information that would alter our drive strategy. We still consider this is the most appropriate site to receive the central section of the main tunnel from Kirtling Street, to drive the eastern section of the main tunnel to Abbey Mills Pumping Station and receive the Greenwich connection tunnel. Details of the review are provided in Volume 5, Appendix R, Section 4.</td>
</tr>
<tr>
<td>King Edward Memorial Park Foreshore</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. We considered the additional information submitted, but there were no factors that we had not previously considered and the alternative views put forward by respondees were not in accordance with our site selection process (e.g. only considered a few specialist environment areas when assessing the potential suitability of sites and paid no regard to all the other disciplines and other specialist</td>
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<td>Site</td>
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<td>After phase two consultation: Review prior to Section 48 publicity</td>
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<td>areas). Instead we believe we can address the site effects through a number of site improvements and mitigation measures. We still consider this to be the most appropriate site to intercept the North East Storm Relief CSO and connect to the main tunnel. Details of the review are provided in Volume 5, Appendix S, Section 4.</td>
</tr>
<tr>
<td>Earl Pumping Station</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. There was no new information or change of circumstances that would have altered our assessment of this site. We still consider this to be the most appropriate site to intercept the Earl Pumping Station CSO and connect it to the main tunnel. Details of the review are provided in Volume 5, Appendix T, Section 4.</td>
</tr>
<tr>
<td>Deptford Church Street</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. There were no factors that we had previously had not considered, and instead, we believe we can address the site effects through mitigation measures. We still consider this to be the most appropriate site to intercept the Deptford Storm Relief CSO and connect it to the main tunnel. Details of the review are provided in Volume 5, Appendix U, Section 4.</td>
</tr>
<tr>
<td>Greenwich Pumping Station</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. We still consider this to be the most appropriate site to intercept the Greenwich Pumping Station CSO and to drive the Greenwich connection tunnel to Chambers Wharf. We reviewed the drive options for the eastern section of the main tunnel and Greenwich connection tunnel, but there was no information that would alter our drive strategy, so no changes were made. We continued to work on the detailed design and mitigation measures for this site. Details of the review are provided in Volume 5, Appendix V, Section 4 and also see the Phase two consultation report.</td>
</tr>
<tr>
<td>Abbey Mills Pumping Station</td>
<td>We reviewed whether there was a need to undertake a back-check for this site and concluded that the back-check process should not be triggered. We still consider this to be the most appropriate site to intercept the Abbey Mills CSO and drive the main tunnel. Details of the review are provided in Volume 5, Appendix W, Section 4.</td>
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</tbody>
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Section 48: Report on site selection process  
Volume 1: Main report
After phase two consultation: Review prior to Section 48 publicity

<table>
<thead>
<tr>
<th>Site</th>
<th>Implications for the phase two preferred site</th>
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<tbody>
<tr>
<td>Station</td>
<td>back-check for this site and concluded that the back-check process should not be triggered. We concluded that transporting materials by barges associated with the volumes from a drive site would be highly undesirable when materials need to be transported reliably and daily over the duration of the construction period. We reviewed the drive options for the eastern section of the main tunnel and Greenwich connection tunnel, but there was no information that would alter our drive strategy, so no changes were made. We still consider this to be the most appropriate site to receive the eastern end of the main tunnel. Details of the review are provided in Volume 5, Appendix W, Section 4.</td>
</tr>
</tbody>
</table>

7.8 Proposed project for Section 48 publicity

7.8.1 Following consideration of on-going engineering developments, phase two consultation feedback, any changes in circumstances and new information, back-check and review process of sites and tunnelling options, we concluded the proposed sites and the use outlined below and shown on Figure 7.2 should be put forward as our proposed project for Section 48 publicity.

7.8.2 We also concluded that the Abbey Mills route remains our proposed route for the main tunnel because: it is the shortest route; it is the least disruptive and most cost-effective option, while still meeting all the required environmental objectives; it requires the least number of worksites.

Proposed main tunnel sites

7.8.3 Main tunnel sites would be used to construct and operate the main tunnel as either drive or reception sites, depending on the direction the TBM's would be driven (see Figure 7.2). The proposed five main tunnel sites and their use are shown in Table 7.3.

<table>
<thead>
<tr>
<th>Site name</th>
<th>Site use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acton Storm Tanks</td>
<td>Main tunnel reception site that incorporates the interception of a CSO.</td>
</tr>
<tr>
<td>Carnwath Road Riverside</td>
<td>Main tunnel drive and reception site and Frogmore connection tunnel reception site.</td>
</tr>
<tr>
<td>Kirtling Street</td>
<td>Main tunnel double drive site.</td>
</tr>
<tr>
<td>Chambers Wharf</td>
<td>Main tunnel drive and reception site and Greenwich connection tunnel reception site.</td>
</tr>
</tbody>
</table>
7.8.4 Proposed CSO sites

CSO sites would be used to construct and operate the CSO interception structures and the associated connection tunnels to transfer flows to the main tunnel (see Figure 7.2). The two proposed CSO sites to be used to drive long connection tunnels are shown in Table 7.4.

Table 7.4 CSO sites and long connection tunnels

<table>
<thead>
<tr>
<th>Site name</th>
<th>Site use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dormay Street</td>
<td>CSO site, Frogmore connection tunnel drive site.</td>
</tr>
<tr>
<td>Greenwich Pumping Station</td>
<td>CSO site, Greenwich connection tunnel drive site.</td>
</tr>
</tbody>
</table>

7.8.5 The nine proposed CSO sites to be used to construct short connection tunnels to the main tunnel are shown in Table 7.5.

Table 7.5 CSO sites and short connection tunnels

<table>
<thead>
<tr>
<th>Site name</th>
<th>Site use and connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hammersmith Pumping Station</td>
<td>CSO site, construction of the Hammersmith connection tunnel.</td>
</tr>
<tr>
<td>Barn Elms</td>
<td>CSO site, construction of the West Putney connection tunnel.</td>
</tr>
<tr>
<td>Putney Embankment Foreshore</td>
<td>CSO site, construction of the Putney Bridge connection tunnel.</td>
</tr>
<tr>
<td>Falconbrook Pumping Station</td>
<td>CSO site, construction of the Falconbrook connection tunnel.</td>
</tr>
<tr>
<td>Cremorne Wharf Depot</td>
<td>CSO site, construction of the Lots Road connection tunnel.</td>
</tr>
<tr>
<td>Chelsea Embankment Foreshore</td>
<td>CSO site, construction of the Ranelagh connection tunnel.</td>
</tr>
<tr>
<td>Heathwall Pumping Station</td>
<td>CSO site, construction of the Heathwall / South West Storm Relief connection tunnel.</td>
</tr>
<tr>
<td>Albert Embankment Foreshore</td>
<td>CSO site, construction of the Clapham/Brixton connection tunnel.</td>
</tr>
<tr>
<td>Victoria Embankment Foreshore</td>
<td>CSO site, construction of the Regent Street connection tunnel.</td>
</tr>
</tbody>
</table>
The one proposed CSO site to be used as a connection tunnel reception site is shown in Table 7.6.

**Table 7.6 CSO site and connection tunnel reception site**

<table>
<thead>
<tr>
<th>Site name</th>
<th>Site use and connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>King George’s Park</td>
<td>CSO site, Frogmore connection tunnel reception site.</td>
</tr>
</tbody>
</table>

The main tunnel would be driven through the CSO drop shaft of four proposed CSO sites shown in Table 7.7.

**Table 7.7 CSO sites and main tunnel driven through the CSO drop shaft**

<table>
<thead>
<tr>
<th>Site name</th>
<th>Site use and connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackfriars Bridge Foreshore</td>
<td>Drop shaft on-line of the main tunnel.</td>
</tr>
<tr>
<td>King Edward Memorial Park Foreshore</td>
<td>Drop shaft on-line of the main tunnel.</td>
</tr>
<tr>
<td>Deptford Church Street</td>
<td>Drop shaft on-line of the Greenwich connection tunnel.</td>
</tr>
<tr>
<td>Earl Pumping Station</td>
<td>Drop shaft on-line of the Greenwich connection tunnel.</td>
</tr>
</tbody>
</table>

**Other sites**

There would also be system modification sites that would be used to control CSOs locally rather than connecting them to the main tunnel. The two proposed system modification sites are shown in Table 7.8.

**Table 7.8 System modifications**

<table>
<thead>
<tr>
<th>Name</th>
<th>System modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shad Thames Pumping Station</td>
<td>To control the Shad Thames Pumping Station CSO.</td>
</tr>
<tr>
<td>Bekesbourne Street</td>
<td>To control the Holloway Storm Relief CSO.</td>
</tr>
</tbody>
</table>

The other worksite would be Beckton STW, which would be used to construct and operate the works to lift the flows from the tunnels for treatment.
Figure 7.2 Proposed project for Section 48 publicity
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>combined sewer overflow (CSO)</td>
<td>A structure, or series of structures, designed to allow spillage of excess wastewater from a combined sewer under increased rainfall conditions. Flows may discharge by gravity or by pumping.</td>
</tr>
<tr>
<td>connection culvert</td>
<td>A covered channel structure that connects an interception chamber to a drop shaft.</td>
</tr>
<tr>
<td>connection tunnel</td>
<td>A tunnel that connects a drop shaft to the main tunnel.</td>
</tr>
<tr>
<td>CSO site</td>
<td>A site that contains the CSO interception chambers, connection culverts and the drop shaft from which the connection tunnel is built. Each site needs to provide enough space for all construction related activities, which vary depending on the diameter of the shafts and the method of tunnel construction.</td>
</tr>
<tr>
<td>drive site</td>
<td>A main tunnel site containing the shaft from which the tunnel boring machine is ‘driven’ forward, ie, starts from. Excavated material is removed from and segments are fed into the tunnel via the shaft at the drive site.</td>
</tr>
<tr>
<td>drop shaft</td>
<td>A vertical, circular structure that connects a connection culvert to a connection tunnel. This is used to drop flow down to the main tunnel level.</td>
</tr>
<tr>
<td>intermediate site</td>
<td>A site that contains the intermediate shafts from which the construction of the main tunnel is supported by activities such as secondary lining. Each site needs to provide enough space for all construction related activities, which vary depending on whether the concrete for the secondary lining is made on the site or made elsewhere and delivered to the site by lorries.</td>
</tr>
<tr>
<td>Lee Tunnel</td>
<td>The Lee Tunnel comprises a storage and transfer tunnel from Abbey Mills Pumping Station to Beckton STW and the interception of the Abbey Mills CSO.</td>
</tr>
<tr>
<td>main tunnel</td>
<td>The tunnel from Abbey Mills to Acton Storm Tanks.</td>
</tr>
<tr>
<td>main tunnel site</td>
<td>A site from which the main tunnel is built. Each site needs to provide enough space for all construction related activities, which vary depending on the type of tunnel boring machine used and whether the site is a drive site, a double drive site or a reception site.</td>
</tr>
<tr>
<td>mitigation measures</td>
<td>Actions proposed to moderate adverse impacts and to enhance beneficial impacts arising from the whole or</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>specific elements of the development.</td>
<td></td>
</tr>
<tr>
<td>pumping station</td>
<td>A vertical, circular structure that has pumps located at the bottom. This is used to lift storm water flows up to the sewage treatment works.</td>
</tr>
<tr>
<td>receptors</td>
<td>People (both individually and communally) and the socio-economic systems they support.</td>
</tr>
<tr>
<td>reception site</td>
<td>A main tunnel site that contains the shaft from which the tunnel boring machine is ‘received’, ie, ends up. The tunnel boring machine is removed from the tunnel via the shaft at this reception site.</td>
</tr>
<tr>
<td>sewage or wastewater</td>
<td>Waterborne wastes from domestic uses of water, derived from households, trade and industry.</td>
</tr>
<tr>
<td>sewerage</td>
<td>A system of pipes for the collection and transportation of domestic and industrial wastewater.</td>
</tr>
<tr>
<td>shaft</td>
<td>Duct/pipe/vertical tunnel.</td>
</tr>
<tr>
<td>storm water</td>
<td>Rainwater that funnels into sewers to be mixed with sewage and is either treated at sewage works or overflows into rivers.</td>
</tr>
</tbody>
</table>
| Thames Tideway Tunnel project       | The Thames Tideway Tunnel project comprises a main tunnel, running from west to east London that is integrated with the existing sewerage system via connection tunnels in order to control 34 ‘unsatisfactory’ CSOs. These tunnels store and transfer the intercepted flows to Beckton STW.  
   The project consists of two main elements:  
   - Works to design, construct and maintain the main tunnel, which provides the majority of the storage capacity and enables transfer of combined sewage to Beckton STW in east London.  
   - Works to control and intercept combined sewage overflows unsatisfactory CSOs and transfer them into the main tunnel. This includes connection tunnels to link intercepted CSOs to the main tunnel. |
| Tideway                             | The tidal area of the River Thames (ie, from Teddington to the Thames Estuary).                                                                                                                                |
| tunnel alignment                    | The horizontal and vertical route of the proposed tunnels, including connection tunnels and main tunnel sites.                                                                                               |
| tunnel boring machine               | A machine with a circular cross-section that is used to excavate tunnels through a variety of ground conditions.                                                                                             |
For further information or to comment on our proposals please see our website: www.thamestunnelconsultation.co.uk

It is very important that you understand the information we have provided. If you need further information in another language, braille, large print or audio format please contact us on 0800 0721 086.