



National Audit Office

Report

by the Comptroller
and Auditor General

Department for Environment, Food & Rural Affairs

Review of the Thames Tideway Tunnel

Summary

1 The Thames Tideway Tunnel (the Tunnel) is a major project to construct a sewer tunnel running 25 kilometres from Acton in West London to Abbey Mills in East London, intercepting storm sewage overflows which would otherwise discharge into the Thames. In June 2014 we published *Thames Tideway Tunnel: early review of potential risks to value for money*.¹ Our report outlined six areas that we considered most critical to achieving value for money for customers and the taxpayer. As the Tunnel is not expected to be fully operational until 2024, we plan to update Parliament on progress at various times: this review is the second of those updates.

Background

2 Spills from Combined Sewer Overflows (CSOs) along the Thames degrade water quality and the environment of the tidal reaches of the Thames (the Tideway). In 1991, the European Union adopted the Urban Waste Water Treatment Directive (the Directive), aiming to protect the environment from waste water discharges, with member state compliance expected for large cities by 2000. The Directive does not specify thresholds for, or provide detailed guidance on, compliance for CSOs. In 2006, the European Commission issued a 'reasoned opinion' stating that the UK was failing to comply with the Directive's requirements for London. In 2010, the Commission started legal proceedings with the Court of Justice of the European Union, which in 2012 found the UK to be in breach owing to the frequency of spills from CSOs along the River Thames. This has meant that the UK was, and still is, at risk of infraction fines if the problem is not addressed.

3 The Department for Environment, Food & Rural Affairs (the Department) has overall policy responsibility for water and sewerage in England, and overseeing the English regions' compliance with European environmental directives.

¹ Comptroller and Auditor General, *Thames Tideway Tunnel: early review of the potential risks to value for money*, Session 2014-15, HC 168, National Audit Office, June 2014.

4 Work has been ongoing since 2000, in part, aimed at achieving compliance with the Directive. Thames Water, a privately-owned company, is responsible for sewerage infrastructure in London, and for developing a solution to the problem of overflows. In 2000, it began funding research into a solution which reported in 2005. Because of implications for public policy, the Department developed strategic objectives for a solution: to secure compliance with the Directive, and to improve the environmental quality of the Tideway by reducing sewage overflows. The Department announced support for the Tunnel as a solution in 2007. In 2014, the Department added a third objective: to ensure sufficient strategic sewer capacity to accommodate London's growth for at least the next hundred years.

5 The Department intends that the project will be delivered and financed privately, although it has made a contingent financial support package available to secure this. Thames Water has planned the Tunnel and proposed its initial design; its customers will meet the costs through their water bills. Since our report in 2014:

- a specially-created private company, Bazalgette Tunnel Limited (Bazalgette) – trading as 'Tideway' – has successfully bid to design, build, own, maintain and finance the Tunnel;
- a regulatory framework has been established covering Bazalgette;
- the government has provided a package of contingent financial support – the Government Support Package (GSP);
- the project has received development consent; and
- Bazalgette started work on various sites during 2016. The Department expects tunnelling to be completed by 2021, and fully operational in 2024 at the latest.

Scope of this report

6 In this report we provide an update on developments since June 2014, including programme progress, and cost estimates. We examine how the Department and the Environment Agency have managed risks in areas which are now substantively complete, particularly in setting objectives and appraising options.

7 In 2014, we did not review the evidence base supporting the decision to build the Tunnel to avoid influencing the outcome of ongoing competitions for the construction and financing of the Tunnel. We now look at the process for developing standards, and for appraising options; the strength of the underlying evidence base (including analysis and quality assurance arrangements); and evidence on the prospects that the Tunnel will deliver the Department's objectives. We look at the risks to customers and the taxpayer which will need to be managed by the public sector to protect value for money during the construction phase. It is too early to form a value-for-money conclusion on the whole project but this report, together with our 2014 report, outlines what we would expect to see when the project is complete.

Key findings

Setting objectives and appraising options

8 After the Directive in 1991, it took a considerable time to develop measurable standards and to appraise options capable of meeting those standards. As the Directive does not specify thresholds for compliance, the Department endorsed standards which the Environment Agency and Thames Water developed. Between 2000 and 2005, the Thames Tideway Strategic Study Steering Group analysed the impact of overflows, proposed environmental objectives, and criteria to define satisfactory performance against those objectives. This resulted in threshold-based standards for dissolved oxygen levels, and rules defining unsatisfactory CSOs along the Tideway which solutions would have to address. With the Department's agreement, Thames Water used these criteria in its appraisal of potential solutions, which concluded in 2010 (Figure 2 and paragraphs 1.3, 2.2 to 2.4 and 2.12 to 2.14).

9 The Department's objectives were broader than simply complying with the Directive, and this is reflected in the criteria used to appraise potential solutions.

We have two observations on these criteria:

- a The evidence was more robust for some criteria than others.** We found that the dissolved oxygen standards were supported by a rigorous scientific approach, which was favourably peer-reviewed by an independent academic and comparable to other English standards for environmental regulation. Thresholds for identifying unsatisfactory CSOs were based primarily on the Environment Agency's judgement which it only reviewed internally (paragraphs 2.7 and 2.8).
- b There was a degree of contingency in the criteria used to test whether the options considered complied with environmental standards.** The Environment Agency agreed with Thames Water that a maximum of four spill events in a modelled 'typical year' would deliver satisfactory environmental performance and compliance with the Directive. The Tunnel is designed to achieve this 'four spills' criterion. Data from 2016 suggests that the number of spills can exceed this threshold without any breaches of the dissolved oxygen standards, and some European Union member states have set less conservative maximum spill thresholds. The Department considers that inferences should not be made from a single year of data, and that thresholds adopted by other member states to demonstrate compliance are not relevant comparators, because of differences in the nature of overflows and water areas affected. The Department considers that the 'four spills' level of protection reflects the Government's aim to achieve its environmental and legal objectives well into the future, having regard for the likely impacts of population growth and climate change (paragraphs 1.7, 2.4, 2.11 and 2.16).

10 In 2007, the Department endorsed the Tunnel based on Thames Water's assessment that it was the lowest-cost option capable of achieving its objectives by 2020. We found options were appraised primarily based on their ability to achieve the dissolved oxygen standards. Our review found a wide range of options had been considered although, after the Department's 2007 decision, Thames Water's analysis of alternatives was less detailed; its costing of alternatives was not independently scrutinised; and combinations of alternative technologies were not appraised. The Department reviewed its position and concluded in 2014 that delaying the Tunnel to consider alternatives further would likely increase the risk of fines for breaching the Directive (paragraphs 2.12, 2.15, 2.16 and 2.19).

11 The Department and the Environment Agency did not fully explore uncertainty in the modelling before endorsing the full tunnel option. Models to forecast spills and dissolved oxygen levels played a key role in eliminating alternatives to a full-length tunnel (Figure 8, page 24). They were used to conclude that all alternatives except in-sewer separation would fail the dissolved oxygen standards and to set the 'four spills' criterion itself. The Environment Agency could not provide us with evidence that it had sufficiently understood the impact of uncertainty on the outputs from the models. The Environment Agency's consultants in 2007 reported that the models could predict dissolved oxygen levels which were overly pessimistic when compared to measurements in practice, and made recommendations to refine the modelling in 2009. The Environment Agency partially adopted these recommendations but has not carried out another validation exercise since 2007. The Environment Agency told us that, although it would have been possible to increase confidence in the model results by obtaining more extensive data sets, it did not consider that any of the areas of uncertainty with the results were sufficient to justify the costs necessary to obtain any improved data (paragraphs 2.17 and 2.20).

12 Correcting for inaccurate predictions could have resulted in a smaller, lower cost tunnel. More accurate modelling is unlikely to have affected the choice of a tunnel as the strategic approach, given assessments that alternatives would either fail to meet all key objectives or do so at significantly higher cost. However, it may have resulted in a smaller, lower cost design of the preferred 'Full Tunnel' option. Refinements to Thames Water's sewer model after 2007 indicated that the planned capacity of the Tunnel would considerably outperform the 'four spills' threshold. This allowed Thames Water to reduce the length of the reference design by 9 kilometres in 2009, saving £646 million, while still achieving the 'four spills' threshold. Further refinements to the modelling could have identified the potential for further capacity reductions, albeit through reducing the diameter of the tunnel, which estimates suggest reduces costs relatively less than reducing the tunnel's length. The Department considers that a tunnel of smaller diameter would not have cost significantly less, based on Thames Water estimates from 2006. It considers that a smaller diameter tunnel would have carried a greater risk of non-compliance and fines, and that, following the 2012 ruling, the European Commission would have known it was possible to capture more spills with minor cost increase. The Department considers that the cost of rectifying a tunnel with inadequate capacity would be prohibitive, and that the Tunnel chosen offers greater certainty that the tunnel will be "future-proof" (paragraphs 2.18 and 2.21 to 2.24).

Current project status

13 A specially-created company will construct the Tunnel, and is incentivised to bring the Tunnel into operational use sooner than planned. The Department appraised the costs and benefits of different delivery models (by the public sector, or by Thames Water, or a separate company with contingent government support), before deciding to support a separate infrastructure provider. Bazalgette was appointed in August 2015 to design, build, commission, finance and maintain the Tunnel, following a competition run by Thames Water. Through a separate procurement competition Thames Water started, Bazalgette contracted with three consortia to build the three sections of the Tunnel. In August 2015, the project plan was for the Tunnel to be operational by 2024, though Bazalgette has given contractors incentives to complete construction earlier (paragraphs 1.10, 1.11 and 3.2).

14 Eventual costs to customers are uncertain. Thames Water's customers will ultimately fund this project, with their contributions depending on the final cost. Tunnel costs added £13 on average to Thames Water customers' annual bills in 2016-17 (in 2016-17 prices). Thames Water has forecast that the peak impact of the project on the average annual household bill will range from £20 to £25 (in 2016-17 prices) in the early 2020s. This projection assumes cost overruns are no higher than 30% of the £3.2 billion target price for the project works; although government considers the probability of this occurring to be below 5%. The lower than expected cost of finance has helped to reduce the expected impact of Tunnel costs on household bills from the 2011 prediction of between £70 and £80 a year (paragraphs 3.4, 3.7 and 3.8).

15 Cost estimates have risen over time during planning, but have remained relatively stable since 2011. Between 2006 and 2009, the cost estimate for the preferred Full Tunnel option increased from £2.2 billion to £4.2 billion in 2016 prices (Figure 11), with Ofwat's consultants attributing increases mainly to more realistic cost estimates. Since 2009 estimates have periodically increased (largely due to scope changes aimed at mitigating the risk of failing to achieve planning consents), and decreased (due to Thames Water's modelling refinements after 2007 which allowed the design of a shorter tunnel). The current £4.2 billion estimate consists of £3.2 billion of works Bazalgette will undertake (including £0.5 billion contingency), and Thames Water's enabling works estimated at £1.0 billion. Experience from costs on the Tunnel's 'sister' project, the Lee Tunnel, has been used to improve estimates for the Tunnel. By completing construction early, Bazalgette is aiming to reduce project costs, which could potentially reduce costs for customers (paragraphs 3.5 and 3.6).

16 The Department estimates that the benefits of the Tunnel will exceed the costs, although both are uncertain. Cost-benefit analysis was not critical to the government's endorsement of the Tunnel option, but it provides important information on whether the overall benefits justify the costs. The Department has estimated that the benefits of the project will be between 1.8 and 3.1 times greater than the costs. Estimated benefits are highly sensitive to assumptions used to extrapolate from the surveys, and the ratio has varied considerably during project development. The Department's estimate does not reflect some important but uncertain benefits, such as averted fines payable for non-compliance with the Directive. Approximately 60% of the estimated annual benefits accrue to households outside of Thames Water's service area, although only Thames Water customers will pay towards the Tunnel's costs (paragraphs 3.9, 3.10, and Figures 13 and 14).

Risks and mitigation arrangements to project completion

17 Construction of the Tunnel carries inherent risks due to the project's size, and the number of stakeholders involved. Our previous work on major projects indicates a number of common causes of project failure or cost overruns, including: over-optimistic assumptions; technical challenges not recognised; limited understanding of interdependencies and related projects; short-term financial decisions adding to longer-term costs; and failures in relationships with contractors or in the contractor delivery model. Some Tunnel project arrangements mitigate against these, for example the project can benefit from experience of similarities with the Crossrail and Lee Tunnel construction projects. But some of these risks could materialise during construction, for example knowledge of ground conditions is imperfect, and contractors will need to work well together to deliver to time and minimise costs. Public bodies will need to monitor the project carefully so they can discuss any evidence of risks materialising with those delivering the project at a sufficiently early stage (paragraphs 3.11, 3.13 and 3.14).

18 Government has provided Bazalgette with a contingent financial support package which seeks to mitigate some risks, transferring liability to the taxpayer if those risks materialise. The Department concluded that private delivery of the project would not be financially viable without some form of government support, because of the scale of the project risks and the implications for financing costs that customers would ultimately fund. The Department considers that a call on the support package is highly unlikely, although it estimates that the impact could be very large (£6.6 billion in its 'reasonable worst case' scenario), if several risks materialise. Until the project has been fully commissioned and has completed testing (expected by February 2027), the Department has agreed to:

- either provide an equity injection to Bazalgette if its cost overruns exceed 30% or discontinue and pay compensation;
- lend to Bazalgette if economic or political events make it unable to access debt capital markets as planned;
- indemnify property and liability claims above insurance limits specified in Bazalgette's existing insurance cover, or where insurance is unavailable;
- provide compensation to investors in the event that the project is discontinued; and
- make an offer to purchase Bazalgette or provide compensation to investors if it goes into special administration and remains there for 18 months (paragraphs 3.8 and 3.15 to 3.17).

19 Arrangements have been established aimed at risk mitigation and early identification of potential calls on the support package. Contractual arrangements for costs and payments (including ‘pain and gain-sharing’) provide Bazalgette and its contractors with financial incentives to deliver on time, or before, and manage the risks of cost overruns. Independent assessors will provide quarterly reviews on Bazalgette’s reported progress and project costs. These assessments fulfil a dual role, enabling Ofwat to identify and disallow expenditure which has not been agreed, and providing advance warning of a call on the support package so the Department can make appropriate preparations. The Department’s arrangements should provide it with evidence of any risks materialising and sufficient means to intervene where necessary, and we will consider the operational effectiveness of these arrangements in future reviews (paragraphs 3.19 to 3.23).

20 Despite construction work starting and the prospect of the UK leaving the European Union, the European Commission could yet seek fines against the UK for a continuing breach of the Directive. The timescale in which it would do so is uncertain, and the Commission told us it has not yet made a decision (paragraph 3.24). We have not audited or considered the effects on this project of leaving the European Union.