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Costs and benefits of the Thames Tideway Tunnel

2015 update

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Introduction

This document accompanies Defra's updated strategic and economic case for the Thames Tideway Tunnel, "Creating a River Thames fit for our future" (September 2015), and sets out more detail on the calculations which have been performed to update the monetary costs and benefits of the Thames Tunnel last estimated in 2011.

Headline results

As reported in the main body of the *strategic and economic case* document, the headline cost and benefits of the Thames Tunnel are as follows (discounted Present Value figures and 2014 prices):

Whole life costs:	£4.1bn
Whole life benefits:	Between £7.4bn and £12.7bn
Overall position:	Benefits expected to exceed costs. Estimated ratio of benefits to costs of between 1.8:1 and 3.1:1. Some wider benefits remain excluded, and the avoided costs of legal infraction are not included.
Commentary on changes since 2011:	Cost estimate updated and now includes financing and government support costs. Benefits range revised upwards, following better accounting for income and population affects, and new information on the impact of the Lee Tunnel on the original benefit survey results.

General approach and caveats

The core analysis reported here is only in respect of costs and benefits to which it is possible to attach numerical monetary estimates. For benefits in particular, this is likely to give only a partial view of the economics of the Thames Tunnel. Benefit estimates are restricted to those associated with reducing adverse impacts of Dissolved Oxygen on fish, better health outcomes for river users (e.g. rowers) and reduced sewage litter and odour. These were the only benefits for which monetary estimation was possible (through a stated preference "Willingness to Pay" survey).

Separate analysis published by Thames Water in 2012¹ illustrates the potential positive impacts of the Thames Tideway Tunnel on the wider economy. Principally, these relate to supporting the ongoing economic development of London by avoiding sewerage infrastructure constraints, and the employment and skills benefits associated with construction. It has not been possible to include these aspects within the main cost-

¹ [Why does London's economy need the Thames Tunnel?](#), March 2012:

benefit analysis reported here, but these wider impacts are nevertheless relevant and discussed in the “Other benefits” section below.

It should also be noted that any financial impact on the UK government arising under a “do nothing” scenario from non-compliance with the Urban Waste Water Treatment Directive (i.e. through fines) has not been accounted for in the main cost-benefit analysis – though illustrative figures showing the potential impact are also given in the “Other benefits” section later in this paper.

The main analysis of costs and benefits should be viewed as high-level, with particular uncertainty attaching to benefit estimates, hence the presentation of these as a fairly broad range.

Cost estimates

The Present Value whole life cost estimate has been estimated by Ernst & Young for the assumed 120 year economic life of the Thames Tideway Tunnel, as the sum of:

- a) Construction, operation and maintenance costs, as financed by customers. These have been derived from the preferred bid for the Infrastructure Provider and Thames Water financial modelling;
- b) The “expected” (probability-weighted) value of any contingent support from the national exchequer under the terms of the Government Support Package for the Tunnel, in respect of certain project risks. This has been estimated by Ernst & Young taking account of estimated probabilities of the various elements of the support package being called;
- c) “Non-financial” costs, arising from traffic congestion during construction, and the environmental costs arising from the transport and disposal of construction waste. These were originally estimated for Defra’s Regulatory Impact Assessment in 2007² and revised in the 2011 update of the benefit-cost analysis (Defra 2011³). For this latest update, the 2011 figure has been updated in line with the GDP deflator which increased by 5.2% between 2011 and 2014.

Summary of total cost estimates (120 years, 2014 prices, Present Value)

Construction*, operation, maintenance (as funded by customers):	£4,052m
Government Support Package (mean Expected Value):	£ 18m
Non-financial costs	£ 28m
Total	£4,098m

Notes:

* Assumes a cost outturn at the 50% level (“P50”). This is the median point of the expected cost distribution having accounted for project risks. Whilst the 2011 estimate was conservatively presented at the P80 level to account for greater uncertainty at that point, more definitive modelling of project risks now allows the use of the P50 level.

² [Regulatory Impact Assessment – sewage collection and treatment for London](#), Defra, March 2007

³ [Costs and Benefits of the Thames Tunnel](#), Defra, November 2011

Core benefit estimates

Since the 2011 update to the benefit-cost analysis, Defra has commissioned a more in-depth independent review and update of the benefits of the Thames Tideway Tunnel (Eftec, 2015⁴). This work, which is being published alongside this note, revisited the original 2006 Stated Preference (“Willingness to Pay”, WTP) study used to derive an aggregate value of the environmental benefits of the Tunnel. In doing so, the objectives were:

- To examine the validity of continuing to use the original 2006 WTP survey results, particularly in the light of the changed macroeconomic circumstances since that time;
- To review the environmental “baseline” (i.e. the conditions existing before the Thames Tideway Tunnel is built) following completion of sewage treatment work upgrades on the Tideway and the Lee Tunnel, and how this relates to the baseline used in the 2006 study;
- To review the methodology used to aggregate individual survey results to provide benefits estimates for the “administrative jurisdiction” (Thames Water customer base) and “benefits jurisdiction” (England as a whole), and make any improvements based on developments in environmental valuation practice since the original study;
- To update the benefits estimates for price and population increases since the 2011 review, and consider the case for including the effects of long-term income and population growth in the aggregate benefits estimates.

The Eftec review has resulted in a revised benefit range for the Thames Tideway Tunnel of **between £7,400m and £12,700m**. The range reflects different scenarios of population and income growth over the life of the tunnel, with the lower end assuming no growth in population or income over 2014 levels, and the upper end assuming growth in both according to assumed profiles set out in Sections 2.5 and 2.6 of Eftec (2015). Overall, both ends of the new range represent significant increases on those presented in the 2011 update of the cost-benefit analysis. The key reasons for the upward revision in the lower bound (i.e. before considering differences in future income and population scenarios) are as follows:

- i. The new estimates no longer involve a 40% reduction in WTP aggregates as a broad-brush adjustment for the effects of the Lee Tunnel on the pre-Thames Tideway Tunnel environmental baseline. This adjustment made in the 2011 analysis, designed to be conservative, was based on the total CSO tonnage dealt with by the Lee Tunnel, but did not have any particular relation to factors specifically accounting for WTP for wider Tideway improvements. Those factors were: Dissolved Oxygen levels as they affect fish; sewage litter; and incidence of “higher risk” occasions for health. In their 2015 study, Eftec were able to make a more

⁴ Economics for the Environment Consultancy Ltd (eftec), *Update of the Economic Valuation of Thames Tideway Tunnel Environmental Benefits, Final report for Defra*, August 2015. Available at <http://randd.defra.gov.uk/> - search for “WT1570”.

systematic assessment of how the Lee Tunnel will affect these factors, based on information presented as part of Thames Water's Application for Development Consent (September 2013). Eftec were then able to consider how these changes would affect the baseline (pre-Thames Tideway Tunnel) scenario as presented to respondents in the original 2006 Willingness to Pay study. Eftec's conclusion was that even after completion of the Lee Tunnel and despite the associated reduction in aggregate spill volumes from the major CSO at Abbey Mills, the factors actually influencing surveyed Willingness To Pay for wider tideway improvements (i.e. Dissolved Oxygen failures affecting fish, sewage litter and "higher risk" health occasions) remain broadly unchanged. As such, Eftec recommended that values elicited as part of the original WTP survey could still be taken as benefits estimates for the Thames Tideway Tunnel post completion of the Lee Tunnel. It is important to note that this does not imply there are no benefits from the Lee Tunnel, especially locally and in terms of reduced CSO spill volume. It is just that the influence on the factors specifically affecting WTP for wider Tideway improvements is limited. For more information see Eftec (2015), Annex 2. As a sensitivity test however, we have also re-estimated the benefit-cost ratio using the original 2011 assumption that the Tunnel only delivered 60% of the overall benefits, but including all the other current updates. While this reduces the ratio it does not change the overall conclusion that the Thames Tideway Tunnel remains cost-beneficial (see **Annex 1** below).

- ii. Since the original 2006 study, spatially disaggregated estimates of household income have been provided by the ONS. It is thus now possible to use income level rather than Socio-Economic Group (SEG) to aggregate individual WTP survey responses to both the Thames Water customer population level and the England level. Income is a more satisfactory variable to include in principle because it represents a genuine constraint to household WTP whereas SEG is a proxy indicator of the budget constraint. The new analysis has revealed that the previous use of SEG underestimated the range of WTP across space, compared with the income-based approach where more spatial variation is observed. This has particular implications for the Thames Water area results where incomes are higher. In turn this has led to mean WTP in the Thames Water area increasing by around a quarter (see Eftec (2015), Annex 6, section A6.1.2).
- iii. The base level of population used to aggregate survey results has been updated by Eftec. Previously an estimate for 2006 (not updated in 2011) was based on the 2001 census, but the new analysis is based on the latest ONS population estimate for 2014, which is 11% higher at the England level.

Other benefits

Wider economic impacts

Since the publication of the last Defra update of the cost-benefit analysis for the Thames Tideway Tunnel, Thames Water has published analysis of its wider economic impacts; namely, those on the "real economy" in terms of growth in "value added" (income or GDP)

and jobs⁵. This report argues that the tunnel could remove potential constraints on future growth in London's economy, critical for wider UK growth, create and sustain construction jobs, and leave a positive skills legacy for London.

The analysis of removing potential constraints on future growth is based on the idea that in the future, new housing development within London could be held back by planners if the sewerage infrastructure is not improved. The London Plan assumes that the Thames Tideway Tunnel will be completed. Housing development allows the labour market available to London's economy to continue to grow in a similar way as enhanced transport infrastructure. Whilst Thames Water acknowledges that it is not possible to make a definitive assessment of the impact of removing future growth constraints, it presents an illustrative assessment. This suggests that over 20 years, the cumulative impact on UK Gross Domestic Product (GDP) of preventing development constraints arising because of sewerage capacity could be between **£5 billion and £15 billion**. This is based on an assumption that 40,000 homes (18% of those expected by 2031) are not built without the Thames Tideway Tunnel, meaning a constraint on population growth of around 0.05 percentage points each year. The range of estimates reflects assumptions about the extent to which economic growth might be transferred elsewhere in the UK.

The Thames Water (2012) work also makes estimates of the employment impact of the Thames Tideway Tunnel. Some 4,250 workers would be directly employed at the height of construction activity, with a further 5,100 indirect jobs created as a knock-on impact. As well as the employment impact (totalling around **9,350 jobs**), the tunnel would build on the skills legacy already started by the Crossrail project, including the establishment of the Tunnelling and Construction Underground Academy (TUCA) and work in schools.

We have not included in the formal cost-benefit analysis for the Thames Tideway Tunnel these economic benefits as estimated by Thames Water due to their illustrative nature, but they highlight potential impacts on the economy which strengthen the case for the project further.

Avoidance of fines under the EU Urban Waste Water Treatment Directive

The EU Urban Waste Water Treatment Directive (UWWTD) requires urban wastewater (sewage) to be properly collected and treated, other than under "exceptional" conditions such as periods of unusually heavy rainfall. In relation to the Thames Tideway, the UK has already been found to be in breach of the Directive by the Court of Justice of the European Union (CJEU). Completion of the Thames Tideway Tunnel, as the preferred option to deal with Combined Sewer Overflows, as soon as practicable will help prevent fines being imposed on the UK for this breach. Fines are a matter for the CJEU, and it has wide discretion concerning the level of fines imposed. In October 2013, the CJEU fined Belgium a lump sum of €10m and a daily penalty of €4,722 for breaches of the UWWTD, relating to non-compliance with an earlier Court judgment from 2004. In November 2013, the CJEU imposed on Luxembourg a lump sum penalty of €2m and a daily penalty of €2,800 for UWWTD breaches. The original judgment that Luxembourg was in breach was in 2006. In April 2014, the European Commission brought a fines action against Greece for non-compliance with a Court judgment from October 2007, seeking a lump sum fine of over €12m plus a €47,462 daily penalty for UWWTD breaches. Putting a cost on UK non-

⁵ [Why does London's economy need the Thames Tideway Tunnel?](#) (Thames Water, 2012)

compliance is difficult but, using the published criteria, we estimate that the European Commission could seek fines in the order of at £100m a year. This would be payable until such time as the Commission considered the UK to have complied with the UWWTD.

The benefit of avoiding financial penalties for breach of the UWWTD is not included in the cost-benefit analysis reported in this paper.

Conclusions

The range of estimated monetary benefit for the Thames Tideway Tunnel is £7.4bn-£12.7bn. This range excludes some important wider benefits, notably of facilitating future GDP growth in London and the UK, for which only illustrative figures are calculable, though the size of estimates given plausible assumptions is significant.

Given the estimated economic costs of £4.1bn, the revised assessment indicates that the Tunnel will be cost-beneficial (i.e. benefits will be at least as high as costs). The ratio of benefits to costs is now estimated in the range 1.8-3.1:1

Estimated cost-benefit performance is stronger than in the previous 2011 assessment. A new in-depth independent review of the environmental benefits of the tunnel (Eftec 2015)⁶ suggests that Defra's high-level benefits assessment from 2011 involved overly conservative assumptions, particularly in terms of the impact of the Lee Tunnel. In addition, Eftec (2015) better accounts for income and population effects in aggregating household-level willingness to pay than earlier work. Different assumptions about treatment of Lee Tunnel impacts do not affect the conclusion that the Thames Tideway Tunnel is cost-beneficial (see Annex 1).

Nevertheless, the Thames Tideway Tunnel cost and benefit estimates above should continue to be viewed as high-level, to support the ongoing government position on what is ultimately a private sector investment, and the range in potential cost-benefit performance is highlighted as an indicator of the uncertainty present in the analysis.

⁶ Economics for the Environment Consultancy Ltd (eftec), *Update of the Economic Valuation of Thames Tideway Tunnel Environmental Benefits, Final report for Defra*, August 2015. Available at <http://randd.defra.gov.uk/> - search for "WT1570".

Annex 1

Alternative treatment of the Lee Tunnel

As reported in the main text, Eftec (2015) recommends that the original Willingness To Pay survey results gathered in 2006, which implicitly related to a scenario before the completion of the Lee Tunnel, could continue to be used in full (after price and population adjustment) to reflect the benefit of the Thames Tideway Tunnel.

In previous cost-benefit analysis (Defra, 2011) an adjustment was made to benefits estimates to account for the Lee Tunnel. Eftec's work now suggests this was overly conservative but this Annex explores the implications of maintaining the 2011 assumptions about the "stand-alone" benefit of the Thames Tideway Tunnel.

The sensitivity of the overall cost-benefit results for the Thames Tideway Tunnel has been explored through two tests. First, an integrated "whole Tideway" assessment is presented, in which the cost of completing the Lee Tunnel is added to the existing analysis to explore the economic case for the two tunnels as a package. Secondly, a notional 40% reduction in aggregate benefits for the Thames Tideway Tunnel taken in isolation, to account for the Lee Tunnel on a similar basis as used in the 2011 update. The 40% proportion was based on the CSO tonnage handled by the Lee Tunnel but did not relate to any cross-Tideway change in specific variables on which WTP was actually based (i.e. fish impacts, sewage litter, or adverse health outcomes).

It should be noted that neither of these two tests is judged appropriate as a current "central" assessment. The "whole Tideway" analysis involves some "sunk costs" – those about which decisions can no longer be made - in relation to the Lee Tunnel, so it does not constitute a true forward-looking appraisal which could be used to inform decisions now. The "40% reduction" analysis, whilst used as a central assessment in 2011, has been shown by Eftec (2015) to be overly conservative when the impact of the Lee Tunnel specifically on variables affecting WTP in the original survey is considered.

Sensitivity Test 1: "Whole Tideway" Assessment

Supposing the estimated benefits of £7.4bn-£12.7bn relate not just to the Thames Tideway Tunnel but also to the Lee Tunnel, one way of accounting for this would be to present a cost-benefit analysis where this level of benefit is weighed against the combined cost of delivering the two tunnels.

The current estimate of Lee Tunnel construction is £635m. To account for finance and operational costs over a 120 year life (consistent with the Thames Tunnel estimates), this cost is uplifted by 6.8% which is the equivalent proportion observed in the Thames Tunnel estimate. This leads to a "whole life cost" estimate of the Lee Tunnel of £678m.

Adding this cost to the £4.098bn estimated for the Thames Tideway Tunnel alone, leads to a "whole Tideway" cost of £4.776bn. When divided into the estimated benefits of £7.4bn-

£12.7bn, this leads to a revised benefit-cost ratio range of 1.5-2.7:1. The two tunnels combined are therefore robustly cost-beneficial (i.e. the ratio exceeds 1:1).

Sensitivity Test 2: 40% benefits reduction

If the aggregate benefit of £7.4bn-£12.7bn estimated for the Thames Tideway Tunnel in the main body of this note is reduced by a notional 40% to mirror the approach taken in the 2011 update, this leads to a revised range of £4.4bn-£7.6bn. Given the estimated cost of £4.098bn, this leads to a revised benefit-cost ratio range of 1.1-1.91:1. Even under this now very conservative adjustment therefore, the tunnel remains cost-beneficial (i.e. the ratio exceeds 1:1).

Conclusion of sensitivity tests

Under Test 1, the wider economic case for the Lee and Thames Tunnels combined is shown to be robust. Under Test 2, even applying the highly conservative 40% reduction in benefit assumed in the 2011 assessment (prior to Eftec's more considered view of the new baseline), the Thames Tideway Tunnel remains cost-beneficial when viewed as a stand-alone project.