FINANCING WATER QUALITY MANAGEMENT AND INVESTMENT IN INFRASTRUCTURE

A public-private approach to delivering major water quality infrastructure in the face of high costs and exceptional project risks: The Thames Tideway Tunnel "super sewer", UK

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National water quality context and main challenges, including the costs of water pollution

England is a developed and mostly post-industrial society with associated water quality issues. Former problems of water pollution from point sources such as factories and other industrial activity have declined through both structural change in the economy and effective regulation. That said, legacy water quality problems from industrialisation include persistent pollution from old mine workings (now managed through public investment in the absence of historic polluters), and morphological alteration to waterbodies as a result of human activity (such as navigation, use of water for power, flood defence activity etc.).

The most significant modern water quality problem is "diffuse" pollution which is difficult to attribute to specific sources. This arises in both rural and urban areas. In the former, agriculture and rural land management collectively causes pollution to waterbodies from runoff of pesticides, nitrates, sediment, organic material etc. In urban areas, a range of substances from silt and sewage overflow to metals and chemicals typically pollute the urban water environment, which is also often characterised as heavily modified from nature in terms of morphology. This can make the water environment unattractive to those living in urban areas, with many waterbodies in towns and cities suffering from legacy modifications reflecting earlier economic uses and pollution.

Population and economic growth contribute to pollution. Growth in urban areas has increased pressure on sewerage systems which risk more frequent overflow. Vibrant urban development activity increases the likelihood of drainage systems being misconnected, with sewage ending up in places where it shouldn't. Similarly, historic policies such as agricultural subsidy frameworks and land use planning systems have contributed to water quality pressures.

Water quality is improving, however, through regulation and investment. Since 2010, water utilities have invested around £3.5bn in improving the water environment. Although 19% of surface waters currently meet "good" or better ecological status as defined in the EU Water Framework Directive, this status involves meeting all of a number of sub-elements such as fish, plant life and water chemistry. When considering those underlying elements individually, some 83% achieve good or better status.

The economic cost of water pollution in England is difficult to estimate, though a 2010 report by the National Audit Office put the cumulative cost of water pollution at between £700m and 1.3bn per annum (NAO 2010). More recent work to assess the costs and benefits of options to deliver the Water Framework Directive suggests that the benefit from preventing deterioration and improving the water environment where technically feasible amounts to around £23bn (Environment Agency 2015).

National policy responses to manage water quality

Point-source pollution has historically been tackled through a framework of regulation implemented by Her Majesty's Inspectorate of Pollution and now the Environment Agency, which is mature. Since 2000, England as part of the UK has adopted an approach set out in the EU Water Framework Directive (WFD) which involves plans to improve the water environment, and prevent deterioration, in each of ten River Basin Districts. Over the 2015-21 period, improvements worth £3.7bn are being implemented across a variety of sectors, with 14.5% of waterbodies expected to see some improvements in at least one quality element. The WFD brings together the management of water quality (including bathing and shellfish waters) with water abstraction and flood management. To be fully successful, this involves strong collaboration both across water management sectors and across stakeholders, and the rational geography for managing such complex interactions is the rural or urban catchment or watershed. English water management is, in principle, built on the internationally recognised practice of Integrated Water Resource Management.

In practice, developing a fully collaborative catchment-based approach to water management has taken time, and is ongoing, but in recent years the Department for Environment, Food and Rural Affairs (Defra) has sought to accelerate the development of a governance framework to deliver true collaborative catchment-based management. Alongside this, it has provided public funding for rural and urban water improvement measures, and worked with the economic regulator of the privatised water utility sector (the Water Services Regulatory Authority or Ofwat) to ensure the water services sector plays a full part in improving the water environment and preventing deterioration. Defra and the Environment Agency also regulate agriculture and provide support to help farmers meet their requirements and improve the water environment.

Case study of innovative water quality policy instrument

Project/Policy Overview

This case study focuses on an innovative approach used to tackle a major diffuse pollution problem in the urban agglomeration of London. The city has evolved organically over many centuries, and so have its drainage and sewerage systems. By the 19th century, earlier informal drainage ditches and open sewers (often based on pre-existing watercourses such as tributaries to the River Thames) had been formed into systems of pipes, culverts, and other waterways which all drained down to the Thames. Sewage entered the tidal River Thames (the "Tideway") untreated, and by the middle of the 19th century, economic and population growth had caused a major problem for water quality in the river. This was not helped by a very slow net flow of material out to sea due to the tidal cycle. Cholera was causing significant numbers of deaths in the city. The infamous "Great Stink" of summer 1858 finally prompted Parliament (based right by the river) to do something, and the engineer Joseph Bazalgette was commissioned to construct two major sewer systems. Broadly speaking, one intercepted all the sewage outfalls on the north bank of the river and one did the same for the equivalent southern "catchment". Each interceptor sewer took sewage to special outfalls several miles downstream of the city in the Thames Estuary. The combined system was constructed over the period 1859-75 when the population of London was around 4 million people.

With progressive enhancement to treatment facilities over the years – including the building of one of Europe's largest sewage treatment works at Beckton on the north bank – the Bazalgette system has served London very well since its construction. By the late 20th century however, economic and population growth was again starting to threaten water quality in the Thames, ironically offsetting a period where the decline of heavy industry on the river had greatly improved it. Now serving a population of around 8 million people, the capacity of the Bazalgette system was starting to be exceeded, meaning that the 57 designed-in Sewer Overflow "safety valves" were starting to discharge after heavy rainfall. This occurs because the

London sewerage system is “combined” – that is, it handles foul and surface water together. By 2010, an annual average of 39 million tonnes of sewage was being emitted from these Combined Sewer Overflows straight into the Tideway. A Combined Sewer Overflow in central London is shown in **Figure 1**.

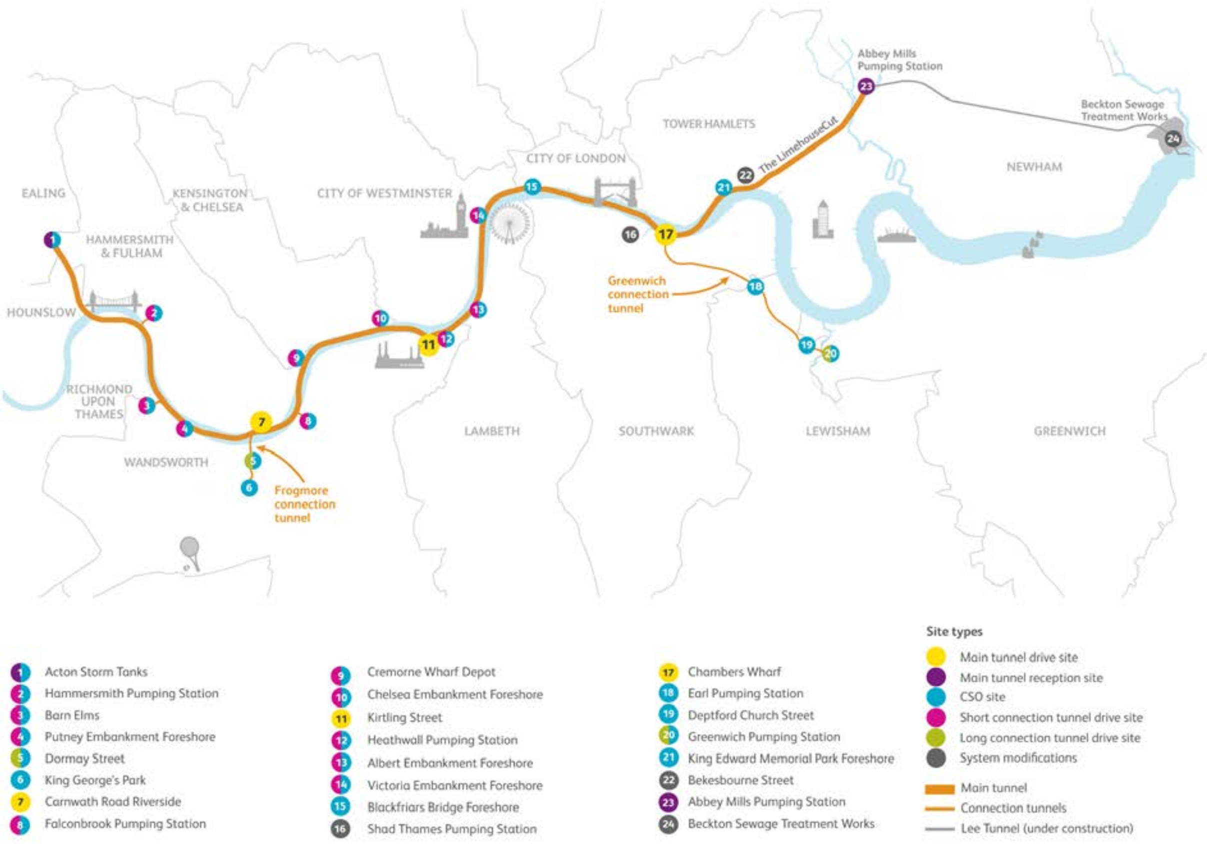
Figure 1 Combined Sewer Overflow on the Thames Tideway (courtesy Thames Water)

In 2001, the water utility (Thames Water), local and national government and regulators the Environment Agency and Ofwat commenced a joint Thames Tideway Strategic Study (TTSS) to consider options to tackle CSOs, increasingly causing adverse amenity, ecological and health impacts. The study reported in 2005 (Thames Tideway Strategic Study, 2005). The most economic feasible solution was to build a new tunnel, under the bed of the Thames, to intercept the overflows from the CSOs, taking material down to the Beckton sewage treatment works for processing. Other options such as widespread introduction of Sustainable Drainage Systems to deal with surface water runoff, and constructing a new separate drainage network for surface water (in both cases, to release pressure on the main combined network) were considered but found to be too costly and/or not feasible. In-river solutions to deal with CSO pollution once it had entered the Tideway (such as skimmer vessels and oxygen bubbling) were also considered and although not found satisfactory as a long-term solution, have been employed on a limited scale to mitigate the worst impacts pending a more permanent solution.

Economic cost-benefit analysis supported the Thames Tideway Tunnel (TTT) option – the latest iteration of this analysis estimates welfare benefits of £7.4-12.7 billon for a whole-life project cost of £4.1bn (Defra 2015, Eftec 2015). However, a fundamental difficulty was delivery – the project would be the largest civil engineering undertaking in the UK water industry, and the project cost was a significant proportion of the capitalised value of the utility company, Thames Water. The project was novel for the sector, involving major tunnelling work under one of the world’s most complex cities. The project’s risk profile was high when compared to that of the utility company which would have meant there was a lack of ability to secure finance for the project through the normal capital markets at something approaching a reasonable cost for its customers.

In response to these difficulties, the government, Ofwat and Thames Water worked together to put in place an innovative public-private arrangement to enable risks to be managed and underwritten to the point that the private capital markets were prepared to finance the project on reasonable terms. In turn, this protected the interests of customers (who ultimately might bear significant project risks and, as a worst case, the implications of the utility company failing), and has enabled the project to proceed. On 24 August 2015, a consortium of investors forming a special purpose vehicle, fittingly named Bazalgette Tunnel Ltd, received its licence from Ofwat to start constructing the project. The consortium includes a range of investors not associated with Thames Water or indeed other water utilities, comprising insurance company Allianz, Amber Infrastructure Group, Dalmore Capital and DIF. A map of the future tunnel is provided in **Figure 2**.

Figure 2 The Thames Tideway Tunnel (courtesy Thames Water)



Reasoning for reform and the introduction of the instrument

Fundamentally, the inability of Thames Water to be able to finance the major Tideway Tunnel project under its normal business model reflected a particular combination of risks, including prioritisation of its core service to its customers.

The unprecedented scale and complexity of the project in the UK water sector and presence of certain unique and exceptional risks associated with tunnelling in specific parts of London, tended to inflate the cost of borrowing. At the same time, because of the way Thames Water was regulated and licensed, it was the only party able to approach the markets for finance to construct an asset in its operating area, but it did so bringing a significant day-to-day regulated business – supplying 8.8 million customers with water services and 14 million customers with wastewater services. Lack of separation of the new tunnel project from the existing business placed very severe constraints on the ability to lend given Thames Water's existing levels of debt.

These particular issues, ultimately affecting the financeability and deliverability of the tunnel, led to two policy interventions: first, a risk-sharing agreement between the private sector and the government, and secondly a modified institutional arrangement for exceptional major projects. To a large extent, these interventions were designed simultaneously (albeit iteratively), but for simplicity, each is considered in turn in the next section.

Policy instrument design

Public-private risk-sharing model

The key principle behind developing a risk-sharing model for the Thames Tideway Tunnel was that different parties have different capacities efficiently to mitigate and absorb different risks, which in turn affects financing costs and ultimately the ability to complete a project. The private sector is best placed to manage most project delivery and construction risks, but is not easily able to absorb some of the unique and exceptional risks which are conceivable when considering the TTT. Whilst very low probability, such risks (for example, catastrophic scenarios such as flooding the London Underground or causing the collapse of significant public and other buildings through tunnelling works) are very high consequence and are not easily insurable. This significantly affects private funders' appetite to provide capital or, at best, materially increases the risk premium they would attach to such funding. Although tunnelling in London is not a new enterprise, much previous tunnelling work has been for transport and utility projects which have been publically funded.

A novel **Government Support Package** (GSP) for the TTT project was constructed, which provided contingent public financial support under very specific circumstances. The GSP is provided for a fee and has five "limbs":

- *Supplemental compensation agreement (SCA):* Government provides an insurance facility to the project for cover above the limits of commercial insurance, including if commercial insurance were available at the beginning of the project but subsequently becomes unavailable.

- *Contingent equity support agreement (CESA):* if the costs of completing the Tunnel are forecast to escalate beyond a specified point (the "Threshold Outturn") the project would have the option of requesting that Government make an injection of equity to allow it to be completed. If Government receives such a request it is committed to provide this equity, subject to its right to discontinue the Project (see below).

- *Market disruption facility (MDF):* in the event that the project is unable to access debt capital markets as a result of a sustained period of disruption in these markets, Government would provide temporary liquidity.

- *Special administration offer agreement (SAOA):* if the provider should go into Special Administration and not have exited after 18 months, Government commits either to make on offer to purchase the provider (at a price at its discretion) or to discontinue.

- *Discontinuation agreement (DA):* Government will have the right to discontinue in a number of circumstances, in particular, in the event that costs of completing the Tunnel are predicted to escalate beyond the Threshold Outturn and the project requests an injection of equity from Government or if insurance claims exceed a specified amount. Where Government opts to discontinue the Project it commits to paying compensation to existing equity and debt investors. This limb of the GSP acts to ensure that Government does not assume unlimited liabilities.

Institutional arrangements

As well as inherent project risk, the simultaneous difficulty of delivering the major Thames Tideway Tunnel project under the existing regulatory model for the privatised water sector in England and Wales prompted a policy project to consider new institutional structures for major projects. Options considered included various models whereby a major project was retained within the existing licensed utility company but with varying degrees of legal and regulatory separation. Ultimately however these options were not found to deliver enough separation of activity to meaningfully affect financeability, or they had implications for the value for money of the Government Support Package.

The outcome of this policy project was new **Specified Infrastructure Project Regulations (SIPR)** introduced by the UK government in 2013 following the Flood and Water Management Act 2010. Under these regulations, water industry projects meeting certain criteria in terms of size and complexity could be "specified", meaning they could be delivered by separate Infrastructure Provider (IP) companies, distinct from the day-to-day utility undertakers. This would enable project risk to be contained and better mitigated by a more dedicated and specialist management, and clearly delineate construction project delivery from water service provision. The Infrastructure Provider structure effectively ring-fences an incumbent water utility from the risk associated with carrying out of major complex infrastructure and to ensure that the utility, in this case Thames Water, is able to continue to deliver its core services.

The terms under which projects could be "specified" were carefully defined, to preserve the well-established arrangements for more routine capital investment in the privatised water sector, which have been highly successful (around £120bn of capital investment has been made by the privatised industry since 1989). Indeed, so far no other projects suitable for "specification" have been identified in the water sector, which highlights the unique and exceptional nature of the Thames Tideway Tunnel. In the case of the TTT, an IP has now been established. The company, Bazalgette Tunnel Ltd, is responsible for the construction, financing and maintaining of the tunnel. Day to day operation of the tunnel, once complete, will be managed by Thames Water.

Project/Policy Outcomes

The simultaneous implementation of the Government Support Package and Specified Infrastructure Project Regulations (which allow adapted regulatory structures) has led to the following outcomes:

- The Thames Tideway Tunnel project – highly socially worthwhile with a Net Present Value of £3.3-8.6 billion – is deliverable at reasonable cost, to the benefit of London's water environment. An Infrastructure Provider and a construction consortium have now both been appointed and construction is proceeding. The final deal for construction of the project involved a very competitive cost of capital. The project cost at Final Business Case stage is £4.1bn. The project would very likely have been undeliverable under a business-as-usual model, though assuming financing was forthcoming, an estimate of "business as usual" cost was around £10bn.

- Costs for water consumers (the ultimate funders of water sector investment) are kept at reasonable levels, and protected in the event of catastrophic risks. As a maximum amount, the TTT will cost an additional £20-25 per customer per annum in the 2020s (in 2014 prices), down from an earlier estimate of a maximum of £70-80 (in 2011 prices).

- Costs to government have been carefully defined only to arise in very specific, low probability circumstances. In the absence of risks materialising, the cost to government is zero, but the presence of the GSP as a "backstop" gives comfort to the private sector and enables efficient private financing.

Lessons learned, challenges with implementation and requisites to make the instrument work

Implementing the GSP and SIPR has involved a concerted policy effort over a number of years. The financial and risk issues have been highly complex, not traditionally part of the Department for Environment's (Defra's) core business, and specialist advice has been essential, as has careful negotiation with private sector parties. This has not been without cost but given the scale of the benefits of the TTT, is assessed to have been worthwhile. Going forward, one operational challenge for government will be to maintain a proportionate "business as usual" monitoring function for TTT construction over a number of years, which could quickly require large-scale resourcing if the risks covered by the GSP actually materialise. This implies certain management and resourcing strategies for the future, but ultimately these low-probability high-consequence scenarios are considered more easily manageable by government than other parties, as discussed above.

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