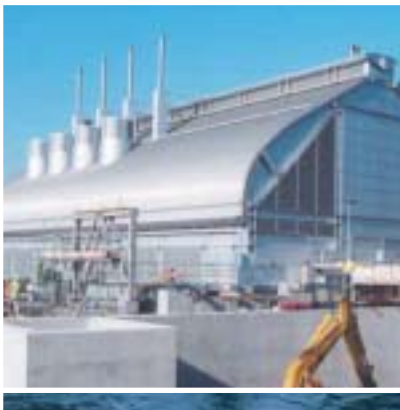
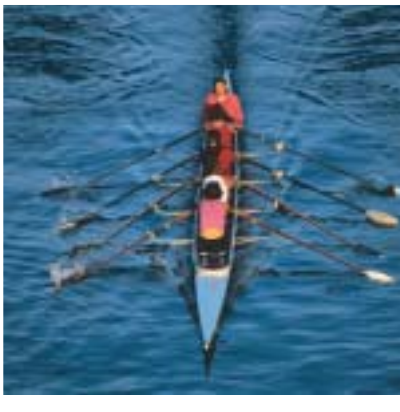
Thames Tideway Strategic Study

Executive Summary

February 2005

Thames Tideway





MAYOR OF LONDON

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Thames Water

RWE Group

Chairman, Chris Binnie

Thames Tideway Strategic Study

It has been my privilege over the past four years to have chaired the Steering Group of this most important study and I am delighted that we can now publish the study reports.

The Thames Tideway Strategic Study investigated the environmental impact of wet weather discharges from 57 Combined Sewer Overflows (CSOs) and found that some discharge storm water and sewage into the River Thames on average once a week. These discharges cause offensive conditions in the river and on the foreshore, result in an elevated health risk to river users, damage the ecology of the river and occasionally kill large numbers of fish.

They occur during periods of moderate to heavy rainfall when the surface water runoff overloads the sewer system. An estimated 20 million cubic metres of untreated sewage is discharged to the river every year.

An enormous amount of work has been undertaken looking into every aspect of these CSO storm discharges to the Tideway: the causes, the impacts, the legal and policy frameworks, the possible solutions and the cost-benefit aspects. We have needed to extend our initial timetable of three years to allow for the reports to be robust and held up to full scrutiny.

I am satisfied that, based on the original remit of the Thames Tideway Strategic Study, this has been achieved and that a 35km long storage-and-transfer tunnel is the preferred solution out of many options considered. The tunnel would run beneath the Thames from Hammersmith in west London and convey the discharges from 36 of the CSOs for collection and treatment at the Crossness sewage works in east London.

Thames Water (who have provided the funding), the Environment Agency, the Department for Environment, Food and Rural Affairs (Defra) and the Greater London Authority have participated in the study; the Office for Water Services (Ofwat) has maintained an observer status. The views of a number of stakeholder groups have also been sought and considered. Now that the study has been completed, the reports have been circulated to Defra and Ofwat and are publicly available.

Given the likely 15-year timescale to deliver the preferred solution and following advice last summer from Government, it has been decided that the study should also consider extending the range of smaller-scale interim measures that could provide some short-term alleviation much sooner than the preferred solution. A separate report on these options and supplementary information concerning the tunnel solution will be produced during 2005.

I sincerely hope that decisions will be made to resolve this unfortunate legacy to London's otherwise superb sewage network designed by the great Victorian engineer, Sir Joseph Bazalgette. Bazalgette's visionary approach of combined sewers that discharge to the Thames during heavy storm rainfall, instead of flooding the streets and properties of London, is today at the root of a problem that many believe is no longer acceptable in the 21st Century.

The remit of the Steering Group does not include the promotion or the delivery of the preferred solution; that is for others to undertake once Ministers and Ofwat have decided on a way forward. I trust therefore that the work of the study will be the starting point for the realisation of the preferred solution.

Readers of these final study documents will recognise the quality of work that has been undertaken and I would like to take this opportunity to praise and to thank all of the many people who have contributed so much over the past four years.

Professor Chris Binnie
Independent Chairman, TTSS Steering Group

Executive Summary

Background

The Thames Tideway Strategic Study was set up, initially as a three-year project, to assess the environmental impact of intermittent discharges of storm sewage on the Thames Tideway, to identify objectives for improvement and to propose potential solutions, having regard to costs and benefits. These sewage discharges are referred to as combined sewer overflows (CSOs) and are derived from London's combined sewerage system, much of which was constructed in the mid-nineteenth century. The system as designed was not intended to convey and retain large quantities of storm sewage, and allowed instead for the large volumes of sewage generated following rainfall to be discharged direct to the river via the CSOs.

Although continuing improvements have been made to the sewerage and treatment service provided for London, the key question is whether these rainfall-derived wastewater discharges are having an adverse environmental effect on the Thames Tideway, and if so, what practicable measures can be taken to reduce this impact.

Legal Issues

Thames Water is the licensed sewerage undertaker for the London area. As such, Thames Water has a duty under the 1991 Water Industry Act to provide and maintain a system of sewers. This duty is enforceable by the Secretary of State and the industry's financial regulator, Ofwat.

In addition to this broad requirement, individual discharges of sewage effluent (both continuous and intermittent) are regulated by the Environment Agency by way of 'consent to discharge'. These consents permit the discharge of sewage effluent and are framed to manage the polluting load discharged, and are the detailed means by which UK and European policies (such as Directives) are implemented.

The Urban Waste Water Treatment Directive (UWWTD) and UK Regulations establish general standards for collecting systems (sewers) and treatment works. Compliance with these requirements is an extension of the duties under the Water Industry Act and is similarly enforceable. Government (DETR, now Defra) has produced guidance in 1997 (to accompany the Regulations) which is the basis for the UK interpretation and implementation of the Directive.

Objectives

The overarching aim of the study (which reflects the overall objective of the UWWTD) is to protect the Thames Tideway from the adverse effects of wastewater discharges. As the Directive sets general requirements, and allows the UK to decide on measures to limit pollution from storm overflows, criteria, in line with the Guidance, have been developed to reflect local needs and benefits to the environment. This leads to three principal objectives:

- To protect the ecology of the Tideway;
- To reduce the aesthetic pollution due to sewage-derived litter; and
- To protect the health of recreational water users.

There are no specific and relevant statutory requirements for water quality of the Thames, although the UWWT Regulations guidance indicates requirements as regards to the limitation of pollution due to litter (aesthetic pollution). It was therefore necessary for the study to establish appropriate water quality standards in anticipation of the Water Framework Directive (WFD), which has similar aims in terms of protecting the ecology.

A specially commissioned study of fish responses to low dissolved oxygen exposure has reinforced some empirical standards based on existing water quality data. These have been used in association with water quality models to estimate an allowable pollution load and support sustainable fish populations.

WHO standards have been used to define a bacteriological threshold above which water users are exposed to 'possible health risk'. This threshold is breached following CSO discharges giving rise to approximately 120 days

of possible health risk per year. The objective for any engineering solution is to reduce, or ideally eliminate these 'health risk days' due to the storm sewage discharges.

The study has considered these three objectives as a 'package' in developing the preferred solution option, an approach supported by the 'willingness to pay' assessment.

In addition to the principal objectives, the study has also considered related topics, which would impact on such a major sewerage scheme, particularly one with a very long expected lifetime. These include the impact of climate change, alleviation of sewer flooding and population growth.

Existing Situation

The study has established that some overflows operate on a frequent basis (some as often as 60 times per year). On average some 20 million cubic metres of storm sewage are discharged annually from all the CSOs, with some individual discharges in excess of a hundred thousand cubic metres. The large quantities of storm sewage containing sewage solids and litter can create significant aesthetic impacts in the river, and increase the health risk for recreational users. The discharges also reduce the dissolved oxygen levels in the river, which on occasion has caused fish kills.

These potential impacts were brought into sharp focus by the storm event on the 3rd August 2004. Whilst the rainfall was exceptional, the substantial fish kill and aesthetic pollution resulted in unprecedented media attention and has entirely justified the existence and efforts of the study.

On behalf of the study, the Environment Agency has assessed the relative contributions of the 57 intermittent discharge points and identified that 36 of these are 'unsatisfactory' in terms of frequency of discharge and/or environmental impact. These 36 comprise the vast majority of the polluting load discharged to the Tideway, and are spatially distributed along its entire length.

The assessment of the operation of the discharges, together with a review of the requirements of the UWWT Regulations and guidance, has raised concerns that substantial parts of the collecting system and some receiving treatment works may not fully meet the requirements of the UWWTD, and associated Regulations. This issue is being considered by Government, taking into account the flexibility allowed by the Guidance and London's specific requirements.

This issue of compliance does not impact on the environmental objectives of the study, or the possible solutions identified, but would determine if action is mandatory and may influence any delivery timescale.

Potential Strategies

A number of intervention strategies and solutions have been evaluated, namely:

1. Adoption of source control and sustainable urban drainage;
2. Separation of foul and surface drainage and local storage;
3. Screening, storage or treatment at the discharge point to river; and
4. In-river treatment.

The only practicable strategy to fully meet all environmental objectives is the interception of the overflows before they meet the river, identified as strategy 3 above. Strategies 1 & 2 were assessed and discounted as either not practicable or not effective as a 'total' solution. Strategy 4 can only meet some objectives, but is expected to continue to play a role in respect of short-term measures.

Solution Options

A selection of possible scheme options has been assessed, but the preferred solution is a large diameter storage-and-transfer tunnel, with a limited rate of pump-out known as Option A (ref). This tunnel would run from Hammersmith in the west, largely under the river, to Crossness Sewage Treatment Works (STW) where a dedicated plant to handle the storm flows can be built to augment the biological treatment capacity. A link tunnel to Beckton STW is also envisaged. The flexibility that this offers will permit the maximum proportion of storm flows to be fully treated.

The proposed tunnel will be of 7.2m diameter and provide approximately 1.5 million m^3 of storage capacity; this will not preclude sewage discharges being made from the existing 36 locations at times of exceptional rainfall, but the tunnel is sized that these exceptional overflows will only occur on such a limited basis (approximately once per year) that compliance with the proposed quality standards is not threatened or compromised. If required, additional storage can be added at a future date (for instance to mitigate the impact of Climate Change) by the construction of lateral storage tanks.

The remaining discharges will continue as present, as they do not have a significant impact.

Cost Benefit Analysis

A comprehensive costs benefit analysis has been undertaken, supported by three separate studies. These comprised a stated preference survey of 1,214 Thames Water customers to evaluate the non-market benefits of the different solutions expressed through respondents' willingness-to-pay for the various environmental improvements the solutions would bring; an environmental costs desk study to evaluate the non-market environmental costs attributable to each solution; and a market benefits study to identify any benefits arising from the solutions that currently have a market value.

The cost benefit analysis revealed that a storage-and-transfer tunnel option, combined with improvements at the STWs, had the highest net benefits. Subsequent sensitivity testing and switching analysis demonstrated that, even though there is uncertainty around some of the assumptions underlying the Cost Benefit Analysis, the benefits would have to drop to a quarter of those assessed to change the conclusion that the net benefits are positive. A further assessment of the refined solution (Option A(ref)) has subsequently been made, and this has confirmed that this remains the most cost beneficial option.

The extent to which respondents understood the stated preference questionnaire has also subsequently been examined. The responses from this smaller scale study largely confirmed these outcomes in that, although some respondents considered the original willingness-to-pay as somewhat high, the amount that respondents were willing to pay for the Tideway improvements was of a similar order to the expected impact on bills.

In response to concerns regarding the wider context of any surveys, further work is anticipated to establish the possible costs in the context of other investment priorities both for water and environmental improvements and wider societal issues.

Environmental and Social Outcomes

The environmental outcomes clearly reflect the objectives, and are a result of a reduction of the quantity of untreated and partially treated sewage discharged to the river after completion of the preferred solution.

Specific outcomes will be: the prevention of major falls of dissolved oxygen - this benefits all the acute risk of fish kills and the chronic impacts on behaviour, which will enhance the sustainability of fish populations; the reduction in the quantities of pathogenic organisms - this will reduce the potential health risk to recreational water users; and a substantial reduction in the amount of sewage-derived litter deposited on the foreshore and in the river - so avoiding potential health risk and aesthetic nuisance, and supporting public enjoyment of the river.

There is expected to be scope to reduce the extent of risk of sewer flooding under some circumstances.

The project will have benefits and impacts on the development of the Thames Gateway, as the reduction of river pollution will enhance the wider environment of the Gateway development. However, it will also involve the treatment and disposal of the tunnel discharge at the Crossness sewage treatment works and this will need to be sensitively implemented alongside the future sewage treatment needs of the Thames Gateway development. The Strategic Planning Authority (GLA) sits on the Steering Group and is, in principle, supportive of the scheme.

It is clear that full implementation will take many years for the preferred technical option. It is highly desirable to initiate some shorter-term measures, if practicable and effective, to reduce the risk of fish kills and limit the extent of aesthetic pollution due to sewage derived litter.

There will, however, be some adverse impacts of the preferred solution; some may be short term, such as disruption and nuisance during the construction phase; others will be longer term such as the additional greenhouse gas emissions from power use and treatment. A major social issue will be the cost, which will be a significant increase in water bills for many years.

Costs

The capital cost of construction of the preferred option (tunnel and the associated treatment facilities) is estimated at £1.5 billion (thousand million), with an annual operating cost of £3.2 million (at 2002/3 prices). This estimate becomes £1.7 billion at 2004 prices.

Provision of additional treatment capacity and improvements to the treatment standards of several sewage treatment works on the Thames Tideway have been confirmed in Thames Water's final determination of price limits for 2005 and beyond.

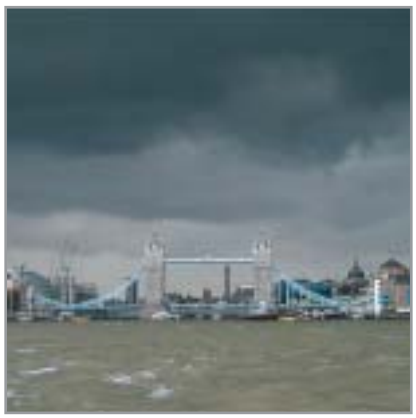
Impact on Customers' Bills

On completion, the average annual sewerage bill is estimated to rise by between £40 and £45 (at 2002-03 prices) over the level it would otherwise reach were the Tideway project not to be implemented. The majority of this increase will take effect steadily over the expected eight to ten year construction period. In the context of the expected 'average water and sewerage bill' by 2009/10 of £261, it would represent a rise of some 17% to over £300.

Timetable for Delivery

Any major tunnel option would be a substantial undertaking and is expected to require at minimum another 5 years of pre-construction planning, promotion and land acquisition etc. Construction time will depend on the final design but is estimated at about 8 years, – and a realistic delivery timescale could be some 15 years from approval. If, for example, approval were given in 2005, this would suggest completion in 2020, assuming there is no unforeseen planning delay.

The scale of treatment works is also a major undertaking, but Thames Water believes that these can be largely completed by 2013.



Risks

The study has identified many of the potential risks to successful delivery of the proposed solution, and these fall under four main headings: Planning, Environmental, Engineering and Financial. Further work is in hand to quantify some of these risks and this will be the subject of a supplementary report, expected later in 2005.

Planning

The biggest uncertainty remains the planning risk, and whether the scheme has to be approved following a public inquiry. This could clearly introduce delays beyond the control of Thames Water and its contractors.

Environmental

The environmental risks are that the assumptions regarding (for example) water quality requirements in advance of the Water Framework Directive prove to be insufficiently stringent. Additional improvements would be required to comply with this or other future directives, re-interpretations and revisions, such as obligations arising from the revised Bathing Water Directive. Similarly, the impact of climate change may be to demand that discharges are made less frequently or to a higher quality. The nature of the proposed solution means that these climate change requirements can be accommodated in the future if necessary.

Engineering

Implementation of a major project, such as a 35-km long storage-and-transfer tunnel, is not without risk and challenge, especially in relation to the construction of the interception structures and the proposed depth of the shafts and tunnels. Several studies were carried out by consultants and experts in their field in support of selection and development of the proposed solution to ensure that it is technically robust. Potential risks have been considered throughout the feasibility study and are well documented together with proposals for mitigation. These risks will continue to be reviewed during the detailed design and pre-construction activities.

The ground conditions which may be expected are also well documented. This is not to say that there is no engineering risk, but that at this early stage, the initial concerns have been addressed and contingency included. The considered view is that the engineering risks associated with construction and operation are manageable and within current limits of technology.

Financial

The financial risks are a combination of generic, such as changes to the taxation regime or cost of borrowing, and those specific to the project.

Conclusion

The Thames Tideway Strategic Study has investigated, researched and assessed the operation and environmental impact of wastewater discharges from the collecting system and treatment works on the river. Objectives and possible solutions have been developed which have been subject to cost benefit analysis.

This work indicates that parts of the London collecting and treatment system require improvement to meet one or more of the objectives.

The study has established that the environmental objectives can only be fully met at least-cost by completing both the quality improvements to the treatment works discharges and by provision of a storage-and-transfer tunnel. (Option A ref) .

It is for Government to decide whether the preferred option identified by the study proceeds and at what pace. The Steering Group has received a request for additional investigations to be carried out to inform this decision and to consider smaller scale measures that could bring earlier improvements to the Tideway. This work is underway and will be reported on during 2005.

An outline delivery timetable for the storage-and-transfer tunnel has been developed and confirms that a five-year period of detailed engineering design and planning would be required. Construction could take a further 8-10 years, so overall solution delivery within 15 years is believed feasible.

For enquiries about the Thames Tideway Strategic Study
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