Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

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Thames Tideway Strategic Study

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Supplementary Report to Government - Summary

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Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

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Thames Tideway Strategic Study

Supplementary Report to Government

Thames Tideway

November 2005

Summary

MAYOR OF LONDON OFWAT ENVIRONMENT AGENCY Thames Water RWE GROUP

Contents Page

1. Background

In June 2004, in advance of the publication (in February 2005) of the main reports from the Thames Tideway Strategic Study, a preliminary interim Report to Government was submitted to Ministers outlining the likely content of the main reports. The response from the Department for Environment, Food and Rural Affairs (DEFRA), and further consideration by the Steering Group resulted in this supplementary report. In summary this comprises further investigation of the proposed long-term tunnel solution and of alternative measures including temporary or interim works and some smaller scale tunnel and/or treatment options to deal with the discharge of storm water from Combined Sewer Overflows (CSOs) into the Thames Tideway.

It should be realised that only the preferred tunnel option A(ref) meets all the objectives within the main Tideway study agreed by the steering group. The alternative options achieve various levels of benefit short of this optimum from limited to substantial. This report attempts to compare and rank these in terms of estimated costs and benefits.

In view of the success of the London Olympic bid a number of sub-options focussed on the CSOs on the river Lee close to the games site have also now been considered.

To put the alternative measures into context it has been necessary to highlight a number of features relating to the nature of London's drainage system and the overflows into the Thames that impose limitations on the options available to achieve the objectives. The work reveals that in order to achieve the stated objectives significant additional storage and flexibility of operation is necessary. It is clear that works of a minor nature, although these may be worthwhile, are unlikely to achieve significant improvements on the scale of the target objectives.

The conclusions and recommendations in this report are based on the reports of previous work carried out as part of the Tideway study and its supporting documentation, and a number of investigations undertaken between summer 2004 and the middle of 2005.

2. Findings

2.1. Interim Measures

In addition to the major sewage treatment works extensions and improvements scheduled for 2012/2014, which on completion will address to a large extent the dissolved oxygen requirements, a number of interim measures are currently being assessed and some are to be implemented by Thames Water. Although they may be of limited benefit, they are an immediate attempt to reduce or manage the most harmful effects of the overflow discharges, by helping manage the levels of dissolved oxygen (DO) and removing some of the visible sewage solids from the river.

It is presumed that the existing ameliorative measures, being the provision of two oxygenation barges and some fixed-point hydrogen peroxide dosing plants, will continue as current.
Interim improvement measures are:

- Pending confirmation advice from the Agency, providing a new hydrogen peroxide chemical dosing plant at Crossness STW (sewage treatment works) and reviewing the performance and capacity of up-river peroxide installations to assist in protecting the upper reaches
- Provision of two specialised river craft with screening plant to remove litter including visible/floating sewage solids
- Installation of two additional water quality monitoring stations to ensure optimal use of re-oxygenation measures
- Provision of advice to recreational river users

These measures have some merit pending a more complete longer-term solution but their impact on sewage derived litter and DO is likely to be small and would do little for the ambient background level of health risk in the Thames. Allowing the river to be polluted and then applying remedial measures is not considered, by the EA, to be a satisfactory long-term solution in principle. Their value is that they can be implemented quickly, are targeted to reduce or limit pollution, and are relatively inexpensive. They also show that the bodies responsible for the Tideway are taking some action. The measures are already part of Thames Water's capital programme for delivery by 2010.

2.2. Smaller Scale Measures

The smaller scale measures generally attempt to provide improvements in the Tideway for lower levels of investment, to a shorter timescale and therefore with earlier benefits, than the preferred option A(ref), in the main reports. They either: a) incorporate a lower storage capacity; b) intercept and convey for treatment overflows from fewer CSOs; or c) involve a lower level process, such as primary treatment, or screening.

a) Smaller Storage Tunnel

Several smaller tunnel options including a review of option H (see main reports 0205), and H+, two new options dealing with the CSOs on the river Lee close to the site of the Olympic games, and a larger composite option H++ have also been considered. They provide various levels of benefit and an attempt has been made to compare these with one another and the earlier options evaluated by the Solutions Group. None fully meets the objectives developed by the Steering Group, and all appear to be less cost-effective overall than the preferred option A(ref), especially if extending them to fully meet the objectives were to be carried out later. All would still allow some level of pollution throughout the length of the river due to tidal effects although some reaches would be improved compared with the current situation.

b) Treatment Plant at Abbey Mills

Storm flows pumped to the river Lee at Abbey Mills represent a significant proportion (about 50%) of the total overflows into the Tideway and discharges could receive enhanced primary treatment to reduce polluting load. This could only be by filtration as bacteriological processes cannot treat intermittent flows, and the limited reduction in BOD load afforded by the treatment plant would not fully achieve the DO objectives. A measure of storage would be required to balance flows to facilitate operation of the plant. Overflows (e.g. during unusual storms) would still occur but pollution is expected to be limited through the application of enhanced primary treatment to most of the overflow discharge.

Such plant would present a serious operational challenge and successful automated functionality could be hard to achieve. This might necessitate manual intervention at the site, which would have significant resource and cost implications.

The estimate of approximately £400M would be more expensive than connecting Abbey Mills flows to the preferred main tunnel option A(ref).

c) Screening Plant where Feasible

It has been established earlier that building screening plant at most CSO locations is not practical. There are a few sites where it could be technically possible to install screening plant. The five most viable sites could be screened at a cost estimated to be over £600M, which is higher than the smaller partial tunnel solutions of option H. Provision of such screening plant could remove screenable solids from some 16% of the total discharge from all the Tideway CSOs. The other CSOs would continue to discharge and tidal effects would carry sewage to other parts of the river largely masking any improvement. Screening a limited number of overflows would partially address only one of the objectives (i.e. the removal of sewage-derived litter). There would be little or no improvement in the levels DO or of public health risk.

Screening large gravity CSOs presents major operational challenges not least because no forward flow is available during storm events creating major storage problems. Pumping through the screens would generally be required to avoid increased flood risk. Experience suggests that this would cause much screenable sewage solid matter to pass through the screens leaving plumes of organic pollution slicks. Of all the technical processes, which have been evaluated through the study, major automated mechanical screening plants on remote sites have now been shown to be limited in their effectiveness and in central London would be disproportionately so costly that more effective and beneficial storage arrangements could be provided at a cost comparable to the equivalent level of screening.

d) Dispersed Storage Units

Providing storage in a dispersed or fragmented manner throughout the sewerage system has the advantage of providing some early benefits but this is outweighed by a longer overall delivery timescale and greater cost. It would be considerably more disruptive and at least five times the volume of storage would have to be provided to cater for the range of storm events because of the spatial distribution of rainfall and the response times of the system. The budget cost is likely to be more than £10bn.

e) Application of Sustainable Drainage Systems (SuDS)

Because London's catchments are densely urbanised, widespread retrofitting of SuDS techniques would be disruptive, costly and technically difficult as insufficient land is available. Due to system constraints, open storage features would not hold clean rainwater but combined storm sewage. The few installations of this type that do exist are already subject to public complaints. To prevent this would entail a large degree of separation to be carried out in conjunction with the attenuation tanks. Implementing SuDS via redevelopment would take decades to have significant impact on CSO discharges.

f) Separation of Sewerage system

As the root cause of the CSO pollution problem is surface water combined with foul sewage flows, separating the two is an obvious potential option for consideration. This could be achieved by having the existing sewers deal only with surface water and installing a completely new foul system. Disruption would be enormous involving construction work in potentially every road in London and the modification of the drainage system for virtually every property. The minimum cost would be £12bn at current rates and an overall cost of £20bn could be possible. Such works would need to be phased over several decades.

g) Trade Effluent Control of Fats and Grease

The accumulation and discharge of fats and grease from the CSOs is a minor, though visible and objectionable, component of pollution. Apart from some specific, managed industrial sources most grease and fat in central London comes from domestic premises not covered by trade effluent regulations. Even total removal of fats and grease from the system would only offer a minor reduction in pollution. Control at source may be of some benefit as a small-scale measure to reduce the aesthetically objectionable matter discharged pending a more complete solution.

DOMESTIC OPTIONS

h) Removal of Sewage Litter at Source (Bag-it and Bin-it)

Since 28 July 2005 the Thames Water website has provided information on how to be a "sewer blockage buster". However, water industry experience of bag and bin it campaigns shows little success in significantly reducing sewage-derived litter. To be of some merit a positive and sustained public response would be needed to enable it to be considered as part of a more complete solution. Previous experience shows that such a response is unlikely and also this option would have no effect in reducing the impact on DO and public health risk.

i) Water Butts

This option offers a minor potential contribution to reducing the amount of rainwater run-off entering the sewerage system. These small tanks only catch rainwater from roofs and could never achieve more than a vary small reduction in discharge even if fitted universally. Currently Thames Water encourages the use of water butts, but to store water and avoid shortages. Used this way butts probably would be full and thus useless when rain fell.

j) Other Domestic Options

Grass roofs, composting toilets and reed-beds with domestic small-scale sewage treatment and reuse of grey water in theory might help, but most of the surface water that causes the significant overflows in London comes from ground level paved areas like roads. There is no certainty that such features would be adopted or maintained, and in any case, Thames would remain responsible for providing effectual drainage.

2.3. Integrated Options and Phased Implementation

The partial options individually have notably less impact than the preferred option A(ref). Although combined options such as H+ and H++ give a higher level of benefit than option H, this is achieved at significantly greater cost. At first sight using some smaller scale options such as source control and SuDs, localised screening or treatment and even a domestic element in optimum localities could produce an “integrated” solution in order to increase the chances of success by not depending on a centralised facility.

However, the research done to date has produced several powerful arguments against this approach.

Screening CSOs locally has been shown to be likely to be impracticable and have limited effect. All the substantial benefits identified from remediation so far are associated with storage options. The two key factors in providing such options are: the location of the storage and the return of flows to treatment.

Centralised storage serves all events anywhere in the catchment. If dispersed, a much larger volumes of storage would have to be provided to achieve the same effect. Although a number of smaller tanks distributed through the network could be built in a shorter timeframe to provide some minor benefits early, a total solution using this method would cost much more and take much longer to deliver overall. The volume required in this way could rise to 8 million m^3 and the spatial distribution of rainfall means that for most localised storm events much of this would not be utilised.

Modelling shows that attenuation in the whole network means that a given volume of storage provided locally to reduce run-off would not be passed on as an equivalent reduction in discharge from the CSOs and cost savings by making the tunnel slightly smaller are also likely to be quite small.

There is little surplus capacity anywhere in the system. Unless flows are returned for treatment near the east London STWs, the lack of network capacity would merely cause overflows elsewhere.

These factors strongly support the provision of a centralised storage solution with an outfall near the east London STW facilities.

The smaller scale measures could be phased as a series of partial solutions and delivered incrementally to build up the level of benefits achievable. As this is attempted the cost quickly escalates. It is considered that any combination of smaller scale options equal in value to the proposed tunnel option A(ref) would not achieve comparable improvements.

Any smaller measures applied to only part of the Tideway, for example option H, may be undermined by the tidal nature of the Thames. Since partial solutions do not catch all the

CSOs, which have been assessed as having an environmental impact, overflows would continue and impacts may occur elsewhere in the river because of the 15km tidal excursion. This may be particularly noticeable in the summer if a major storm follows a long dry spell and a large load of sewage solids overflows into the Thames especially at periods of low flow. The west London option(s) could limit the effects of this from reaching the upper part of the Tideway.

The preferred option A(ref) could be implemented in phases. There are two options for phased implementation: sequentially and in parallel

i) The tunnel could be constructed sequentially in sections to spread the cost over a longer period. A three-stage implementation increases the cost by just over £250M and could delay overall completion to 2030 or even later.

ii) The sections of the tunnel could be constructed in parallel. There would be additional costs of approximately £70M but delivery could be brought forward by over a year.

This approach could help to reduce the concerns over the length of time taken for complete implementation and could also be applied to the combined options.

The order of construction could be influenced by the 2012 Olympic Games and options 1 and 2 are suitable modifications to the method of implementing the Tideway storage solution considered to prioritise improvements to the river Lee close to the games' site. Although the impact of these options alone on the whole Tideway would be limited, the impact on the Lee would be significant and greatly improve water quality in and around the site of the games. Such options could form the first part of a complete Tideway solution to be completed later.

To achieve this partial solution in time for the games would entail an early start in 2006. Given the known difficulties of obtaining necessary planning approvals this approach has to be considered as a high-risk strategy, and it will be difficult to guarantee delivery to the required timescale.

2.4. Update on Continued Investigations

a) STW Upgrades

Certain issues and risks around the likely ability of the works upgrades to cope with returned flows and increased sludge have been reviewed. The project risk register and contingency sums have been modified to provide more reliability that these risks can be accommodated and cost variations met for a range of potential forecast values.

b) Impact of Non-Connected CSOs

Prioritisation of the CSOs by the EA reduced the number to be intercepted from the active 57 to the 36 with highest priority. The remaining 21 cannot be practically screened and the design, compliance testing and forecasts of improved water quality all indicate no action is required as they do not operate frequently or cause an adverse ecological impact.

c) Average Annual Volumes Discharged

In February 2005 the Steering Group Report stated that the average annual discharges of storm sewage into the Tideway were typically 20 million m^3. Recently published figures have been much larger but these include STW discharges omitted from the earlier figure. Updated modelling has also shown the earlier figure to be an underestimate. Thus a more accurate figure for the total annual overflow discharges is nearer 50 million m^3. It is estimated that 32 million m^3 is discharged from the CSOs, and 20 million m^3 from the sewage treatment works. Work is in hand at Beckton, Crossness and Mogden to significantly reduce overflow discharges from the works. The revised estimate has no bearing on the calculations for the size and forecast performance of the preferred option A(ref) where figures for actual rainfall events were used. The modelled design figures are not influenced by observed discharges and remain unchanged.

d) Similar Projects Elsewhere

A number of other projects worldwide have been considered and it is evident that interception, storage and return to treatment solutions have been adopted in a number of other places both in the UK and internationally. Screening and dedicated storm treatment installations are not much used. Storage is sometimes combined with a range of other measures such as rainfall rerouting, real time control, and SuDs. The main Tideway investigations have shown the limitations of using such techniques in Central London.

2.5. Current Tunnel Proposal Aspects

Clarification of several issues associated with the preferred storage tunnel option A(ref) was requested. Many of these issues had already been investigated and were contained in the detail of existing reports or were under continuing investigation.

a) Sustainability and Environmental Issues

The newly proposed pumping station and treatment plants would consume approximately 11GWhrs of energy per year. To offset this energy requirement three potential options for the utilisation of renewable energy have been identified. These are wind generators, bio fuels and sludge incineration. Dependent upon optimisation of the existing Sludge Powered Generators (SPG) it should be possible to exceed the energy sustainability requirement of 10%.

Disposal of the tunnel spoil could have environmental implications should landfill be unavoidable; however the vast majority of the material will have a significant reuse value. The key issue is timing, synchronising with other significant projects that may require or be able to utilise the surplus material to be disposed of. The proposed Thames Gateway development and flood improvements give reason to be optimistic. Possible contamination of the aquifer is potentially more serious either during construction or from leakage from stored storm water during operation, but these risks can be largely avoided.

b) Interception Shafts

Further investigations have shown that the Interception shafts represent a lower area of risk than previously thought although they present a range of potential challenges both above and below ground. Many unavoidable shaft locations are sensitive and the depth presents a number of technical issues for which specialised techniques have been included and the cost estimate and contingency suitably updated. All the interception shaft sites have been studied and outline plans and layouts prepared. All were found to be feasible although for several sites alternatives were prepared should problems arise. Three of the shafts need to be sunk in the river and the PLA have agreed to this in principle.

c) Construction Overrun

The potential costs associated with construction overrun should problems be encountered are covered by the contingency sum allowed. The average cost of delay would be approximately £1m per month to cover site establishment and management. Obviously there may be other costs related to the resolution of the encountered problem.

d) Risk Assessment

All risk items are subject to review to mitigate their impact, but in particular the top five have been directly addressed. A key example of this being site availability for the main shafts. The recommendation is that these sites be acquired at an early stage. An allowance for this has been made in the Project Plan for Outline design to cover the acquisitions of options to purchase together with completion of acquisition following planning application.

e) Update of the Cost Estimate

All estimated costs were based on the second quarter of 2002 in line with submissions for Asset Management Programme 4 (AMP4) and updated to 2004. Review of the construction indices show an increase of 11.56% to the third quarter of 2004. Applying this factor increases the budget cost for the preferred storage tunnel option A(ref) from £1,527m to £1,699m

f) Reliability of the Cost Estimate

More detailed analysis has shown that the cost estimate compares favourably with similar sized tunnelling projects like the Channel Tunnel Rail Link (CTRL). Several items of risk have now been more reliably costed and the estimate increased. This is balanced by a commensurate reduction in the contingency sum which now stands at a little over 24% overall with a statistical certainty of 75% of avoiding cost overrun. The scale of the project shows that the total cost is relatively insensitive to variations in the volume of storage provided and the unit cost improves significantly as the total volume increases.

g) Land acquisition and planning issues

The issues associated with land acquisition, planning applications and EIA (Environmental Impact Assessment) have been continually reviewed and updated throughout the study. The main issue could be delays due to the planning approval process. The outline programme includes an allowance of 18 months for a public inquiry if called for. One of the key mitigating measures is to acquire the sites for the main shafts by private treaty and avoid compulsory purchase, which might entail a public inquiry. Early acquisition of these sites is a key requirement and requires funding.

h) Traffic congestion issues

It is proposed to service construction of the main storage tunnel by river barge to minimise impact on traffic congestion. The main traffic impact will arise from the construction of the CSO interception structures. The high level review of impact on traffic congestion has been calculated with regard to street works and HGV movements. The impact of traffic congestion has been calculated to be £18M, but by adopting an alternative arrangement for the works at Vauxhall Bridge and Savoy Street it may be possible to further reduce this amount.

i) Combined Use Tunnels

Consideration has been given to combining the sewer tunnel with other major transportation tunnels to maximise economy but none of these has so far proved a realistic option.

3. Conclusions and Recommendations

3.1. Interim Measures

Implementation of the interim measures should be completed by 2010, and the completion of the STW improvements will be in 2012 and 2014. The effectiveness of new peroxide dosing station at Mogden has been monitored through 2005, and investigation of opportunities for effective additional facilities elsewhere along the Tideway will complete shortly

3.2. Smaller Scale Measures

None of the smaller scale measures on their own provides significant benefits. Some proposed combinations of measures could provide significant targeted storage and flexibility of operation, which could go some way towards achieving the objectives. However, for these the cost approaches or exceeds that of the preferred option A(ref) for less overall benefit.

The river Lee option 2 is considered to be the most effective way to improve the state of the river Lee before the Olympic Games in 2012. This scheme would also be able to form the first part of the preferred option A(ref). Construction would have to start in 2006 to be ready in time.

Localised screening plant should generally be avoided as having notably minimal impact and presenting a major operational challenge, which would also apply to a primary treatment facility at Abbey Mills or Heathwall.

The incremental provision of some of the smaller measures could achieve some early benefits pending completion of the preferred option A(ref).

3.3. Phased Implementation

Phasing implementation of the preferred option A(ref) to spread the cost of delivery over a longer period would increase costs by over £200M overall and could delay completion to 2025 or later.

Constructing either the preferred option A(ref) or a combination option in parallel phases is recommended and would enable shorter delivery timescales without excessive extra costs.

3.4. Outline Design

The Project Plan for progressing the preferred option A (ref) through the next stage of outline design, planning application, EIA and land acquisition is detailed is proposed with an estimated cost of £63M.

It is recommended that approval to progress pre-planning work for the preferred option A(ref) be given as soon as possible. It is recommended that funding to progress the project through design, planning and land acquisition be allocated as soon as the decision on the way forward is made.

Consideration should be given to prioritising the eastern section of the chosen option to facilitate environmental improvements in the river Lee.

The recommended outline design stage is a necessary precursor to most of the smaller scale measures as well as option A(ref). Further opportunities to review the strategy and approve or reject continuation before major funds were committed could be:

- at the end of the first year before planning applications are submitted by which time the outline design would be completed and the planning application and EIA issues will be clearer.
- prior to any expenditure for land acquisition
- at the end of year 5, by which time the EIA and public inquiry should be complete and planning approvals granted.

Any delay in the approval from now on would put back the completion date of the preferred option A(ref) or any scheme with significant storage capacity.

For enquiries about the Thames Tideway Strategic Study
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