Upton upon Severn Flood Alleviation Scheme Waterfront Proposals

Introduction

1.1 The EA has been developing a scheme to reduce the risk of flooding in Upton-upon-Severn. The scheme is split into two cells, the Waterfront and New Street. At present the Waterfront is partially defended by temporary defences. Following the flooding of 2007, the EA has made a strategic decision to reduce its reliability on temporary defences. This would increase resilience by, wherever possible, developing a permanent flood defence scheme and reduce the ongoing storage, maintenance and deployment costs associated with temporary barriers.

1.2 Consequently, the Upton-upon-Severn Flood alleviation scheme has been advanced in the programme over other schemes that may have more properties at risk and deliver more in terms of DEFRA Outcome Measures. An extensive option appraisal exercise has been undertaken by the EA’s consultants, Jacobs to define the most acceptable scheme at Upton-upon-Severn. The scheme selected includes a brick faced concrete wall at the Waterfront.

1.3 This report will consider the replacement of a brick faced concrete wall currently proposed by the Self Raising Flood Barrier (SRFB) product for the Waterfront element of the Upton upon Severn Flood Alleviation scheme. The option appraisal work did not consider SRFB as they do not satisfy the need to make defences at Upton-upon-Severn as resilient as possible.

1.4 Aesthetically, the SRFB would cause little or no visual intrusion to the Waterfront, but this report considers the issues surrounding the technical and economic viability of using SRFB.

Construction, Operation and Maintenance of Self Raising Flood Barriers

2.1 The SRFB is constructed from polyester and laminated with Kevlar to protect it against damage by trees and other debris in the river. The centre section is constructed from a PUR-foam core which forms a strong sandwich construction which floats. The ends of the barrier are sealed with two rubber seals.

2.2 The barrier is installed inside a prefabricated steel chamber or a pre cast concrete chamber which is set into deep excavations. The construction will require deep excavations which creates additional construction health and safety risk.

2.3 The installation of the barrier requires flood water to be channelled into the chamber to cause it to rise. As the flood water recedes the barrier will descend.
2.4 The SRFB requires no operational presence to operate. However without supervision any obstruction or malfunction will not be observed and the whole defence could be compromised if one section jammed and did not rise. If the SRFB was to be used over a short length eg across a road, this would be a risk, which if it occurred emergency measures, such as stop logs, could be implemented. However if SRFB was installed over the whole length of the Waterfront, this risk would become more significant, because just one element failing to operate would compromise the whole scheme.

2.5 The self raising nature of the barrier could introduce health and safety concerns as the barriers begin to rise before the paths along the river would be flooded. This could at worst trap people the wrong side of the defence who had been walking down the river side unaware of the rising defences were about to operate at Upton. As the barrier rises without warning for the initial part of its travel it would create a trip hazard for partly sighted or elderly pedestrians. Remote monitoring and a suitable alarm system could help reduce this hazard, but there would still be a residual risk.

2.6 The SFRB has a steel cover which fits over the recess into which the floating section sits, this has a hinge and will need lubricating. The inlet works and chamber will require maintenance on a regular basis to control the build up of river silts. This can be achieved by using a high pressure jetter and tanker so as not to wash the sediments into the river. The EA does not currently operate such equipment and would have to contract in this service. Without having had full field trials of the system the extent of these costs are at present indeterminate.

Technical Analysis of Self Raising Flood Barrier

3.1 In factory conditions, the SRFB is seen to work efficiently and is an innovative solution to provide a barrier to water. However, in the UK, it has not been trialled anywhere to be able to make a judgment as to whether it would be sufficiently robust in a flood situation. From research to date the SRFB has been used elsewhere in Europe, but predominantly in short lengths to protect accesses. A trial of the SFRB in a tidal situation has been suggested to see how it would work in “real life”.

3.2 All demountable defence and temporary flood defence systems procured by the EA must be British Standard kitemarked. Whilst it is understood that there are currently issues with the testing of products, the SRFB has been available for several years and has not yet been approved.

3.3 With any civil engineering structure, there needs to be structural and geotechnical calculations completed to ensure the structure is safe to construct and operate. It has been established from the geotechnical analysis that the bearing capacity of the soil at Upton is not sufficient to support the weight of and loads applied to it during flood conditions using traditional foundations. Currently a mini-pile wall solution has been designed to support the wall.

3.4 The proposal to put in SFRB included piers at 50m intervals to support the SRFB as it rises, however there was In the examples seen of SFRB the “trough” has been installed with solid ground on either side. In Upton upon Severn there would be substantial hydraulic pressures placed on the SFRB. To prevent overturning moments causing the structure to fail the base would need to be tied into a piled foundation.

3.5 The SRFB is considered to be a demountable defence by the EA. Although it does not require resources for operation as many other demountable defences, like flood gates or aluminium post and planks systems, there are still residual risks that the SFRB will not operate as expected. As a result, to construct the SFRB would be contrary to EA national policy for demountable defences, which states that their length and height should be minimised by incorporating permanent raised defences wherever possible.
3.6 Considering the technical, maintenance and health and safety risks and lack of UK field trials of the SRFB system, the inherent risks in installing the product are too great to consider its use over the whole length of the Waterfront in Upton upon Severn.

Costs of Self Raising Flood Barrier

4.1 In any project promoted by the EA, it must be shown to be economically viable. This is an assessment that the costs of the scheme are outweighed by the benefits. In order to ensure that these are compared in an equitable way they are costs at today’s prices as a Present Value.

4.2 The current scheme for a mini-pile wall to produce a scheme with a standard of protection equivalent to once in every 150 years has a construction cost estimated at £1,310k, based on tender received from one of our framework contractors. On to this a further £1,043 has been estimated to cover design, service protection and diversion, land agent fees, site investigation, compensation, environmental enhancements, planning and public consultation, cost consultant fees, contingency and inflation. This produces a a Present Value cost of £2,353k for the Waterfront scheme.. This is compared to the Present Value benefits of £4,446k for protecting the Waterfront to this standard. This produces a scheme for the Waterfront with a cost benefit ratio of 1.89.

4.3 UK Flood Barriers of Droitwich have supplied a cost of £1,800k to design and construct the full-height SRFB at Upton upon Severn. However, these costs do not include for a suitable foundation. From the tender bids received, an estimate of the cost of this work has been made at a figure of £681k.

4.4 Although the costs provided by UK Flood Barrier includes for design of the SRFB, any design would need to be independently checked. No additional costs have been included for this as this would be offset by a reduction in design costs for the reinforced concrete wall in the existing scheme.

4.5 To include all the elements for a SRFB scheme at the Waterfront a rough estimate of costs are derived as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>£k</th>
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<tbody>
<tr>
<td>Cost of SRFB, design and construct</td>
<td>1,800</td>
</tr>
<tr>
<td>Plus foundation costs</td>
<td>681</td>
</tr>
<tr>
<td>Construction cost</td>
<td>2,481</td>
</tr>
<tr>
<td>Cost to design, compensation, service diversions etc</td>
<td>1,043</td>
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<td>3,524</td>
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4.6 To consider the Present Value of this option, the ongoing maintenance would need to be considered. At this time it is difficult to assess how much jetting work would be required and how much it would cost. Replacement of some elements of the scheme will be required over its design life of 100 years, which would not be necessary for a fixed reinforced concrete wall. A figure of £2k per year should be allowed for maintenance, which equates to a Present Value of £60k and the total replacement of the SRFB after a design life of 50 years, discounts back to a Present Value of £355k.
4.7 This produces a Present Value Cost of the scheme of £3,939, which compares to the Present Value Benefits of £4,446 and produces a cost benefit ratio of 1.13. Funding for the Upton upon Severn scheme would come from DEFRA Grant-in-Aid funding. The EA is tasked with achieving an average cost benefit ratio, for all flood defence schemes nationally, of 5. Each individual scheme is expected to be “robustly” cost beneficial. This is interpreted as a cost-benefit of 1.5 or more, so that if costs increase for any reason then the scheme still remains economically viable. If the SFRB scheme was the only option at Upton upon Severn the cost benefit value of 1.13 for the scheme would become borderline to take forward and is unlikely to be robust enough to be approved.

4.8 Alternative schemes for SFRB have been proposed with a small wall and a smaller element of SRFB. Although these reduce the cost of SRFB, they increase cost of the reinforced concrete and mini pile foundation and reduce the achievement of the objective to make the defence invisible outside flood situations. It should also be noted that UK Flood Barriers are the sole suppliers of SRFB in the UK. Within the EA’s procurement procedures, it is not possible to directly buy in their services without suitable competition.

4.9 Nationally, the priority which different schemes are given is made on the basis of their Outcome Measures score. Currently the Upton upon Severn scheme has been prioritised because of the increased resilience it provides. This increased priority would be removed if SRFB was used. The Outcome Measures achieved by the Upton upon Severn scheme would be reduced if SRFB was used, due to its higher cost. Consequently, it would be reassessed against other schemes across the country and other more beneficial schemes would take its place. It is likely that progress on the scheme would be halted.

**Conclusion**

5.1 Technically, because there have been no field trials, the ongoing maintenance costs and residual risks of using SRFB cannot be quantified. As such, the taxpayer would have to take on the inherent risks with employing an untried system. Economically, there is uncertainty over the long term cost of using SRFB, but even using the costs so far estimated make the use of SFRB not viable for the taxpayer.

5.2 Although it is accepted the SFRB would be less intrusive than a wall, on both technical and economic grounds, it should not be considered for the Waterfront section of the Upton upon Severn Flood Alleviation scheme.