



Ten Steps to efficiency in Flood and Coastal Risk Management

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Balfour Beatty

About Balfour Beatty

Balfour Beatty is a leading international infrastructure group. With 15,000 employees across the UK, Balfour Beatty finances, develops, delivers and maintains the increasingly complex infrastructure that underpins the UK's daily life. Delivering projects across flood and coastal risk management, transportation, power and utility systems, social and commercial buildings: from Crossrail and the Channel Tunnel Rail link, Heathrow T2b to the M25, M60, M3 and M4/M5; Sellafield and soon Hinkley C nuclear facilities; to the Olympics Aquatic Centre and Olympic Stadium Transformation.

Balfour Beatty has extensive experience of coastal and flood protection works and a reputation for technical excellence and outstanding service delivery. Over the last 20 years, we have delivered more than 75 coastal protection and flood defence projects amounting to over £500 million for clients including local authorities and the Environment Agency on schemes averaging a Benefit Cost Ratio (BCR) 10:1. We have reduced the risk to approximately 100,000 properties on schemes completed since 2010.



Introduction

According to the Committee on Climate Change¹ (CCC), storms, flooding and drought already account for 10-35% of all delays or interruptions of service to infrastructure such as electricity, road and rail networks. Such incidents are projected to increase over the coming decades. Flooding, in particular, has become a regular event, with annual occurrences having an increasing impact. More than five million homes in England – one in six properties – are at risk of flooding², and according to meteorological records, six of the seven wettest years have occurred since the year 2000³.

The cost to the UK economy of flood damage, both in terms of the effect on homeowners and business, far outweighs the costs of building and maintaining infrastructure relating to their protection. For example, the cost of the December 2015 floods, which followed storms Desmond, Eva and Frank, is predicted to exceed £5 billion⁴. On average, floods cost the UK economy £1 billion annually⁵. On the other hand, for every £1 spent on flood defences, an estimated £8 is saved⁶ in areas such as insurance and the mitigation of potential damage to properties and businesses.

In the context of the UK's deficit and the economic uncertainty surrounding Brexit, however, the onus is on all those involved in commissioning, designing, building and maintaining flood defences to ensure that limited resources are used as efficiently as

possible. This is why the Government announced, in confirming its £2.3 billion capital investment for the building of flood defences, that Defra and the Environment Agency had to work together to deliver a minimum of 10% efficiency savings by 2019-2020⁷. According to the Environment Agency's Long-Term Investment Scenarios⁸, a 10% decrease in unit costs after 2021 could reduce the long-term risk by 15% compared to the present day, whereas rising costs of construction, supply constraints or unhelpful land management approaches might push costs up.

One way to help deliver savings is to consider the whole life costs when commissioning a new scheme. Another element is to streamline central office processes. These are both approaches that Defra and the Environment Agency are beginning to take. There is, however, only so much that can be achieved through such approaches, important though they are. Big savings must still be found.

In this context, this paper considers steps which commissioning authorities, Government and the infrastructure industry could take together in order to drive efficiencies in the effective delivery and maintenance of flood defences, without compromising on quality or safety.



¹ Managing climate risks to well-being and the economy, CCC Adaptation Sub-Committee Progress Report, 2014

² Environment Agency, Flooding in England: A National Assessment of Flood Risk, 2009

³ Met Office, 2016

⁴ Flooding economic impact will breach £5 billion, KPMG, 28 December 2015

⁵ House of Commons Library research paper, Reducing Flood Risk, 2010

⁶ Environment Agency, Flooding in England: A National Assessment of Flood Risk, 2009

⁷ HMT, Spending Review and Autumn Statement 2015, November 2015

⁸ Flood and Coastal Erosion Risk Management, Long-term Investment Scenarios (LTIS), Environment Agency, 2014

Key points

- Project teams which take a collaborative approach, allowing contractors to suggest ideas throughout the project, can deliver significant efficiencies.
- Standardising specifications and solutions is an effective way of keeping costs down.
- By placing the emphasis on the whole life cost of the scheme it is possible to deliver significant cost savings and environmental and safety benefits.
- The best way to keep costs down is to make the decision on location and scope as early as possible and to stick with it. Changes result in additional costs.
- Early Contractor Involvement is an excellent way of delivering efficiency savings and reviewing potential whole life costs. This approach, however, requires strong relationships, not only between the customer and the contractor, but also between the contractor and the project design and supply chain. It therefore pays to invest time in building these relationships and maintaining them over the long-term.
- The longer those working on a scheme have to consider the right solutions, the easier it is to undertake effective community engagement and to develop schemes that communities support and are affordable.
- The use of collaborative framework agreements such as those offered by Scape Group is recognised increasingly as an effective way to drive efficiencies in this area.
- Balfour Beatty has worked with a number of clients who have made significant savings by packaging several schemes.
- Contracts which allow for delivery to be undertaken over the longer-term allow for real innovation, cost savings and adapting to new data.
- We would welcome a more strategic and longer-term funding approach for flood and coastal risk management, which would enable best use of the available money and would be more efficient than increasing spend via one-off additional payments.
- It would be more efficient over the long-term to maintain spending on flood maintenance. This is not only due to the 'catch-up' required to bring the flood assets back up to the necessary standard, but also because there may be an adverse economic impact from flooding where defences have not been adequately maintained.
- Balfour Beatty encourages the Government to develop a long-term capital and maintenance programme for flood management, which would protect funding beyond the current six-year term to 2021. This would include the additional amount identified for flood repairs as set out in the Government's recently published Resilience Review⁹.
- We would welcome publication of details of the funding beyond 2021 as soon as possible so that authorities can properly plan for the future and gain maximum efficiencies.
- In the absence of full devolution in the short-term alternative economic modelling should be considered. This would make a more robust economic case for infrastructure investment broadly across the country.
- Research into new methods for gaining a full picture of the wider economic development and regeneration benefits associated with infrastructure projects should continue.
- There is no evidence that new data and modelling on flood risk and climate change is being fully used by policy-makers, planners, developers and property owners.
- Balfour Beatty believes that measures should be put in place to ensure that infrastructure providers have to build in flood resilience. This would encourage asset owners to ensure that they fully understand their risks.
- We believe that consistency and compliance with BIM level 2 should be prioritised across the industry.
- Working on a catchment basis allows for a strategic approach to be taken while delivering flood protection as efficiently as possible for local communities.
- We urge each of the devolved administrations to develop comprehensive strategies for flood risk management. The strategies should adopt a holistic approach and include better land-use and planning policy, increased resilience for existing housing stock and improved flood defences.

⁹ National Flood Resilience Review, HMG, September 2016

The ten steps

Steps for commissioning authorities and contractors

1. A collaborative approach: encouraging innovation

In our experience, project teams which take a collaborative approach, allowing contractors to suggest ideas can deliver significant efficiencies. This can include the use of techniques such as off-site precast manufacture. At St Stephens Avenue in 2002, for example, Balfour Beatty developed a high-quality, 4 metre long, 18 tonne precast wave wall panel. This allowed us to construct the sea wall three times faster than had been done previously, while also reducing the risk to those working on the scheme. Since 2002, we have used precast sea defences for all high-risk elements of work on coastal schemes. This has resulted in major efficiencies for our customers. Standardising specifications and solutions is an effective way of keeping costs down.

We have seen similar efficiencies delivered on other schemes where the commissioning body took a partnering approach, such as Blackpool in 2007, which saw the UK's first major use of glass fibre reinforced polymer reinforcement (GFRP) in a coastal

environment, rather than using the more conventional stainless steel. By placing the emphasis on the whole life cost of the scheme, Balfour Beatty and Blackpool Council worked together to select GFRP, delivering significant cost savings and environmental and safety benefits.

It is important, however, to differentiate between making changes which can safely deliver savings while maintaining quality, and making changes which add cost. The best way to keep costs down is to make the decision on location and scope as early as possible and to stick with it. Changes result in additional costs. Furthermore, the longer those working on a scheme have to consider the right solutions, the easier it is to undertake effective community engagement and to develop schemes that communities support and are affordable.

2. Investing in strong relationships

Balfour Beatty analysis has shown that the longer a combined team has to work together on each scheme and to plan, the more significant the efficiencies¹⁰. Early Contractor Involvement is an excellent way of delivering efficiency savings and reviewing potential whole life costs. This approach, however, requires strong relationships, not only between the customer and the contractor,



¹⁰ Improvements in Coastal Scheme Delivery 2002-2016, Balfour Beatty, 2016

but also between the contractor and the project design and supply chain. It therefore pays to invest time in building these relationships and maintaining them over the long-term. On the Humber, Trent and Ouse catchments, for example, Balfour Beatty's large local teams have in recent years built many defences for the Environment Agency, Associated British Ports and the local authorities. This local expertise means that we know the river and its tributaries, understand the risks of working in these areas and know the local supply chain. This knowledge helps us deliver schemes as efficiently and safely as possible.

3. Better procurement

According to the Centre for Economics and Business Research, the UK's public sector procurement is the most expensive and slowest in the EU¹¹. In our experience, public sector clients also often lack the expertise to commission construction work and may therefore be missing opportunities. Public sector procurement is therefore an area which has the potential to deliver significant efficiencies.

The use of collaborative framework agreements such as those offered by Scape Group is recognised increasingly as an effective way to drive efficiencies in this area. With OJEU and other tendering processes already completed, the frameworks deliver time and cost savings by avoiding the often time-consuming and expensive procurement processes for each project.

Furthermore, while public sector bodies consider outcomes in flood and coastal risk management such as efficiency and the number of

houses protected, frameworks such as Scape also have a focus on growth. For example, they mandate that their delivery partners pay their local supply chain on time to support local businesses and ensure investment in apprenticeships and local training.

4. Undertaking schemes simultaneously

Balfour Beatty has worked with a number of clients who have made significant savings by packaging schemes. The Humber Flood Prevention Strategy package is one such example. In addition to the efficiency benefits of only having to undertake a single tender process for the package, further gains can be realised by:

- sharing resources and staff across the different schemes, providing job sharing opportunities, reducing staffing needs for community liaison activities, site supervision, and design and management activities;
- buying supplies in greater quantities leading to cost savings in the procurement of construction materials;
- providing key supply chain partners with a larger value and volume of work;
- employing a core team, based in a central location, to provide input through the project lifecycle and a single point of contact for construction planning and programming, identifying early opportunities for efficiency savings;
- effective reuse of materials, for example by packaging schemes with a surplus of fill with schemes with a need for fill, savings can be achieved in terms of time and environmental impact.

5. A longer-term view

In Balfour Beatty's experience, contracts which allow for delivery to be undertaken over the longer-term allow for real innovation, cost savings and adapting to new data, for example on climate change. Much of the work we undertake on the coast also adds considerable social value, particularly on use of SMEs and the skilling of the local workforce, adding to local growth. An example of this is the £300 million Thames Estuary Asset Management Programme, where Balfour Beatty is working as part of an integrated team to deliver the ten-year programme. This will involve strengthening tidal walls and embankments, refurbishing works of active assets (including major flood barriers), new assets such as pumping stations, capital renewals and replacements.



¹¹ CEBR and Gatewit, July 2013

Steps for Government

6. A long-term funding approach

The funding of flood risk management is an emotive subject, with some complaining that their area loses out or that more should be spent. Meanwhile, not all work in the 6 year programme is fully funded. While the public Government funding for flood risk management during the 2010-2015 period was initially due to decline, it was eventually higher than planned due to the injection of a one-off additional amount following the winter 2013-2014 floods.

Although the additional funding is welcome, providing it in this way does not allow long-term planning and is therefore less efficient than announcing the whole amount up front would be. We would therefore welcome a more strategic and longer-term approach which would enable best use of the available funding and would be more efficient than increasing spend via one-off additional payments.

Similarly, with regard to maintenance funding, the UK has over 24,000 miles of linear flood defences and 46,000 structures¹². The Environment Agency is responsible for the maintenance of over £20 billion of these flood defence assets. A 2014 National Audit Office (NAO) report,¹³ however, highlighted that funding for maintenance had dipped in recent years, showing that between 2010–2011 and 2013–2014, within the Environment Agency's 10% overall revenue reduction, funding for flood asset maintenance had gone down by 14%. The Worsfold Review¹⁴ demonstrated that as maintenance spending declined so did the percentage of critical assets that met the Environment Agency's required standard – from 99% to 94%. Any figure below 97% is taken to represent an unacceptable risk to those areas at risk of flooding.

It would be more efficient over the long-term to maintain spending on flood maintenance. This is not only due to the 'catch-up' required to bring the flood assets back up to the necessary standard, but also because there may be an adverse economic impact from flooding where defences have not been adequately maintained.

We therefore welcome the announcement in the 2015 Autumn Statement that the Government will sustain maintenance spending over the course of this Parliament. It is important to note, however,



¹² Environment Agency, *Flooding in England: A National Assessment of Flood Risk*, 2009

¹³ NAO, *Strategic Flood Risk Management*, 2014

¹⁴ The Worsfold Review, *Flood and Coastal Risk Management (FCRM) Maintenance Review*, Mark Worsfold, September 2014

that as more flood defence assets are built, the maintenance bill will increase.

Balfour Beatty encourages the Government to develop a long-term capital and maintenance programme for flood management, which would protect funding beyond the current six-year term to 2021. This would include the additional amount identified for flood repairs as set out in the Government's recently published Resilience Review¹⁵. We would also welcome publication of details of the funding beyond 2021 as soon as possible so that authorities can properly plan for the future and gain maximum efficiencies.

7. Rebalancing the economy

In a number of infrastructure-related areas, the way the impact of the scheme and therefore its value is calculated means that some schemes are automatically cancelled out. In terms of flood defences, for example, the value of assets protected is a key element in the economic formula for deciding where taxpayers' money should be spent. This can skew the system towards wealthier areas where property prices are higher. This calculation therefore works against the Government's priority of rebalancing the economy. Neither does it reflect adequately the economic growth that could be unlocked by undertaking the works.

The Government is attempting to address this issue through the flood and coastal delivery targets it sets for the Environment Agency. The Government's Outcome Measure 3¹⁶, for example, relates to the number of properties with reduced risk in deprived areas. In recent years this has led to the prioritisation of projects in socially deprived areas including Blackpool, Salford and Portsmouth. In the absence of full devolution in the short-term, however, alternative economic modelling should be considered. This would make a more robust economic case for infrastructure investment more broadly across the country. We believe that research into new methods for gaining a full picture of the wider economic development and regeneration benefits associated with infrastructure projects should continue.

8. Better use of data and information

In recent years, there have been significant improvements in models which consider the impact of climate change and extreme rainfall on flood risk. There is as yet, however, no evidence that this data is being fully used by policy-makers, planners, developers

and property owners.

At the same time infrastructure providers and owners, from water companies to railways, power companies and others, are often ill-prepared for flooding. Balfour Beatty believes that measures should be put in place to ensure that these organisations have to build in flood resilience, something that could be pursued through regulatory regimes and would involve more planning, analysis and investment by asset owners. This would encourage asset owners to ensure that they fully understand their risks.

Building Information Modelling (BIM) is another way of working collaboratively, using digital technology, to facilitate efficiency in the design, building and maintenance of infrastructure through, for example:

- early design prototyping to show how an asset will look and operate, helping customers make informed choices and speed up the approval process;
- easy modelling of a range of options and assessment of each choice, demonstrating which would be most efficient to construct and operate over the lifetime of the asset;
- reduced energy use and carbon production through life-cycle modelling;
- identifying and eliminating any potential safety issues by using BIM's 4D capabilities to sequence construction works on screen and develop the shortest and safest approach;
- provision of data that can be integrated with facilities management programmes to ensure a comprehensive set of asset data is available.

The Government has mandated that public sector centrally procured infrastructure projects had to use BIM by April 2016. Balfour Beatty was one of the first contractors to be officially certified for BIM level 2 compliance and is extending its use to all projects, not just those for central government. We are at the forefront of using BIM and have delivered, or are in the process of delivering around a hundred projects using the tool. We also played a founding role in establishing the Construction Industry Council BIM 2050 Task Group, with the aim of sharing knowledge and improving efficiency. However, many other companies have still not adopted BIM, meaning that opportunities to deliver innovation and efficiencies are being missed. We believe that

¹⁵ National Flood Resilience Review, HMG, September 2016

¹⁶ Flood and Coastal Resilience Partnership Funding, Defra, May 2011



consistency and compliance with BIM level 2 should be prioritised across the industry.

9. Working with nature

Balfour Beatty believes that working on a catchment basis allows for a strategic approach to be taken while delivering flood protection as efficiently as possible for local communities. This involves working collaboratively with all of the stakeholders, at a river catchment scale – a natural, geographic area, beginning with an assessment of flood risk in all sectors, including power and transport infrastructure for example. Such an approach can deliver improvements across a range of areas and sectors in addition to flood risk management, including improvements to wildlife and water quality. A good example of this is the approach taken by Balfour Beatty and our partners on the award winning £21 million Flood Alleviation Scheme in Morpeth, Northumberland and the River Wansbeck catchment. This scheme involved a number of related measures, including building new flood defences in the town itself, as well as an upstream reservoir on the River Wansbeck to hold back floodwater during torrential rain. Existing flood defences were also strengthened, while measures were put in place to safeguard protected species on the river, including otters and crayfish.

This approach, which Defra has already taken some steps to

encourage¹⁷, could be extended to assess flood risk needs from source to the sea, meeting the desire for ‘natural flood management’ on uplands in order to optimise funding and outcomes. Natural approaches have many benefits, only one of which is the delivery of efficiencies. Returning rivers to natural routes, for example, can reduce the movement of sediment into critical flood channels and at the same time slow flows, thereby reducing peak river levels. We also believe that there should be a greater focus on ‘water balance’, particularly relating to land use, to ensure that flooding – and drought – are not being worsened unnecessarily.

10. A comprehensive strategy

Balfour Beatty believes that the points made above reinforce the case for each of the devolved administrations to develop comprehensive strategies for flood risk management. The strategies should adopt a holistic approach, and include better land-use and planning policy, increased resilience for existing housing stock, improved flood defences and affordable insurance.

We believe that flooding must no longer be treated as a short-term issue, but must be better linked with broader urban planning, development, environmental and farming processes – all of which have a direct effect on flooding intensity, damage potential, and frequency.

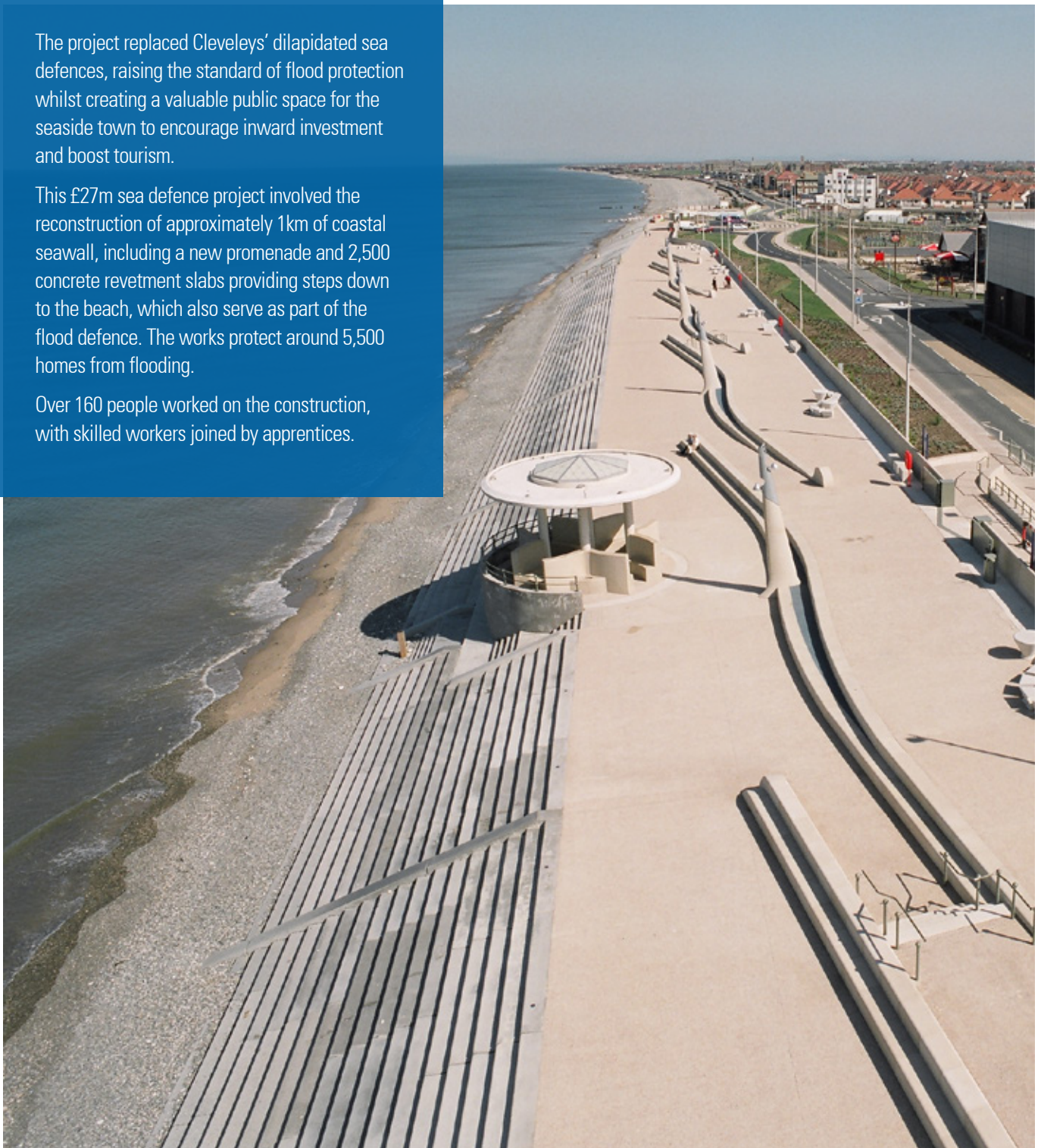
¹⁷ Catchment Based Approach: Improving the quality of our water environment, Defra, May 2013

Case study: **Cleveleys Coastal Defences**

The project replaced Cleveleys' dilapidated sea defences, raising the standard of flood protection whilst creating a valuable public space for the seaside town to encourage inward investment and boost tourism.

This £27m sea defence project involved the reconstruction of approximately 1km of coastal seawall, including a new promenade and 2,500 concrete revetment slabs providing steps down to the beach, which also serve as part of the flood defence. The works protect around 5,500 homes from flooding.

Over 160 people worked on the construction, with skilled workers joined by apprentices.



Collaborative working

Balfour Beatty's relationship with the local authorities spans 16 years, during which time we have developed a fully collaborative approach enabling us to deliver consistently high quality sea defences that exceed the customers' requirements. On this scheme which was constructed in tandem with the Blackpool Central Area scheme, the partnership, made up of Blackpool Council, Wyre Borough Council, the Environment Agency and Balfour Beatty were able to innovate to deliver £18m savings from the initial cost of the two projects through the creation of a purpose built shared precast manufacturing facility. For example, the intermediate wave wall precast structure was split into smaller structural components enabling overall concrete volumes to be reduced by 30%. Standardisation of design principles for the precast concrete units also enabled significant cost savings to be made at Cleveleys without sacrificing quality.

Further efficiencies were delivered by building on designs from other successful coastal defence projects to reduce the amount of work involved, while replicating successful techniques from these schemes rather than revising methodologies mid-construction ensured a "right first time" approach.



Achievements

The project received a number of awards including a Considerate Constructors 'Gold' Award and the British Construction Industry (BCI) 'Project of the Year' award 2011.

This scheme raised the bar for coastal defences, particularly in relation to local tourism. Others are now looking to replicate it as a minimum standard.



Veena Hudson

Head of Public Affairs | Balfour Beatty
veena.hudson@balfourbeatty.com
+44 (0)20 7963 4235 | +44 (0)7790 340 693
www.balfourbeatty.com