Leeds Flood Alleviation Scheme Phase 2

Outline Business Case

Version No: V6.0

***Date*: October 2018**

BUSINESS CASE APPROVAL SHEET

1 Review & Technical Approval

Project title	Leeds Flood Alleviation Scheme Phase 2		
Authority project reference		EA reference	F/1819/0659
Lead authority	Leeds City Council	Date of submission	9 October 2018
Consultant	BMMjv	Document stage (SOC/OBC/FBC)	OBC
Previous document	n/a	Previous doc ref	n/a

Job title	**Name**	**Signature**	**Date**
'I confirm that this project meets our quality assurance requirements, environmental obligations and Defra investment appraisal conditions and that all internal approvals, including member approval, have been completed and recommend we apply to the Environment Agency for capital grant and local levy in the sum of £			
Authority Project Executive			
'I have reviewed this document and confirm that it meets the current business case guidelines for local authority and Internal Drainage Board applications.'			
Business case reviewer			
'I confirm that the project is ready for assurance and that I have consulted with the Director of Business Finance'			
Area Flood & Coastal Risk Manager			

NPAS Assurance ☐ Projects £100k - £10m (Tick the appropriate box)	Large project review group (LPRG) ☒ Projects >£10m

Recommended for approval			Date
NPAS or LPRG Chair			
Project total as approved £		Version number	
Project total made up of:	Capital Grant (£k)		
	Levy (£k)		
	Other Contributions (£k)		

2 Project Financial approval

Financial scheme of approval	Project total	**Name**	**Signature**	**Date**
Director of Finance (del)	All >£100k	Julie Akkermans	Email, see below	21/12/18
Executive Director of FCRM	£1m -£10m	John Curtin	Email, see below	28/12/18
Executive Director of Operations	>£10m	Toby Willison	Email, see below	27/12/18

3 Defra approval

Date sent to Defra (or N/A)		Version number (if different)	
Date approved by Defra (or N/A)			
Comments			

From: Willison, Toby
Sent: 27 December 2018 13:23
To: FSOD <FSOD@environment-agency.gov.uk>
Cc: Curtin, John <john.curtin@environment-agency.gov.uk>; Akkermans, Julie <julie.akkermans@environment-agency.gov.uk>; PA ExecutiveDirectorFCRM <PA.ExecutiveDirectorofFCRM@environment-agency.gov.uk>; Mitchell, Becky <becky.mitchell@environment-agency.gov.uk>
Subject: Re: For Technical Approval: F/1819/0659 - Leeds FAS Phase 2 OBC

Rachel,

I approve.

I note that this is for a scheme to deliver a 1% level of protection and will be lead by Leeds CC. The scheme qualifies for £65m 'grant' that is made up of FDGiA and Booster funding. I also note the LPRG approval.

Toby

From: Curtin, John
Sent: 28 December 2018 15:51
To: FSOD <FSOD@environment-agency.gov.uk>; Willison, Toby <toby.willison@environment-agency.gov.uk>; Akkermans, Julie <julie.akkermans@environment-agency.gov.uk>
Cc: PA ExecutiveDirectorFCRM <PA.ExecutiveDirectorofFCRM@environment-agency.gov.uk>; Mitchell, Becky <becky.mitchell@environment-agency.gov.uk>; Hodge, Ian <ian.hodge@environment-agency.gov.uk>; Allison, Ken <ken.allison@environment-agency.gov.uk>
Subject: RE: For Technical Approval: F/1819/0659 - Leeds FAS Phase 2 OBC

Hi

I have reviewed the document and discussed with Ian.

This has my approval but on the basis set out in Ian's letter to Leeds CC dated 13th December 2018. Any additional request for support for phase 3 would need to be subject to separate assurance and approvals.

Cheers,

John Curtin
Executive Director of Flood and Coastal Risk Management

From: Akkermans, Julie
Sent: 21 December 2018 15:14
To: FSOD <FSOD@environment-agency.gov.uk>; Curtin, John <john.curtin@environment-agency.gov.uk>; Willison, Toby <toby.willison@environment-agency.gov.uk>
Cc: PA ExecutiveDirectorFCRM <PA.ExecutiveDirectorofFCRM@environment-agency.gov.uk>; Mitchell, Becky <becky.mitchell@environment-agency.gov.uk>
Subject: RE: For Technical Approval: F/1819/0659 - Leeds FAS Phase 2 OBC

Hi

Following on from LPRG's recommendation I am happy to approve this on behalf of Pat as Finance Director.

Thanks
Julie

Julie Akkermans | Senior Finance Business Partner | Defra group Finance – EA team

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1. Executive Summary

1.1 Introduction

1.1.1 This document forms the outline business case (OBC) for the Leeds Flood Alleviation Scheme Phase 2 (LFAS2), a major project which will reduce flood risk to residential, commercial and industrial property and infrastructure assets along the River Aire, Leeds, West Yorkshire. Once approved, this scheme will be the second and final phase of Leeds City Council's (LCC's) plans for managing current and future flood risk in the city from the River Aire.

1.1.2 In the immediate aftermath of the devastating 2015 Boxing Day flood, which was of a magnitude in excess of a 0.5% annual exceedance probability (AEP) event, the Government announced a new flood alleviation scheme in Leeds. This would include traditional flood defences, upstream storage and natural flood management measures throughout the upper catchment to provide a good level of protection for Leeds. The indication at this time was that the total cost of a 1% AEP would be in the order of £65m using estimates developed prior to 2015. The commitment by Government in the spring 2016 budget was based on the scheme being eligible for £5m FCERM GiA and a provision of remaining funding through the Defra Booster fund of £30m between then and 2021 and an indicative allocation of £30m thereafter to complete the scheme subject to business case approval.

1.1.3 The thorough options appraisal has identified three main scheme options for consideration, as summarised in Table 1 below.

1.1.4 The Economically Preferred Scheme, as identified in this OBC using the Defra/Environment Agency's FCERM Appraisal Guidance (excluding the wider benefits of natural flood management), is a flood walls & minor conveyance works scheme that provides a 1.33% AEP standard of protection with climate change to 2069. This is a lower standard than is currently provided to the Phase 1 area completed in the last 12 months.

1.1.5 The 1% AEP option has a Present Value cost £14m greater than the 1.33% AEP option and is arguably an economically sound investment increasing the wide economic benefits by some 40%. However, the specific flood reduction benefits are considered by Defra as set out in a policy decision to be insufficient to support an increase of investment to the 1% AEP scheme. The remainder of the benefits are derived from non-specific-FCERM benefits i.e. carbon sequestration associated with tree planting.

1.1.6 The option for a 1% AEP standard of protection with climate change to 2069 scheme as shown in Table 1, includes a catchment wide natural flood management (NFM) programme that would bring transformational change delivering several of Governments strategic ambitions as set out in the 25 Year Environment Plan, and to do so on a landscape scale. It would significantly contribute to realising the vision of the Northern Forest in the Aire catchment, restore and create new habitat, increase biodiversity resilience, improve water quality through reduced sedimentation and provide c.£90million worth of benefits through carbon sequestration.

Table 1: The three main options for consideration

1 in 75 1.33% AEP	1 in 100 1% AEP	1 in 200 0.5% AEP
Economically Preferred Scheme compliant with Defra/EA Appraisal Guidance and PF Rules Capital Cost: £62.8m (£56.2m PV) £62.1m WLC Present Value Excluding the wider benefits of natural flood management	**Economically Preferred Scheme including Non FCERM Benefits** Capital Cost: £86.7m (£77.2m PV) £76.4m WLC Present Value Including the wider economic benefits of natural flood management	**Local Choice Preferred Scheme including additional benefits to Phase 1** Capital Cost: £112.1m (£99.7m PV) £109.6m WLC Present Value Including the wider economic benefits of natural flood management
New flood walls and minor conveyance works	+ Catchment-wide NFM programme & flood wall optimisation	+ upstream flood storage/attenuation area
Additional **1,509** Net Jobs Additional **£44.2m** Net GVA pa Additional **£669.8m** GVA NPV (10 years) **1,563** new dwellings **97** businesses would be protected from risk of flooding *Benefit to Cost Ratio including GVA – 12.8*	Additional **1,509** Net Jobs Additional **£44.2m** Net GVA pa Additional **£669.8m** GVA NPV (10 years) **1,563** new dwellings **117** businesses would be protected from risk of flooding *Benefit to Cost Ratio including GVA – 11.7*	Additional **1,669** Net Jobs Additional **£88.2m** Net GVA pa Additional **£774.4m** GVA NPV (10 years) Uplift to Phase 1 Benefits £14.4m **1,613** new dwellings **370** businesses would be protected from risk of flooding *Benefit to Cost Ratio including GVA – 9.4*
Net Present Value £65.9m *iBCR is 1.9*	*Net Present Value* £148.1m *iBCR is 6.8*	*Net Present Value* - £143.1m *iBCR is 0.9*
Defra Contribution: £62.8m (FCERM Grant in Aid & Booster Funding)	Defra Contribution: £79.8m	Defra Contribution: £83.6m (£79.8m + £3.8m)
Local Contributions: £0m	Local Contributions: £6.9m	Local Contributions: £28.5m
TBC	TBC	LCC lead delivery, own risk and take on Operation & Maintenance

1.1.7 The Defra Partnership Funding formula restricts FCERM-GiA contributions, primarily on the basis of benefit to reducing flood risk to residential properties and is to the disadvantage of Leeds City in this instance where approximately 77 residential homes will see a reduction in flood risk, whilst several hundred non-residential properties will benefit from investment, unlocking future growth potential and significantly reducing flood damage in the round, yet are not eligible for FCERM-GiA. Government recognise this problem, alongside the urgency of the scheme and have therefore indicated an additional special grant or 'booster' allocation to facilitate scheme delivery.

1.1.8 The Leeds City Council preferred option for a 0.5% AEP standard of protection with climate change to 2069 scheme, the Local Choice Preferred Scheme, as shown in Table 1, would alleviate the impact of a re-occurrence of a similar magnitude flood that of the 2015 Boxing Day flood and so provide maximum confidence of low flood risk for future investors. Communities along this reach of the river are still recovering from the extensive damage and disruption caused by the major flooding in December 2015. Had the flood occurred on a normal working day, rather than Boxing Day, the impacts would have been far more severe. The flooding heavily affected a significant number of local businesses, a number of which have since failed or have relocated outside of the area.

1.1.9 The Local Choice Preferred Scheme would deliver a consistent level of protection across both the Leeds FAS Phase 1 and Phase 2 reaches, eliminating the requirement, other than routine maintenance, for future interventions within the identified benefit period. In addition to the measures included in the 1.33% and 1.0% AEP schemes the large storage area upstream of the city will enable lower raised defences in the city. This will enable the waterfront to be a core part of the city's regeneration and so keeping the river open for future generations to enjoy. This option effectively delivers the anticipated Phase 3 of the Leeds FAS. It would support the recent National Infrastructure Commission recommendation that all properties should where feasible benefit from a minimum 0.5% AEP standard of protection or greater for large urban areas and cities.

1.1.10 It is recognised that the economically preferred scheme compliant with Defra/EA Appraisal Guidance and PF Rules is the 1.33% AEP scheme however if the local choice scheme (0.5% AEP) is supported by Government, Leeds City Council (LCC) will lead on its delivery, contribute £10m to the cost, underwrite £18.5m of other local contributions, underwrite all risk of overspend, protecting the FCERM-GiA allocation, and take on the future operation and maintenance of the scheme at an estimated cost of circa £7m PV.

1.1.11 The Government has currently committed £65m towards a scheme for Leeds. LCC have committed £28.5m (£25.8m PV). There is a residual shortfall of £18.6m (£15.8m PV) against the Locally Preferred Scheme (0.5% AEP). This document presents a transparent and accurate case for investment.

1.2 Strategic case

1.2.1 LCC has a long standing strategic ambition for the city to be protected from a flood with a 0.5% AEP risk of occurring within any given year (0.5% AEP standard of protection) and to ensure the city is resilient to climate change. Leeds is the third largest employment centre in the UK and contributes £16.3 billion gross value added (GVA) to the UK economy annually. Managing flood risk effectively is essential to sustain commercial confidence and to ensure that Leeds remains an attractive location in which to do business.

1.2.2 Leeds is a major transport hub centred on Leeds Station, the future terminus of HS2. The River Aire valley upstream of the station provides a vital transport corridor, with eastern rail lines linking Kirkstall, Airedale and commuter settlements in Wharfedale to the wider national rail network. The A65 passes along the river corridor, and this is the primary highway connection between Leeds Station and Leeds Bradford International Airport, and for many businesses and commuters based in the west of the city.

1.2.3 The Local Choice Preferred Scheme is critical to the delivery of several of the ambitions within Leeds City Council's Best Council Plan, most notably 'Supporting communities and tackling poverty' and 'Promoting sustainable and inclusive economic growth'.

1.2.4 A catchment-wide approach to options identification and appraisal has been adopted by Leeds City Council, working in close partnership with the Environment Agency, to ensure that the solutions proposed are cost-effective and sustainable in the long term.

1.2.5 The Local Choice Preferred Scheme aligns with the Upper Aire Flood Risk Management Strategy, which was produced and approved by the Environment Agency in 2010. This strategy identifies flood defences for Leeds to 0.5% AEP standard of protection within the Short Term Objectives.

1.2.6 The LFAS2 project has the following objectives:

- to reduce flood risk to people and property as much as can be economically justified, providing a good standard of protection to the areas currently at risk;
- to stimulate sustainable economic growth in developed and previously developed floodplain areas, where there is no scope to restore these to functional floodplain;
- to increase the ability of people and businesses to cope with, and rapidly recover from, the impact of floods;
- to work in partnership with communities and stakeholders to create a great place for living; protecting and enhancing the natural environment and landscape, whilst improving access to recreational opportunities; and
- to demonstrate best value for money.

1.2.7 These objectives represent the breadth of the benefits that the Local Preferred scheme will provide and are being used to attract partnership funding contributions.

1.3 Economic case

1.3.1 A short list of options that have best potential to achieve the project objectives was developed comprising the following:

- Option 1 - Do nothing;
- Option 2 - Do minimum;
- Option 3a - Conveyance improvements and linear flood defences along the study reach with a wider conveyance corridor created upstream of Wellington Bridge;
- Option 3b – Conveyance improvements and linear defences plus removal of obstructions and corridor improvements plus natural flood management
- Option 4 - As above, plus construction of an on-line flood storage reservoir at Rodley.
- Option 5 - As above, plus construction of an on-line flood storage reservoir at Calverley.

1.3.2 Option 4 was discounted due to the potential adverse impact on existing environmental assets. Table 2 below summarises the scheme costs and benefits for options 3a, 3b and 5.

Table 2: Summary of Economic Assessment

	1.33% AEP	1.0% AEP	0.5% AEP
	Option 3a	**Option 3b**	**Option 5**
Scheme Description	**Walls and Minor Conveyance works**	**Option 3a plus Catchment-wide NFM programme and Wall Optimisation**	**Option 3b plus Calverley Storage Area**
Scheme Cost (£m)			
EA approval project capital cost	62.8	86.7	112.1
Economic Appraisal Present Value (£m) *	62.1	76.4	109.6
Total Damage(£m)			
Total Damages	35.4	34.3	25.5
Residual Damages (£m)			
Residual Damage (Residential)	*1.3*	*1.3*	*1.0*
Residual Damage (Non -residential)	*29.0*	*28.1*	*20.5*
Residual Damage (Other)	*5.1*	*5.0*	*4.1*
Benefits (£m)			
Damage Avoided	127.4	128.5	137.3
Intangible Benefits	0.6	0.7	0.7
Uplift to Phase 1 Benefits	0.0	0.0	14.4
Sub-total Flood Risk Benefits	***128.0***	***129.2***	***152.4***
Wider Benefits from NFM and habitat (OM4)	0.0	95.3	100.4
Total Benefits	***128.0***	***224.5***	***252.8***
Net Present Value			
Net Present Value (Flood Risk Benefits Only)	65.9	52.8	42.7
Net Present Value (Flood Risk and Wider NFM Benefits)	65.9	148.1	143.2
iBCR			
iBCR (Flood Risk Benefits Only)	1.9	0.1	0.7
iBCR (Flood Risk and Wider NFM Benefits)	1.9	6.8	0.9
iBCR (inclusive of GVA Benefits)	12.9	6.8	4.0
BCR			
BCR (Flood Risk Benefits Only)	2.1	1.7	1.4
BCR (Flood Risk and Wider NFM Benefits)	2.1	2.9	2.3
BCR (inclusive of GVA Benefits)	12.8	11.7	9.4
Funding			
Defra FCERM GiA	7.6	7.6	7.6
Defra Booster	55.2	57.4	57.4
Local Contributions	0.0	6.9	28.5
Funding Shortfall	-2.2	14.8	18.6
	Economically Preferred Scheme compliant with Defra/EA Appraisal Guidance and PF Rules	Economically Preferred Scheme including NFM Benefits	Local Choice Preferred Scheme including benefits to Phase 1

*** Refer to** *Table 29* **and** *Table 33* **for details of the origins of the costs quoted Economically Preferred Scheme compliant with Defra/EA Appraisal Guidance and PF Rules (1.33% AEP)**

1.3.3 The Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG) was applied to determine the Leading Option. Five options, including the "Do Nothing" and "Do Minimum" Options were also evaluated.

1.3.4 Application of Stage 1 of the FCERM-AG (Page 273) identified that all shortlisted options had an average cost benefit ratio greater than 1. The option with the highest benefit cost ratio is the "Do Minimum" scenario.

1.3.5 The application of Stage 2 of the decision rules in FCERM-AG (excluding the wider benefits of natural flood management) indicates that the Leading option would be to carry out conveyance improvements and to construct linear defences where these are required along the reach to provide a 1.33% AEP standard of protection (SoP) to 2069, with a 20% peak flow uplift allowance for climate change impacts.

1.3.6 Application of the decision rules does not support the selection of the next option with a greater standard of protection, when the non-flood risk benefits of natural flood management are excluded from the 1.0% AEP option, as the iBCR is less than 3.0.

1.3.7 Therefore, the Leading Option is the 1.33% AEP standard of protection with allowance for climate change to 2069. The capital value of this option is **£62.8m** (**£56.2m PV)**.

1.3.8 The BCR of the Leading Option (excluding the wider benefits of natural flood management) is **2.1** and the iBCR is **1.9.**

1.3.9 Sensitivity testing was undertaken in accordance with Stage 4 of the decision rules. The sensitivity analysis did not change the selection of the Leading Option – the 1.33% AEP SoP with climate change to 2069.

1.3.10 The 1.33% AEP SoP with climate change to 2069 offers an equivalent 132 year standard of protection in 2019 and an equivalent standard of protection at the end of the appraisal period in 2118 of 75 years.

1.3.11 Therefore the Leading Option is confirmed as the Economically Preferred Scheme compliant with Defra/EA Appraisal Guidance and PF Rules (excluding the wider benefits of natural flood management). This has been used to calculate the FCERM GiA contribution.

1.3.12 This scheme is eligible for **£7.6m (£6.8m PV)** of FCERM GIA (**£5m (£4.6m PV)** pre-2021; **£2.6m (£2.2m PV)** post-2021).

1.3.13 This does not increase the indicative allocation of funding in the current spending review period.

1.3.14 *Table 3* summarises the approval values in capital cost and present value terms.

Table 3: Funding Allocations, Indicative Allocations and Contributions for the Economically Preferred Scheme

Economically Preferred Scheme compliant with Defra/EA Appraisal Guidance and PF Rules (1.33% AEP)	**Capital Cost (£m)**	**Present Value (£m)**
Scheme value	62.8	56.2
Total Contribution from Defra		
FCERM-GIA	7.6	6.8
Defra Booster	55.2	49.5
Local Contributions		
Not applicable	0.0	0.0
Sub-total	**62.8**	**56.3**
Indicative Allocation in FCERM Consented Programme to 2021*		
FCERM-GIA	5.0	4.6
Defra	29.1	27.0
Sub-total*	**34.1**	**31.6**
Indicative Allocation in FCERM Consented Programme post 2021*		
FCERM-GIA	2.6	2.2
Defra	26.2	22.4
Sub-total	28.7	24.6
Funding Required in addition to the indicative allocations in the consented programme (post 2021)		
FCERM-GIA	0.0	0.0
Defra Booster	0.0	0.0
Sub-total	0.0	0.0

*Current expenditure based on construction programme estimated through early supplier engagement

Economically preferred scheme including NFM Benefits (1.0% AEP)

1.3.15 The option for a 1.0% AEP scheme would bring transformational change delivering several of Governments strategic ambitions as set out in the 25 Year Environment Plan, and to do so on a landscape scale. It would significantly contribute to realising the vision of the Northern Forest in the Aire catchment, restore and create new habitat, increase biodiversity resilience, improve water quality through reduced sedimentation and provide c.£90million worth of benefits through carbon sequestration.

1.3.16 A Defra flood policy decision was made during the review of this business case that "although the significant natural flood features enhance the economic benefits by some 40%, they do not provide a sufficient increase in FCRM benefits that can support an increase of investment to the 1.0% AEP scheme".

1.3.17 The capital value of this option is **£86.7m (£77.2m PV)**.

1.3.18 Focussing on flood risk benefits only, the BCR of the 1.0% AEP scheme is **1.7** and the iBCR is **0.1.** When the non flood risk benefits of the natural flood management programme are included, the BCR is increased to **2.9** and the iBCR to **6.8**.

Table 4: *Funding Allocations, Indicative Allocations and Contributions for the* 1.0% AEP *scheme*

Economically Preferred Scheme including NFM Benefits (1.0% AEP	**Capital Cost (£m)**	**Present Value (£m)**
Scheme value	86.7	77.1
Total Contribution from Defra		
FCERM-GIA	7.6	6.8
Defra Booster	72.3	64.3
Local Contributions		
Woodland Trust	6.9	6.0
Sub-total	***86.7***	***77.1***
Indicative Allocation in FCERM Consented Programme to 2021		
FCERM-GIA	5.0	4.6
Defra	30.0	27.9
Sub-total	***35.0***	***32.5***
Indicative Allocation in FCERM Consented Programme post 2021		
FCERM-GIA	2.6	2.2
Defra	27.4	23.8
Sub-total	***30.0***	***26.0***
Funding Required in addition to the indicative allocations in the consented programme (post 2021)		
Defra Booster	14.8	12.5
Sub-total	**14.8**	**12.5**

Local Choice Preferred Scheme including additional Phase 1 Benefits

1.3.19 Providing a 0.5% AEP standard of protection for Leeds is critical to the delivery of several of the ambitions within Leeds City Council's Best Council Plan, most notably 'Supporting communities and tackling poverty' and 'Promoting sustainable and inclusive economic growth'.

1.3.20 The Economically Preferred Scheme would not provide protection to residents and businesses against a flood of the magnitude experienced in December 2015.

1.3.21 The Economically Preferred Scheme (1.33% AEP) does not satisfy the ambition set out in the Environment Agency's Upper Aire Flood Risk Management Strategy to deliver a 0.5% AEP standard of protection for Leeds. The Economically Preferred Scheme (1.33% AEP) would provide a lower standard than is currently provided to the Phase 1 area, and does not meet all of the critical success factors for reducing flood risk in the city. Furthermore, it would leave an unacceptable level of residual risk post implementation which would negate the investment in a flood event of a magnitude greater than 1.33% AEP.

1.3.22 The standard of protection offered by the economically preferred option (1.33% AEP) derived through application of appraisal guidance and partnership funding rules and the Defra policy decision on excluding non-FCERM benefits is not acceptable to LCC and

there is arguably a strong economic case for Government to support the 1.0% AEP scheme as the economically preferred solution. LCC consider that a total contribution of circa £83.6m FCERM-GIA is a sound economic investment with a single BCR of 2.9.

1.3.23 Further consideration was given by Leeds City Council to the next incremental options to provide a higher standard of protection to Phase 2 in accordance with Stage 5 of the FCERM guidance.

1.3.24 The 1.0% AEP SoP with climate change to 2069 would also not provide protection residents and businesses against a flood of the magnitude experienced in December 2015. It also does not satisfy the ambition set out in the Environment Agency's Upper Aire Flood Risk Management Strategy to deliver a 0.5% AEP standard of protection for Leeds.

1.3.25 Leeds City Council do not consider therefore, that the 1.0% AEP scheme delivers a good standard of protection for the residents, businesses and the community along the reach. It does not meet all of the critical success factors for reducing flood risk in the city. Furthermore, it would leave an unacceptable level of residual risk post implementation which would negate the investment in a flood event of a magnitude greater than 1.0% AEP.

1.3.26 Due to the physical constraints of the catchment and to ensure that Phase 2 does not adversely impact on Phase 1, the highest SoP which can be achieved is a 0.5% AEP standard of protection with climate change allowance to 2069.

1.3.27 The 0.5% AEP year SoP with climate change to 2069 offers an equivalent 270 year standard of protection in 2019 and an equivalent standard of protection at the end of the appraisal perion in 2118 of 160 years.

1.3.28 The capital cost of the Best Alternative Option, hereafter referred to as the Local Choice Preferred scheme is **£112.1m (£99.7m PV).** This delivers a BCR of **2.3** and an iBCR of **0.9**. The iBCR is not greater than 3 and therefore does not change the outcome of Stage 2 of the Decision rule.

1.3.29 The Local Choice Preferred scheme would deliver a consistent level of protection across both the Leeds FAS Phase 1 and Phase 2 reaches, eliminating the requirement for future interventions. This effectively delivers Phase 3 of the Leeds FAS at the same time.

1.3.30 The Local Choice Preferred scheme incorporates flood storage upstream of the Phase 2 reach at Calverley. This storage enables the heights of the walls to be reduced throughout the Phase 2 reach, reducing the impact of the proposals on riparian residents, the local community and businesses and not severing the connection between the river and the urban realm.

1.3.31 The Local Choice Preferred scheme would also introduce new wetland and woodland habitat within the reach in addition to the natural flood management proposed in the 1.0% AEP scheme across the catchment upstream of the city, providing further benefits to the ecology and the environment as well as the associated social wellbeing and health benefits. The proposals include the provision of new access bridges and tracks to improve connectivity between communities and the environment.

1.3.32 In addition to the benefits derived by the Economically Preferred scheme under the FCERM-AG, and the wider benefits derived by the 1.0% AEP scheme (inclusive of the non -FCERM benefits), the Local Choice Preferred scheme will also deliver significant economic benefits and is estimated to generate GVA benefits of **£774m** when assessed using the HM Treasury Green Book Appraisal Guidance.

1.3.33 Notably outside of the allocation model, within the Defra Partnership funding policy, the Local Choice Preferred scheme could indirectly better protect **971 exisiting residential** properties, in blocks of flats within the flood zone. The project will help create an additional **1,669 jobs**, unlock housing land for **1,613 new houses**. The scheme would provide improved flood protection to **370 businesses** in the reach. **The benefit to cost ratio, including GVA, is 9.4.** These costs are inclusive of risk (95th percentile) and take into account the differing extents of wall required. They are also inclusive of LCC and Technical Advisor costs.

1.3.34 The Local Choice Preferred Scheme therefore satisfies the UK Government and Leeds City Councils aspirations to provide a good level of protection whilst also delivering wider economic benefits for the Leeds City Region and UK PLC. It would also support the recent National Infrastructure Commission recommendation that for a 0.5% AEP standard for major cities.

1.3.35 Sensitivity analysis on the Best Alternative Option confirmed that the BCR would not reduce to less than one unless there was a significant increase in costs of **£143m PV** in addition to the **£109.6m PV** cost of the 0.5% AEP scheme or a reduction in benefits of **56%**.

1.3.36 The funding strategy for the Local Choice Preferred Scheme is summarised in *Table 5* below.

1.3.37 LCC are contributing **£10m (£8.9m PV**) capital funding, actively seeking and underwriting primary contributions of **£18.5m (£16.7m PV**) including the contribution from the Woodland Trust. LCC are underwriting the risk of the scheme above the approval value of £112.1m, protecting the FCERM-GIA allocation and take on the future operation and maintenance of the scheme at an estimated cost of circa £7m PV.

1.3.38 Taking account of LCC contributions, the funding shortfall for the locally preferred scheme including Phase 1 Benefits is **£18.6m (£15.6m PV)** on the basis of a contribution from Defra of £65m. If Defra increase the funding allocation to the value of the 1.0% AEP scheme, the funding shortfall is **£3.8m (£3.2m PV)**.

1.3.39 LCC are actively seeking contributions to close this residual gap of **£3.8m (£3.2m PV)** in funding including securing other funding sources and completing a competitive tendering exercise.

Table 5: Funding Allocations, Indicative Allocations and Contributions for the Local Choice Preferred Scheme (0.5% AEP)

Local Choice Preferred Scheme including additional Phase 1 Benefits (0.5% AEP)	**Capital Cost (£m)**	**Present Value (£m)**
Scheme value (A)	112.1	99.7
Total Contribution from Defra		
FCERM-GIA	7.6	6.8
Defra Booster	72.3	64.0
Sub-total (B)	**79.8**	**70.8**
Currently programmed as follows		
FCERM-GIA (Pre 2021)	5.0	n/a
Defra Booster (Pre 2021)	30.0	n/a
FCERM-GIA (Post 2021)	0.0	n/a
Defra Booster (Post 2021)	30.0	n/a
Sub-total (C)	**65.0**	**n/a**
To be amended following application of FCERM-AG confirming the Economically Preferred Option		
FCERM-GIA (Pre 2021)	5.0	4.6
Defra Booster (Pre 2021)	29.1	27.0
FCERM-GIA (Post 2021)	2.6	2.2
Defra Booster (Post 2021)	26.2	22.4
Sub-total (D)	**62.8**	**56.2**
Local Contributions		
Leeds City Council Contributions	10.0	8.9
Woodland Trust	6.9	6.0
Primary funding sources identified and underwritten by LCC	11.6	10.7
Sub-total (E)	**28.5**	**25.6**
Funding Shortfall if Defra contribute to the Economically Preferred Option (1.33% AEP) (A-D-E)	20.8	17.8
Funding Shortfall if Defra contribute £65m (A-C-E)	18.6	15.5
Contribution from Defra towards 1.0% AEP		
FCERM-GIA (Pre 2021)	5.0	4.6
Defra Booster (Pre 2021)	30.0	27.8
FCERM-GIA (Post 2021)	2.6	2.2
Defra Booster (Post 2021)	42.3	36.2
Sub-total (F)	**79.8**	**70.8**
Residual Shortfall if Defra contribute £79.8m (A-E-F)	**3.8**	**3.2**

1.4 Commercial case

1.4.1 A contract for the feasibility and preliminary design services was awarded to BMMjv (BAM Nuttall and Mott MacDonald joint venture), with support from Arup and Thomas Mackay Limited and was tendered through Lot 4 of the WEM Framework.

1.4.2 The construction phase of the works will be tendered competitively through Lot 4 of the WEM Framework. The NEC3 Engineering Construction Contract (ECC), Option C Target Cost Contract with activity schedule, will be used.

1.4.3 A separate Technical Advisory Services contract is proposed. This will be tendered competitively and will make use of the NEC3 Professional Services Contract.

1.4.4 The construction cost estimate has been generated by BMMjv Cost Team and verified by cost manager using the Project Cost Tool benchmarked against the actual costs from the Leeds FAS Phase 1 over the past 36 months and information related to similar schemes completed elsewhere. The costs have also been benchmarked against the Environment Agency's project cost tool.

1.5 Financial case

1.5.1 The summary breakdown of the Local Choice Preferred Scheme over the next five years and beyond is shown in *Table* 6 below. The total capital cost estimate is **£112.1m**.

Table 6 - Profile of costs

(£k)	Economic appraisal (PV)	Whole-life cash cost	Total project cost (approval)
Costs up to OBC	1,991	1,991	1,991
Costs after OBC			
Staff costs	2,940	3,281	3,281
External fees	4,000	4,452	4,452
Construction & site costs	45,651	51,137	51,137
Natural Flood Management	13,154	15,000	15,000
Environmental	4,668	5,523	5,523
Optimism Bias	29,688	33,397	-
Risk at 95%ile or similar[1]			26,635
Risk at 50%ile or similar	-	-	
Risk – Calverley Flood Storage Reservoir	-	-	1,585
Inflation			2,505
Future costs (construction + maintenance)	5,027	16,818	-
	2,514	8,409	
Future optimism bias	-	-	
Project total costs	**109,632**	**140,010**	**112,110**

1.5.2 The annualised spend profile is shown in *Table 7* below.

1.5.3 In the aftermath of the 2015 Boxing Day flood which was of a magnitude in excess of a 0.5% AEP event, as part of the spring 2016 budget the government announced a new flood alleviation scheme in Leeds which would include traditional flood defences, upstream storage and natural flood management measures throughout the upper catchment to provide a good level of protection for Leeds. The indication at this time was that the total cost would be in the order of £65 million using estimates developed prior to 2015. The commitment by government was based on the scheme being eligible for £5m FCERM GiA and a provision of remaining funding through the Defra Booster fund of £30m between then and 2021 and an indicative allocation of £30m thereafter to complete the scheme subject to business case approval.

[1] For the purpose of calculating the net present value for the economic appraisal and whole life costs, an optimism bias value was applied at 50%, which exceeded the 95%ile risk value derived in a detailed quantitative assessment of the risks associated with the best alternative scheme undertaken by the project team, which was then run through a Monte Carlo simulation. The Risk value represents 50% of the approval value following deduction of the Natural Flood Management Measures and Advance works, which already incorporate an allowance for risk.

1.5.4 The Economically Preferred Scheme, compliant with Defra/EA Appraisal Guidance and PF Rules, is a scheme that provides a 1.33% standard of protection with climate change to 2069. This has a capital cost of **£62.8m (£56.2m PV)**.

1.5.5 The Economically Preferred Scheme, inclusive of Non-FCERM benefits, is a scheme that provides a 1.0% AEP SoP (with climate change to 2069) and has a capital cost of **£86.7m (£77.2m PV)**.

1.5.6 The Local Choice Preferred Scheme, with additional Phase 1 benefits, is a scheme that provides a 0.5% AEP standard of protection with climate change to 2069. This has a capital cost of **£112.1m (£99.7m PV).**

1.5.7 If this scheme is supported, Leeds City Council (LCC) will lead on its delivery, contribute **£10m (£8.9m PV)** to the cost, underwrite **£18.5m (£16.7m PV)** of other local contributions, underwrite all risk of overspend protecting the FCERM-GIA allocation and will take on the future operation and maintenance of the scheme at an estimated cost of circa £7m PV.

1.5.8 Taking account of LCC contributions, the funding shortfall for the Locally Preferred scheme is **£18.6m (£15.6m PV)** on the basis of a contribution from Defra of £65m. If Defra increase the funding allocation to the value of the 1.0% AEP scheme, the funding shortfall is **£3.8m (£3.2m PV)**. LCC are currently seeking confirmation of funding from the Floods Minister.

1.5.9 LCC are actively seeking contributions to close the residual shortfall of **£3.8m (£3.2m PV)** in funding including securing other funding sources and completing a competitive tendering exercise.

1.5.10 In the event of an overspend, if costs increase above the approved amount of **£112.1m**, then LCC will look to fund these costs directly or from local contributions.

Table 7: Overall affordability

Annualised spend profile (£m)	**Yr 0 2017**	**Yr 1 2018**	**Yr 2 2019**	**Yr 3 2020**	**Yr 4 2021**	**Yr 5+ 2022+**	**Total**	
Construction & other costs	2.1	4.2	14.9	19.9	20.1	22.8	**83.9**	
Optimism bias & risk	0.0	1.0	5.4	7.3	7.4	7.2	**28.2**	
Project total costs	2.1	5.2	20.3	27.1	27.4	30.1	**112.1**	
FCERM-GIA								
Consented Programme to 2021	0.0	0.0	2.4	2.6	0.0	0.0	5.0	**7.6**
Allocation required post 2021	0.0	0.0	0.0	0.0	1.3	1.3	2.6	
Defra Booster								
Consented Programme to 2021	2.1	4.1	9.5	14.1	0.0	0.0	30.0	**72.3**
Funding Request post 2021 - Inclusive of an indicative allocation of £30m	0.0	0.0	0.0	0.0	18.3	9.2	27.4	
Funding Request post 2021	0.0	0.0	0.0	0.0	1.3	13.6	14.8	
Subtotal	***2.1***	***4.1***	***11.9***	***16.9***	***20.8***	***24.0***	***79.8***	
Less: Contributions								
LCC	0.0	0.0	2.4	3.3	1.8	2.5	10.0	
LCC Underwriting of Contributions	0.0	1.0	5.3	5.3	0.0	0.0	11.6	
Woodlands Trust	0.0	0.0	0.7	1.6	2.2	2.4	6.9	
Sub-total	2.1	5.2	20.3	27.1	24.8	28.9	109.3	
Current Funding Shortfall	0.0	0.0	0.0	0.0	2.6	1.2	3.8	
Total	**2.1**	**5.2**	**20.3**	**27.1**	**27.4**	**30.1**	**112.1**	

Note: The figures used in this table are to 1 decimal point and as such incur some minor variation through rounding, however this does not effect the totals.

1.5.11 The project team are expediting the delivery of the scheme at pace with an anticipated start on site in Summer 2019. If there is a delay to the approval of the scheme, the construction programme may slip. In this scenario the funding profile and draw-down of contributions would alter and may significantly affect the affordability of the scheme as it would jeopardise time limited primary funding sources identified.

1.5.12 Since January 2016, a better understanding of the engineering and land acquisition required to implement Phase 2 has been developed; and these works have now been costed and valued by the Contractor who built Phase 1. The indicative costs discussed in January 2016 were £65m, but with the new understanding and with contractor costings a revised figure is now **£112.1m (£99.7m PV).**

1.5.13 Without external national funding to make up the **£14.8m (£12.6m PV)** shortfall, then it is unreasonable to assume that the **£28.5m** allocation underwritten by LCC to provide for a 0.5% scheme is guaranteed. This offer is likely to lose support because it will be unattractive for developers and investors and so the expected creation of new jobs and a stronger economy will be lost. The programme for delivery is likely to be impacted and there is potential that promotion of Leeds FAS Phase 2 and 3 will stall. The goodwill and support of the Planners, of stakeholders and the wider public may be lost, and the knowledge and understanding of Council officers and their counterparts at the Environment Agency will be dissipated. The new opportunities promised by Leeds FAS Ph2 and Ph3 will not be realised, and existing employment and residential properties and the city infrastructure will continue to be vulnerable to the flooding witnessed in December 2015

1.6 Management case

1.6.1 This scheme will be managed by Leeds City Council (LCC), the Lead Local Flood Authority.

1.6.2 In accordance with the Integrated Assurance & Approvals Plan (IAAP), there are three lines of assurance embedded in the structure and governance of the scheme.

1.6.3 The first line of assurance is the 'Frontline' – this is carried out by the Project Team, Project Director, Project Board and Programme Board who will ensure quality standards are being followed. The principle of "getting it right first time" is being adopted for all aspects of the project including planning, risk management, reporting and governance.

1.6.4 The second line of assurance is 'Management Overview and Compliance' – this is carried out to ensure that the frontline controls are working, and operating standards are being complied with.

1.6.5 The third line of assurance is 'Independent Assurance' – carried out by people totally independent of project/programme delivery. It checks that both the frontline and management overview compliance assurance is working.

1.6.6 The Leeds FAS Programme Board, which was established in 2013 to govern Phase 1 of the scheme, will also be responsible for the governance of Phase 2. The Programme Board includes representatives from Leeds City Council, the Environment Agency, Yorkshire Wildlife Trust, Yorkshire Water Services Limited and Network Rail.

1.6.7 For the Phase 2 scheme, the Programme Board will be attended by the LCC Project Director and representatives from the successful delivery partner. This Programme Board will be supplemented by Project Boards for work packages within the project. Change management will be managed and reported in accordance with Leeds City Councils Project Management methodology, and also in accordance with the NEC conditions of contract. All project variations will be reported to the Programme Board and will need to be within the Executive Board approved budget for the delivery of the scheme.

1.6.8 The key strategic risks have been assessed using the Risk Potential Asssement in accordance to Major Project governance. This concludes the scheme is Medium Risk

because of the uncertainty relating to the funding commitment from Defra. Once this is confirmed, it is anticipated that the overall rating will become Low.

1.6.9 The key strategic risks identified, and how they are being managed, are summarised below:

- **Political:** The scheme requires the support and full engagement of a wide range of partners across political boundaries within the River Aire catchment. The risk is that partners and political commitment to supporting the scheme varies and becomes a barrier to delivery. This is being actively managed through the Programme Board composition and the stakeholder engagement strategy.
- **Financial:** Risks identified within this section include the amount and possible conditions attached to both the primary and secondary funding sources identified.
- **Dependencies:** A delay in the approval, or related funding commitment from the Floods Minister represents a significant risk to the programme spend, and the confidence of other funders. This could jeopardise time limited primary funding sources already identified which in turn may significantly affect the affordability of the scheme. This is being managed through ongoing political and assurance engagement, and is supported through updates to the Environment Agency's programme management office.
- **Public:** the works will impact on local residents, a school, river users and local wildlife sites and existing flood plain currently in private ownership. These risks are being managed through public consultation, environmental impact assessment and partnership working with local groups including volunteers.

1.7 Recommendation

1.7.1 The thorough options appraisal has identified three main scheme options for consideration.

1.7.2 In the aftermath of the 2015 Boxing Day flood which was of a magnitude in excess of a 0.5% AEP event, as part of the spring 2016 budget the Government announced a new flood alleviation scheme in Leeds which would include traditional flood defences, upstream storage and natural flood management measures throughout the upper catchment to provide a good level of protection for Leeds. The option for a 0.5% AEP scheme, the Locally Choice Preferred Scheme, would alleviate the impact of a re-occurrence of the 2015 Boxing Day flood and so provide maximum confidence of low flood risk for future investors.

1.7.3 The Local Choice Preferred Scheme would deliver a consistent level of protection across both the Leeds FAS Phase 1 and Phase 2 reaches, eliminating the requirement for future interventions. This option effectively delivers Phase 3 of the Leeds FAS at the same time. It would realise the recent National Infrastructure Commission recommendation that for a 0.5% AEP for major cities.

1.7.4 **Whilst we recognise that subject to appraisal guidance and partnership funding arrangements, the derived option is a 1.33% AEP solution, this does not meet with LCC critical success factors and does not yield the greatest economic benefit. We recommend therefore that consideration is given to extend beyond the policy-derived solution and we seek approval for the local preferred choice (0.5% AEP) as set out in this business case.**

1.7.5 If this scheme is supported, Leeds City Council (LCC) will lead on its delivery, contribute £10m to the cost, underwrite £18.5m of other local contributions, underwrite all risk of overspend and take on the operation and maintenance estimated to cost c.£7m.

1.7.6 The Leader of LCC, with full support from all parties within the council, cross party support from all eight Members of Parliament for Leeds, the Chambers of Commerce and the Chief Executive, is currently seeking confirmation of funding from the Floods Minister.

2 Strategic case

2.1 Introduction

2.1.1 The Local Choice Preferred Scheme promoted within this Outline Business Case stems from a long standing strategic ambition for the city to have a 0.5% AEP standard of protection (SoP) and to ensure the city is resilient to climate change.

2.1.2 In the immediate aftermath of the devastating 2015 Boxing Day flood, which was of a magnitude in excess of a 0.5% annual exceedance probability (AEP) event, the Government announced a new flood alleviation scheme in Leeds. This would include traditional flood defences, upstream storage and natural flood management measures throughout the upper catchment to provide a good level of protection for Leeds. The indication at this time was that the total cost of a 1% AEP would be in the order of £65m using estimates developed prior to 2015. The commitment by Government in the spring 2016 budget was based on the scheme being eligible for £5m FCERM GiA and a provision of remaining funding through the Defra Booster fund of £30m between then and 2021 and an indicative allocation of £30m thereafter to complete the scheme subject to business case approval.

The problem and the need for intervention

2.1.3 Leeds is the third largest employment centre in the UK and contributes £16.3 billion gross value added (GVA) to the UK economy annually. The study area is primarily employment land, which makes a significant contribution to this overall total. Managing flood risk effectively is essential to sustain business confidence and to ensure that Leeds remains an attractive location in which to do business.

2.1.4 Leeds is a major transport hub, centred on Leeds Station, the future terminus of HS2. The River Aire valley upstream of the station, provides a vital transport corridor, with eastern rail lines linking Kirkstall, Airedale and commuter settlements in Wharfedale to the wider national rail network. The A65 passes along the river corridor, and this is the primary highway connection, between Leeds Station and Leeds Bradford International Airport, and for many businesses and commuters based in the west of the city.

2.1.5 Communities along this reach of the river are still recovering from the extensive damage and disruption caused by a major flood in December 2015. In spite of this flood occurring on a public holiday (Boxing Day), the flooding still heavily affected local businesses, a number of which have failed or have relocated outside of the area. Had the flood occurred in working hours, the impacts would have been far more severe.

2.1.6 There are established pockets of existing housing along the reach and aspirations for significant new housing developments on brownfield site along the Aire Valley within the LCC Boundary, capitalising on the transport connectivity and riverside amenity.

2.1.7 Most areas upstream of the station do not currently benefit from formal flood defences meaning that there is no consistent level of protection against flooding. The only formal flood defences are upstream of Kirkstall Bridge which protects the recently constructed retail park.

2.1.8 There are a number of structures which have been identified as potentially fulfilling a flood defence function. These are described in *Table 8*.

Table 8: Structures identified as potentially fulfilling a flood defence function

Ref	Description
A	Left bank sheet pile and masonry clad walls between Kirkstall Abbey weir and Kirkstall Bridge
B	Left bank embankments beside shopping centre access road between Kirkstall Bridge and Morrison's.
C	Kirkstall goit sluice gates
D	Embankments beside Kirkstall goit.
E	Left bank walls between Armley Mills and Viaduct Road
F	Left bank walls between Viaduct Road and the A58
G	Left bank walls around the old "Yorkshire Post" site.

2.1.9 There a number of obstructive structures located within the reach. These are described in *Table 9* below.

Table 9: Obstructive structures in the reach

Ref	Description
A	The dry arch at Kirkstall Road bridge.
B	Redcote Lane bridge substructure
C	Armley Mills weir
D	Armley Mills goit
E	Armley Mills redundant rail bridge
F	Milford Place footbridge
G	Viaduct Road bridge
H	The 4 left hand arches at the Dark Arches

2.1.10 The study area has been subject to flooding on eight occasions in the past 150 years, most recently in 2015. *Table 10* lists the major flood history for the area.

Table 10: Major Flooding History

Date	Description of Event
November 1866	This is the largest recorded flood on the River Aire at Leeds, during which several people drowned. Floodwater ran down Kirkstall Road to a depth of 1m, and into city centre
September 1931	Severe flooding in Leeds.
January 1939	Kirkstall power station was inundated with floodwater.
January 1944	Severe flooding in the lowland areas and in Leeds.
September 1946	Flooding throughout catchment; the largest flood in Leeds on record since 1866. Floodwater ran down Kirkstall Road and into city centre.
October/ November 2000	The severity of the peak flood level in Leeds was estimated at a 1 in 25 (4% AEP) year event. 100 properties flooded. Flooding of Leeds city centre narrowly avoided. Halifax Building Society temporarily transferred a call centre to Northern Ireland at a cost to them of £1M.
August 2004	Flooding from surface water and tributaries triggered by intense short-duration rainfall. Estimated at 1 in 3 (33% AEP) year event
June 2007	Serious flooding throughout the catchment and wider area, affecting 400 properties and causing £80 million damages across Leeds, York and Wakefield. 80 properties flooded in Leeds. Estimated at 1 in 13 (8% AEP) year event.
December 2015	Serious flooding on boxing day resulted in the flooding of 678 commercial properties and 3368 residential properties, as well as other significant infrastructure including highways, railways, electricity sub-stations and telecommunications installations across Leeds.

2.1.11 Hydraulic analysis indicates that the threshold of flooding in the study area is a 1 in 30 year flood, following which the River Aire overtops its banks and results in flooding to properties and infrastructure.

2.1.12 The areas with the lowest standard of protection are at St. Ann's Mill and Weaver Street. Commercial and office properties are at risk in these locations.

2.1.13 The railway has a standard of protection of less than a 1 in 2 years.

2.1.14 Existing communities and businesses remain at significant risk and flooding remains a major disincentive to development. The floods on Boxing Day 2015 only served to highlight how vulnerable some parts of the city still remain.

2.2 Strategic alignment

2.2.1 There are a number of strategic regional and local strategies which support the development of Leeds Flood Alleviation Scheme Phase 2 (LFAS2). These strategies are described below.

2.2.2 The Local Choice Preferred Scheme is critical to the delivery of several of the ambitions within Leeds City Council's Best Council Plan, most notably 'Supporting communities and tackling poverty' and 'Promoting sustainable and inclusive economic growth'. The Vision for Leeds includes the following key priority areas:

- Best City for business – comprehensively supporting the sustainable growth of the Leeds economy through safeguarding jobs in the area protected by flood defences. The Local Choice Preferred scheme positively impacts on opportunities presented by the South Bank Master Plan (Europe's largest regeneration area with the potential to create 35,000 new jobs and 4000 new homes), High Speed 2, the A65 Kirkstall corridor and its interface with wider existing Network Rail infrastructure.
- Best City Region – The Local Choice Preferred scheme protects accessibility to the city, thus contributing to the Vision for Leeds 2030 by safeguarding the city region transport strategy and helping the city become ready for High Speed 2.
- Best City for health and well-being – supporting people to live in their homes, earn their livelihoods, run their businesses and enjoy their city safely. By adopting a catchment based approach to flood risk management citizen engagement and stewardship will enable Leeds to realise a holistic solution to flood risk management. The people of Leeds and the Aire catchment will be at the vanguard of community ownership, with high engagement with their quality places and sound knowledge of their local flood protection measures.
- Best City to live – enabling the growth of Leeds whilst protecting the distinctive green character of the city through works to waterfront areas, emphasising the civic and community importance, whilst fitting within urban context, sense of place and identity.
- Strong nationally and internationally – An innovative engineering approach together with a community connection places Leeds at the forefront of engineering flood risk management solutions which would be globally recognised.

2.2.3 This scheme aims to bring transformational change that will deliver several of Defra's strategic ambitions set out in the 25 Year Environment Plan, and to do so on a landscape scale. It will realise the vision of the Northern Forest in the Aire catchment, restore and create new habitat, increase biodiversity resilience and improve water quality through reduced sedimentation. By taking a catchment approach and incorporating flood storage areas, the raised defences in the city itself will be lower, enabling the waterfront to become a core feature of the city's regeneration and so keeping the river open for future generations to enjoy.

2.2.4 The Local Choice Preferred scheme aligns with the Upper Aire Flood Risk Management Strategy, which was produced and approved by the Environment Agency in 2010. This strategy identifies "Flood defences for Leeds" within the Short Term Objectives.

2.2.5 This project is located within the Humber River Basin and is part of the River Basin Management Plan (RBMP) Humber River Basis District[i]. The objective of the RBMP is to encourage organisations to work together to improve the environment. The plan focuses on the protection, improvement and sustainable use of the water environment. The RBMP identifies that the key reasons for poor status of the River Aire is due to foul and surface water discharges, physical modifications and diffuse pollution from agriculture. This project aims to align within these core objectives by incorporating works to enhance and restore the existing river bank and habitats adjacent the river. The programme of natural flood management measures will also assist in reducing surface water runoff and sediment mobilisation to the River Aire.

2.2.6 The National Infrastructure Commission (July 2018) recommended that all properties should where feasible benefit from a minimum 0.5% AEP standard of protection or greater for large urban areas and cities. The Local Choice Preferred scheme would achieve this standard of protection.

2.2.7 The Local Choice Preferred scheme also contributes significantly to a number of other strategic regional and local strategies, summarised below.

2.2.8 It is key to the future growth of the Leeds City Region (LCR). The Strategic Economic Plan (SEP) was published by LCR Local Enterprise partnership (LEP) in 2016. It sets the framework for investment decisions by the LEP with the ultimate aim of growing the Leeds City Region's economic potential. The plan states flood risk reduction is a key area that is critical to future perfomance of the region and is a significant issue for growth. The SEP identifies a flood risk reduction programme incorporating flood defences, green infrastructure and resilient development as one of its headline priorities. It also states that its spatial priority areas – the largest of which is the Leeds South Bank – need to incorporate resilience to climate change and ensure access to high quality green (& blue) infrastructure is provided in order to maximise the inclusive growth potential of the city region economy.

2.2.9 The area benefiting from the scheme extends from the west of the city boundary into the heart of the city. It is directly adjacent to Leeds Station, a major transport hub and the future terminus of High Speed 2. The River Aire valley upstream of the station provides a vital transport corridor, with the A65 and eastern rail lines linking Kirkstall, Airedale, Bradford and commuter settlements in Wharfedale to the wider national transport network. This project will play a significant role in realising the full economic benefits of existing government investment in transport infrastructure. There are also established housing areas along the reach which will benefit from the scheme.

2.2.10 On a sub-regional level the Leeds Social and Economic Growth Strategy is centred on creating opportunities and prioritising growth. The provision of a higher SoP will support the development of the employment opportunities, protect housing within the Aire Valley and increase the resilience of infrastructure throughout the valley. The scheme will also deliver improvements and enhancements to the environonments and habitats along the waterfront.

2.2.11 Other relevant sub-regional strategies include:

- Leeds City Region Green & Blue Infrastructure Strategy;
- West Leeds Development plan and
- West Yorkshire Combined Authority's Green Streets initiative.

2.3 Development of the Phased Approach to the Leeds FAS

2.3.1 The first formal project appraisal for Leeds was in 2007, the Leeds FAS PAR ("the original PAR"), was approved in 2010 by the Environment Agency (EA) Board following review by the National Review Group. It presented a comprehensive scheme for the River Aire through the whole of Leeds. The preferred option was a 0.5% AEPSoP scheme

comprising 17.5km of raised riverside defences. This project had a scheme value of £188m in 2010.

2.3.2 In Autumn 2010, the Department for the Environment, Food and Rural Affairs (Defra) indicated to the EA and Leeds CC that this scheme was unlikely to be approved for funding. When considered by the EA under Partnership Funding arrangements, the comprehensive scheme remained unaffordable. The report "Leeds FAS – Post PAR High Level Option review," (February 2011), re-considered aspects of the scheme, including further consideration of upstream storage, replacement of restrictive bridges and value engineering, but this range of measures did not deliver the necessary cost reductions.

2.3.3 The EA subsequently commissioned the Leeds Alternative Solutions Study (LASS) (Nov 2011) to consider the potential affordability of a smaller scheme focussed on the city centre downstream to the Lower Aire Valley Enterprise Zone. This study included assessment of proposals to replace existing weirs on the navigation with movable structures.

2.3.4 The "Leeds City Flood Alleviation Scheme PAR" (2013) developed from the LASS and presented the business case for options developed in that study. Leeds City Council (LCC) planned to address the flood risk to Leeds in phases with the first phase protecting the city centre from Leeds train station to Knostrop, including works at Woodlesford.

2.3.5 Leeds Flood Alleviation Scheme Phase 1 (LFAS1) was led by LCC, with support from Arup, and delivered by BMMjv under the Environment Agency's WEM Framework in 2017. This scheme reduces the risk of flooding to properties and people between Leeds railway station downstream to Woodlesford and involves the modification of the Crown Point and Knostrop Weirs, the merging of the canal and river at Knostrop and the construction of linear defences between Holbeck and Woodlesford.

2.3.6 The wider aspiration as defined by the Upper Aire Flood Risk Management Strategy (2010) is to provide a 0.5% AEP SoP. Due to funding constraints the Leeds Flood Alleviation scheme was sub-divided into 3 phases. Phase 1 was delivered in December 2017 and provides 1.0% AEP SoP to Leeds City Centre. Phase 2 was orginally intended to provide 1.33% AEP SoP from Newlay Bridge to upstream of the Leeds Station. The final phase was to uplift the defences to provide 0.5% AEP SoP from Newlay to Woodlesford.

2.4 Proposed Outcomes of Phase 2

2.4.1 This Phase 2, as now outlined in this business case, will meet the objectives of the original phases 2 and 3, by delivering a 0.5% AEP SoP in a single scheme. LFAS2 will protect residents and businesses along the reach from Newlay Bridge to Leeds train station, focusing on the areas worst affected during the December 2015 floods. The scheme will also provide increased flood protection downstream from Leeds Train Station to Woodlesford.

2.4.2 Any containment and conveyance improvements considered on LFAS2 have potential to increase peak flood flows and levels downstream. There is a strategic allowance of 2% was incorporated into the hydraulic design for LFAS1 for the potential increases in peak flow/level associated with containing floodwater in Leeds upstream of the station that was based on the information available at the time.

2.4.3 The impact of Phase 2 has been considered in all shortlisted options to ensure that there is no detriment to flood risk within the Phase 1 boundary.

2.4.4 LCC's ultimate strategy is to provide a consistent and good level of flood protection through the city[2] that is commensurate with Leeds' status as a core city, and its status as the third largest manufacturing city and the second largest financial and legal centre.

2.5 Environmental and other considerations

[2] It is considered strategically highly inadvisable to provide a higher SoP on LFAS2 than on LFAS1, as this would result in a potential future scenario where LFAS1 benefit areas flooded when LFAS2 was still protected.

2.5.1 The existing environment along the LFAS2 study reach is characterised by the urban and industrial nature of the city centre heading west to Kirkstall, with large areas of green space and agricultural land along the River Aire beyond the city up to Calverley. The River corridor is characterised by areas of mature woodland and vegetation including three clusters of Tree Preservation Orders (TPOs), and Kirkstall Valley Nature Reserve. There are no internationally or nationally designated ecological sites on this section of the River Aire. There are some locally designated sites of interest.

2.5.2 The River Aire serves as an important wildlife corridor with potential for fish, bats and otters extending west from the City. Invasive species are present along the river banks and include Japanese Knotweed, Giant Hogweed and Himalayan Balsam.

2.5.3 The physical constraints include:

- Local residential properties, community assets and businesses along the river banks,
- Kirkstall Abbey, a Scheduled Monument and the adjacent Kirkstall Weir;
- listed structures including Armley Mills and the existing sluice gates, Kirkstall Bridge, and several listed weirs;
- the Airedale and Wharfedale commuter railway line runs alongside the river and crosses it at multiple locations;
- the A65, a key highway corridor serving the western suburbs, Bradford, Ilkley, Skipton, Leeds Bradford Airport; and
- utilities including a substation, a Yorkshire Water Pumping Station at Calverley and high voltage overhead lines.

2.5.4 There are numerous recreational assets within the study area including public rights of way, public open spaces, sports facilities, canoe and fishing access, navigational waterways, the “Cycle Super Highway” to Bradford and two regionally/ nationally important museums.

2.5.5 A Preliminary Environmental Information Report (PEIR) has been prepared based on the preferred option to identify the environmental issues and opportunities that may arise from the scheme (Appendix M). This report will accompany a request for an Environmental Impact Assessment (EIA) Scoping Opinion from Leeds City Council in accordance with the Town Country Planning (EIA) (England and Wales) Regulations 2017 (the “EIA (Town and Country) Regulations”). A full Environmental Impact Assessment will be undertaken to support the planning application for the preferred option. The EIA will identify the impacts of the scheme, both positive and negative, and will discuss mitigation measures embedded into the design and enhancements to reduce the overall impact of the scheme on the environment and surrounding communities.

2.5.6 The PEIR has identified Ecology, Historic Environment, Townscape, Landscape & Visual Amenity, Water Environment and Noise and Vibration as key issues due to the sensitive nature and receptors along the River Corridor and areas of high ecological value including Kirkstall Valley Nature Reserve. In addition, the scheme area is rich in cultural heritage with designated sites and structures adjacent to the River including Kirkstall Abbey and Armley Mills.

2.5.7 The likely environmental impacts of the scheme in the short term, during construction are:

- potential construction impacts on the aquatic environment, residential property and businesses, community and recreational facilities;
- visual and noise impacts to residential properties and businesses during construction;
- permanent and temporary loss of habitat;
- risk of increased sedimentation during in-channel working within the River Aire and disturbance to the aquatic environment;

- reduced accessibility to existing riverside access;
- potential impact on setting of listed assets during construction if works are within close proximity;
- disturbance to, and risk of injury or killing of protected species and fish species, during construction; and
- clearance of invasive species along the river corridor.

2.5.8 The likely environmental impacts and opportunities in the medium to long term include:

- visual impacts associated with the linear defences in sensitive locations such as those within close proximity to residential properties and businesses;
- enhancements and improvements to existing ecology and quality of water under the Water Framework Directive; protection of designated historic assets from future flood risk such as Kirkstall Abbey and Armley Mills;
- removal of redundant structures increasing the risk of flood risk along the River Aire;
- potential creation of public amenity spaces and recreational areas;
- potential operational impacts to open space and recreational areas during a flood event;
- potential disturbance resulting from construction traffic routes through residential areas;
- changes to surface water drainage; and
- landscape maintenance and management plan for the River Corridor.

2.5.9 High walls will inevitably constrain opportunities to regenerate the river corridor, including at locations that may yet to have committed regeneration proposals in place.

2.5.10 Other assessments that have been undertaken to inform the PEIR are the Preliminary Ecological Appraisal (Appendix M) and a Water Framework Directive (WFD) Compliance Assessment (Appendix Q). The latter states that WFD objectives are:

- That the scheme results in no deterioration in waterbody status;
- The proposal does not prevent the achievement of good ecological status or potential of the waterbody; and
- The work will contribute to the WFD improvement measures to be delivered as part of the River Basin Management Plan.

2.5.11 Three waterbodies were identified to have potential for effects resulting from the scheme; 'Aire from Gill Beck (Baildon) to River Calder', 'Carlton Beck from Source to River Aire', and the 'Aire and Calder Carb Limestone/Millstone Grit/Coal Measure' groundwater body.

2.5.12 Following a preliminary WFD assessment, it was established that there was unlikely to be impact to Carlton Beck from Source to River Aire' and the 'Aire and Calder CarbLimestone/Millstone Grit/Coal Measures'groundwater body and these waterbodies were screened out of further assessment.

2.5.13 The detailed assessment of 'Aire from Gill Beck (Baildon) to River Calder waterbody concluded that the majority of the works will have negligible effect and will not cause deterioration in the status of the waterbody. However, the construction of the flood storage area control structure may result in a permanent change to the hydromorphology of the 'Aire from Gill Beck (Baildon) to River Calder' waterbody.

2.5.14 A targeted geomorphological assessment of the channel and banks will be carried out and, if necessary, recommendations made to reduce the impact of the new structure and channel arrangement.

2.5.15 With the implementation of the recommendations made, the Scheme is not expected to result in deterioration in the status of any WFD waterbodies, will not prevent the achievement of future known objectives, and provides opportunities to contribute to the delivery of the RBMP. Therefore, it is considered at this stage that the Scheme will be compliant with the WFD.

2.6 Investment objectives

2.6.1 To encourage and justify funding, investments and contributions the following objectives forming the scheme have been agreed, in consultation with stakeholders:

- to reduce flood risk to people and property as much as can be economically justified, providing a good standard of protection to the areas currently at risk;
- to stimulate sustainable economic growth in developed and previously developed floodplain areas, where there is no scope to restore these to functional floodplain;
- to increase the ability of people and businesses to cope with, and rapidly recover from, the impact of floods;
- to work in partnership with communities and stakeholders to create a great place for living within - protecting and enhancing the natural environment and landscape, whilst improving access to recreational opportunities within the study boundary and the wider catchment; and
- to demonstrate best value for money.

2.6.2 The primary funding sources for the scheme, and their objectives, are as follows:

- Environment Agency (EA) Flood and Coastal Erosion Risk Management (FCERM) Grant in Aid:
  - To reduce the risk of flooding to households and avoid the cost of damages associated with flooding to households, businesses, agriculture, local government, communications, infrastructure, utilities and public health.
- Defra Booster Funding:
  - This funding, provided by Defra to specific communities and cities following the devastation of the December 2015 floods, enabled schemes to be progressed and delivered at an accelerated pace.
- Leeds City Council Capital Contribution and Underwriting of others
  - LCC contribution to a 0.5% AEP standard of protection to increase flood resilience and reduce the risk of flooding where possible across the Leeds City Centre and Kirkstall Road areas to a good standard of protection.

2.7 Current arrangements

2.7.1 EA main river flood management activities along the main river Aire within the Phase 1 and Phase 2 areas is focused on planning, permitting and development regulation, awareness raising, flood warning, emergency response, as well as periodic channel inspection and maintenance.

2.7.2 LFAS1 comprises floodwalls downstream of Leeds station and moveable weirs at Crown Point and Knostrop. These assets, which are operated and maintained by LCC, provide a 1.0% AEP SoP with climate change allowance to 2069.

2.8 Main benefits of scheme implementation The scheme will provide increased flood protection to existing communities, businesses and key infrastructure in Leeds. This will help the city to thrive and grow sustainably, and be resilient to climate change.

2.8.2 The scheme will provide a wide range of economic, social and environmental benefits, including supporting future employment and housing growth. These benefits are summarised in *Table 11* below.

2.8.3 The project incorporates an extensive programme of natural flood management (NFM) works focused on mitigation of longer-term climate change impacts. This is an ambitious programme with the following principles:

- The programme is evidence-led and is developed with a clear focus on maximising the flood risk reduction outcomes of the interventions.
- The works delivered by the NFM programme for the upper & mid Aire are developed and delivered in alignment with all flood risk reduction schemes across the catchment.
- Monitoring is considered from initial design, incorporated into the projects and appropriate funding sources found.
- Sustainable maintenance measures are built into the approach from the outset.
- The programme is delivered in such a way that the social capital outcomes are maximised:
    - Community engagement and ownership, including links to stewardship and resilience
    - Skills & apprenticeships
    - Education and school involvement.
- The programme is delivered in such a way that other complimentary outcomes are maximised, improving:
    - biodiversity and ecological resilience, through habitat linking
    - water quality
    - air quality, and
    - carbon sequestration.

2.8.4 This OBC has considered the ecosystems services benefits and has not included for hydraulic benefits from the NFM programme. However the benefits will be monitored and quatified during delivery and will be reported back to the Programme Board following further development investigation.

Table 11: Summary of scheme benefits

	Strategic objective	Scheme benefit
1	To reduce flood risk to people and property as much as can be economically justified, providing a good standard of protection to the areas currently at risk	**77 existing residential properties** moved from zones of significant or very significant risk, access and egress safeguarded to **1,408 existing residential properties** in flats within the floodplain. **370 existing businesses** protected from the risk of flooding.
2	To stimulate sustainable economic growth in developed and previously developed floodplain areas	Up to **9 hectares of developable land** protected from the risk of flooding, resulting in an **£88.2m pa increase in net GVA** for Leeds and an additional **1,669 jobs** created through associated benefits. Up to **1,613 new homes** estimated to be constructed on land designated for housing growth benefiting from reduced flood risk. **Key tourist attractions**, including the **Leeds Industrial Museum** directly protected, with numerous others within Leeds City Centre and along the Kirkstall Road Corridor indirectly benefiting.
3	To protect and enhancing the natural environment and landscape	**Invasive species treatment** and removal along the river corridor. **New forest planting** throughout the city reach and wider River Aire catchment. **Carbon sequestration** provided by the proposed tree planting **New wetland habitats** and amenity spaces at Kirkstall Meadows, within the proposed Calverley flood storage area and throughout the Upper Catchment. **Restoration of moorland areas** in the Upper Catchment. **Floodplain restoration** and **river re-meandering** in the Upper Catchment. Many squared km of **improved habitat** throughout the wider catchment as part of the NFM programme of works.
4	To increase the ability of people and businesses to cope with, and rapidly recover from, the impact of floods	**28 electrical substations** and **9 telecommunication centres** and equipment protected from risk of flooding. **Airedale and Wharfedale Railway** lines prevented from flooding, as well as the **A65** and the road network to the north and south of Leeds train station. **Reduced sense of vulnerability to flooding**. Reduced reliance on medical facilities by alleviating the mental and physical stress caused by flooding.
5	Work in partnership with communities and stakeholders to create a great place for living, improving access to recreational opportunities	Improvements in **pedestrian connectivity** and **river crossings**. Creation of **new public open spaces**, such as Kirkstall Valley Waterside Park, that will include pedestrian footpaths and cycleways running parallel to the river, **Better connections from the city centre** to features of interest such as Armley Mills, Cardigan Fields and Kirkstall Abbey. Reduced impact on community and social facilities including direct protection of **5 leisure facilities, 2 places of worship,** and **2 educational facilities.**
6	Demonstrate best value for money	The overall economic benefits over a 100-year period **are estimated to be:** • £150m (existing) • £774.4m (future growth and regeneration)

2.9 Main risks

2.9.1 Project risk reduction workshops have been held. The contributors included representatives from LCC, the Environment Agency, BAM Nuttall, Mott MacDonald, Arup and Thomas Mackay. The Project Risk Register is contained in Appendix K.

2.9.2 In terms of lessons learned, it is important to highlight that the team present at the Risk Workshop were involved with the design and delivery of LFAS1. Many of the risks identified and the associated mitigation measures are informed by experience of delivering similar works over the last three years. A proportionate part of this session was dedicated to identifying potential opportunities which have also been recorded and will be revisited during the specimen design phase.

2.9.3 A Risk Potential Assessment (RPA) has also been completed (Appendix AB). This identifies the main strategic risks associated with the scheme. It currently has a Medium Risk rating due to the uncertainty relating to the funding commitment from the Floods Minister. Once this is resolved, it is anticipated that the scheme will become Low Risk.

2.9.4 The key strategic risks can be categorised under the following headings:

- Political**:** The scheme requires the support and full engagement of a wide range of partners across political boundaries within the River Aire catchment. The risk is that partners and political commitment to supporting the scheme varies and becomes a barrier to delivery. This is being actively managed through the Programme Board composition and the stakeholder engagement strategy.
- Financial**:** Risks identified within this section include the amount and possible conditions attached to both the primary and secondary funding sources identified.
- Dependancies**:** A delay in the approval, or related funding commitment from the Floods Minister represents a significant risk to the programme spend, and the confidence of other funders. This could jepordise time limited primary funding sources already identified which in turn may significantly affect the affordability of the scheme. This is being managed through ongoing politicial and assurance engagement, and is supported through updates to the Environment Agency's programme management office.
- Public**:** the works will impact on local residents, a school, river users and local wildlife sites and existing flood plain currently in private ownership. These risks are being managed through public consultation, environmental impact assessment and partnership working with local groups including volunteers.

2.9.5 The key delivery risks can be categorised under the following headings:

- Technical: During the Specimen Design stage we have recognised risks associated with developing the design to a level where tenders can be sought in competition and further post-contract risks in connection with detailed design development and temporary works design proposals. The delivery methodology has been considered including the need for a temporary river diversion at Calverley. Specialist supplier and contractor performance have also been identified as potential risks, particularly during commissioning.
- Environmental: Aside from working within and adjacent to the river which has a diverse range of habitats suitable for protected species, our works have the potential to impact on sensitive locations such as at Kirkstall Valley Nature Reserve. To mitigate the risks, our co-located team will include a full-time Ecologist advising on the calendar for works, including protected species and invasive species surveys. We have identified potential opportunities for habitat creation at Calverley. In addition, the requirement for a flood control structure within the river corridor at Calverley has the potential to create geomorphological impacts, which will require further assessment and potential mitigation through design. Another key risk to delivery is the scheme area is rich in cultural heritage with designated sites and

structures adjacent to the River including Kirkstall Abbey and Armley Mills. Any design will need to be sympathetic to the setting of these assets.

- Programme: All of the above factors contribute to the overall programme and time risk from delay in approvals (including Major Projects Approval Process) and confirmation of funding from the Floods Minister, through to commissioning of the proposed barriers and availability of trees for the NFM programme. Risk quantification and mitigation have been informed through detailed discussions with BAM Nuttall based upon lessons learned from LFAS1 around activity durations and time risk allowances for the impact of weather and coordination for specialist suppliers works to provide an informed delivery programme.
- Commercial: In addition to the tender return risks we have identified risks associated with inflationary pressures on both materials (including trees) and availability of suitably skilled resources to deliver the proposals and the potential impact within a target cost contractual arrangement.

2.10 Constraints

2.10.1 *Table 12* summarises the key constraints to the successful implementation of the scheme.

Table 12: Constraints to the preferred solution

Ref	Constraint Description	Type	Impact on Scheme	Mitigation
001	Planning approval. Planning approval will be required to prior to construction commencement	External	Delay to programme	Programme required actions to submit Planning Application
002	Third party approval – Calverley. Failure to secure approvals to develop attenuation feature at Apperley affects overall proposal	External	Delay to programme. Design change required to omit the storage area from the scheme.	Stakeholder engagement commenced to secure approval.
003	Legislative approval – Water Framework Directive. Failure to secure WFD approval	External	Delay to programme. Increased cost to address issues and redesign scheme.	WFD scoping assessment has been completed. Programme to ensure time to develop WFD solution.
003	Legislative approval – Listed Building Consent. Failure to secure Listed Building Consent	External	Delay to programme. Increased cost to address issues and secure LBC.	Programme required actions to submit Planning Application. EIA scoping study completed to define issues.
004	Ground conditions – Impacts on selected design.	External	Delay to programme. Increased cost to address ground conditions.	Site Investigation to be completed to inform the design development.
005	Third party approval – Network Rail. Failure to agree construction methodology for flood defence works in proximity to NR assets.	External	Delay to programme Increased cost to agree construction methodology.	Early engagement with NR. NR are part of the Project Board.
006	Third party approval – Main River consent. Failure to obtain FDC.	Internal	Delay to programme Increased cost to agree construction methodology.	Contractor to be procured through WEM Framework.
007	Third party approval – A65 City West Development Site. Failure to obtain approvals for attenuation zone.	External	Delay to programme. Increased cost to address issues and redesign scheme.	Early stakeholder engagement with landowners.
008	Third party approval – agreement of landowners to NFM measures.	Internal	Delay to programme Increased cost to agree construction methodology.	Contractor to be procured through WEM Framework. Scheme is not reliant upon delivering 100% of the proposed opportunities.

Ref	Constraint Description	Type	Impact on Scheme	Mitigation
				Earl engagement and co-design process to improve landowner ownership of site design and implementation.
007	Existing planning approvals implemented. Planned development commences in advance of FAS works	External	Alters the design to integrate with new developments.	Early Stakeholder engagement with landowners.
009	Access to river. Constraints due to existing built environment and ecology impacts on proposals	External	Delay to programme. Increased cost to address issues and redesign scheme.	Early Contractor involvement during OBC to consider buildability of proposals.
010	Existing utilities prevent implementation of scheme.	External	Delay to programme. Increased cost to address issues and redesign scheme.	Early identification of diversions and commencement of enabling packages in advance of main works.
011	Third party approval – Purchase of agricultural land for Calverley storage area	External	Delay to programme. Increased cost to address issues and redesign scheme.	Negotiations for land purchase have commenced
012	Third party approval – funding sources for scheme insufficient	External	Delay to programme Unable to complete full scheme	LCC to underwrite the funding shortfall. Scope to be reviewed if necessary to deliver consistent SoP

2.11 Dependencies

2.11.1 At a strategic level project objectives and delivery will be dependent upon the following:

- maintaining existing level of support from Leeds City Council and MPs as well as other councils along the River Aire Upper Catchment, including Bradford Metropolitan District Council, Craven District Council, North Yorkshire County Council, Pendle Borough Council, Lancashire County Council and the Yorkshire Dales National Park.
- obtaining support and approvals from stakeholders with assets in the area, including but not limited to Environment Agency, Canals and Rivers Trust (CRT), National Grid, Network Rail (NR), Highways England, Yorkshire Water (YW), Yorkshire Wildlife Trust, Woodhouse Grove School and Kirkstall Flood Recovery Group.

2.11.2 At a project level the delivery will be dependent upon obtaining the following approvals:

- Confirmation of Funding from the Floods Minister;
- Planning permission for the proposed works will be required from Leeds City Council;
- Environmental Permits and other relevant permits or licences from the Environment Agency;
- Access to third party land for the purposes of construction and
- Entry on to third party land at Calverley.

3 Economic case

3.1 Introduction

3.1.1 This section summarises the economic apprasial for the proposed flood defence. A copy of the Economic Appraisal is contained in Appendix F.

3.1.2 The economic appraisal has been undertaken in accordance with the FCERM Appraisal Guidance.

3.2 Critical success factors

3.2.1 The critical success factors identified for the project are summarised in Table 13 below and have been used, in conjunction with the overall project objectives stated in Section 3.3.1, to guide the option long list development and shortlisting process.

Table 13: LFAS2 critical success factors

No	Critical success factor	Measurement criteria	Importance (1-5)
1	Protect communities worst affected by the Boxing Day 2015 flood.	Number of existing business and residential properties moved out of zones of very significant or significant risk.	1
2	Provide a standard of protection to the benefit areas that is compatible with future social, environmental and economic regeneration of the River Aire corridor.	The SoP provided by each option and its likely compatibility with wider social, environmental and economic strategies.	1
3	To avoid increases in flood risk to adjacent communities, including those protected by LFAS1.	Peak flood levels, and flooding durations, in adjacent locations.	2
4	To protect the essential infrastructure systems critical for the avoidance of disruption to economic activity across the city region and beyond.	The SoP provided to utilities, road and rail links by each option considered	2
5	To align with wider environmental programmes and help deliver RBMP objectives for the Aire catchment.	Full compliance with WFD legislation. Supporting realisation of specific objectives in the RBMP.	2

3.3 Long list options

3.3.1 A catchment-wide approach was adopted to establish a long list of options to achieve the project objectives, mindful of the project success criteria set out in *Table 13*. This included investigations in partnership with key project stakeholders to determine the potential for natural flood management techniques alongside more traditional forms of flood risk management.

3.3.2 Viability studies, including hydraulic modelling and budget costing, were undertaken to understand the constraints, benefits and relative cost of these options. A number of options were rejected as a result of these studies.

3.3.3 Table 14 sets out the options included in the long list and which of these options were rejected based on the outputs of the initial viability studies. A copy of the long list appraisal is contained in Appendix V, in which the specific reasons for rejecting options from the long list is recorded.

Table 14: Summary of long list appraisal outcomes

Option	Description	Benefits delivered /Issues involved	Reason for short list or rejection
Linear defences	Assumes linear defences are constructed along the river in all locations required to achieve a given SoP within the benefit areas	Provides increased level of protection to properties	Height of walls can be varied to achieve a range of standards of protection
Linear defences plus removal of obstructions	As above, but including removal of Milford Place Footbridge, Armley Mills Rail Bridge, lowering of Leeds station weir and river corridor improvements upstream of Wellington Bridge	Removing obstructions from the river channel reduces the flood levels upstream of the obstruction.	The following elements were rejected from further consideration: - removal of Leeds station weir - modification of Kirkstall Abbey weir and Newlay Weir
Linear defences, removal of obstructions, plus conveyance improvements/by-pass channels	As above, with removal of Kirkstall Valley Nature Reserve weirs, opening up Kirkstall Goit and construction of bypass channels at other goits/weirs.	Improving conveyance through Kirkstall Goit and Kirkstall Forge offers a hydraulic benefit during flood conditions.	The following elements were rejected from further consideration: - increased channel capacity at The Goit - bypass channel at Kirkstall Abbey weir - use of Newlay goit.
Linear defences, removal of obstructions, conveyance improvements/by-pass channels, plus attenuation at a range of sites upstream of the city	As above plus river corridor improvements upstream of Wellington Bridge, plus construction of upstream flood storage areas.	Inclusion of attenuation upstream can assist in reducing the pass forward flow. Promising sites were identified at Rodley and Calverley	The following elements were rejected from further consideration: - flood storage at KVNR or Kirkstall Meadows were both rejected on cost-effectiveness grounds - flood storage in the Upper Aire Catchment washlands rejected on cost-effectiveness grounds.
As above, plus NFM	As above, plus catchment-wide targeted natural flood management (NFM) measures	NFM makes sense for a wide range of reasons. Phased delivery over longer timescales is recommended	NFM shortlisted as being well aligned with project objectives and key success criteria

3.4 Short list options

Overview

3.4.1 Five options were appraised in detail: those briefly described in *Table 14* above, plus the "do nothing" and "do minimum" options, resulting in the shortlist of 6 option as shown in *Table 15*. Further details of the shortlisting process can be found in Appendix J.

Table 15: Shortlist of options

	Option	Description	Benefits delivered /Issues involved
1	Do nothing	The baseline against which all other options are appraised. This scenario assumes that all capital and maintenance investment would cease.	
2	Do minimum	Considers the current maintenance regime continuing but does not include replacing the existing defences at the end of their design life.	This option does not meet the project objectives
3a	Linear defences plus removal of obstructions and corridor improvements	Linear defences within the scheme boundary to provide continuity of defence including removal of Milford Place Footbridge and Armley Mills Rail Bridge, plus river corridor improvements upstream of Wellington Bridge	Removing obstructions from the river channel reduces the flood levels and defence heights upstream of the obstruction.
3b	Linear defences plus removal of obstructions and corridor improvements plus natural flood management	On-line defences; removal of Milford Place Footbridge and Armley Mills Rail Bridge; and diversion of flow through Kirkstall Goit; and corridor improvements upstream of Wellington Bridge	Inclusion of attenuation upstream can assist in reducing the pass forward flow.
4	Option 3b plus attenuation at Rodley	On-line Defences; removal of Milford Place Footbridge and Armley Mills Rail Bridge; and diversion of flow through Kirkstall Goit; and corridor improvements upstream of Wellington Bridge	Inclusion of attenuation upstream can assist in reducing the pass forward flow.
5	Option 3b plus attenuation at Calverley	On-line Defences; removal of Milford Place Footbridge and Armley Mills Rail Bridge; and diversion of flow through Kirkstall Goit; and corridor improvements upstream of Wellington Bridge	Inclusion of attenuation upstream can assist in reducing the pass forward flow.

Technical assessment

3.4.2 Hydraulic modelling was used to assess the effectiveness of each short listed option; overall cost effectiveness was established using a cost model. The standard of protection, and hence the assumed benefit afforded by each option, was fixed across the suite of measures within each combination, with only the defence height and length being modified to reflect the SoP afforded.

3.4.3 The results concluded that the most cost effective option (at all but the highest standards of protection) is to construct linear flood defences, with conveyance improvement works to the Redcote Lane bridge, Milford Place footbridge and Armley Mills rail bridge.

3.4.4 However, there is a clear upper limit to the SoP achievable using a linear defences-only solution. This is for two reasons:

- it would be strategically inadvisable to provide a higher SoP on LFAS2 than on LFAS1, given that LFAS1 protects the higher value assets, including the commercial areas downstream of Leeds Station and around and beneath the proposed Leeds HS2 station. Such a proposal would result in a potential future scenario where LFAS1 benefit areas flooded when LFAS2 was still protected;
- containment and conveyance improvements on LFAS2 have potential to increase peak flood flows and levels downstream. LFAS1 made an allowance of 2% for the potential increases in peak flow/level associated with containing floodwater in

Leeds upstream of the station, based on the information available at the time. Any proposals that had a greater impact than 2% will compromise the SoP provided by LFAS1. The analysis indicates that this threshold is around 310m^3/s. This would require the scheme to include measures to mitigate these impacts such as raising the LFAS1 defences downstream or by attenuating upstream. The latter is the only socially, environmentally and politically viable option on this project.

3.4.5 Therefore, any solution implemented for LFAS2 that provides a higher SoP than LFAS1 needs to include provision of upstream storage to attenuate peak flows.

3.4.6 Flood Storage options were considered at both Rodley and Calverley. Options to provide storage in the upper catchment were ruled out during the long list appraisal (Refer to Appendix V for further details).

3.4.7 The flood storage option at Calverley does not obviate the need for linear defences. However, this area has capacity to fully mitigate the downstream impacts of containment and conveyance improvement along the reach. .

3.4.8 The peak flow reductions that a storage option provides extend downstream to the LFAS1 benefit area. Therefore, the appraisal therefore takes account of the reductions in residual flood damages in the LFAS1 benefit area.

3.4.9 The capacity of storage at Calverley was maximised to provide the highest SoP which can be achieved alongside raised defences through the reach.

3.4.10 This approach negates the need for a discrete Phase 3 scheme as the benefits would be delivered through implementation of the proposed Phase 2 scheme.

Environmental assessment

3.4.11 The key positive and negative environmental effects for each of the shortlisted options are summarised in Appendix X. The environmental impact of the preferred option is described in detail in the Preliminary Environmental Information Report (PEIR) in Appendix M.

3.4.12 There are potentially significant environmental impacts associated with the height of the linear defences, including impacts to setting, business viability and PRoW users. In general, walls over 1.1m high start to affect views of the river for children; at 1.5m high adults become affected; 2.1m high walls would have a severe impact on river views.

3.4.13 In locations such as Armley Mills, Kirkstall Bridge and between Viaduct Road and Milford Place, high walls would likely have a significant adverse effect related to landscape and visual amenity. These issues also have implications for the future regeneration of the river corridor that are challenging to capture in an environmental assessment, which focuses on existing and known future receptors only.

3.4.14 It is clear however, that extensive lengths of high floodwall are unlikely to be compatible with future social, environmental and economic regeneration of the River Aire corridor, which is a key success factor for the project.

3.4.15 The proposals will require submission of a planning application and accompanying flood risk assessment demonstrating that there will be no increases in flood risk downstream caused by the proposals. This places a clear constraint on linear defences-only solutions, as discussed above in the technical assessment

3.4.16 Taking the above into account, it is highly unlikely that a scheme including high walls would obtain planning consent.

3.4.17 The potential for significant effects on ecology, landscape and visual amenity and community associated with options requiring the use of Rodley Nature Reserve would make this a very challenging option to promote. This option would not consistent with the objectives and critical success factors related to alignment with wider environmental programmes and objectives. This is due to the sensitive nature of Rodley Nature Reserve, which provides a key community facility and area of open space of high ecological value. A large number of protected species are present at this site. This option has already

received strong opposition from local conservation groups involved with the public consultation. The flood storage area at Calverley on the other hand is significantly less ecologically-sensitive and is the environmentally preferred option as it has opportunity for the creation of new wetland habitat.

3.4.18 The table below outlines some the key potential environmental impacts and opportunities associated with the preferred option.

Table 16 Environmental Impacts and Opportunities

Topic	Issue	Mitigation or Enhancement
Townscape, Landscape and Visual Amenity	Change in Landscape	Ensure materials and form of the linear defences successfully blend into the existing landscape character. Co-ordinate materials palette with the developer.
	Views of river	Co-ordinate landscape proposals with the developer's plans.
	Loss of trees and planting	Survey trees on the left bank to confirm categories, levels of protection and the species which should be used as replacements. Replace planting and trees (proposal for a 3:1 replacement approach)
	Change to the landscape context, setting and character	Assess the planting species and landscape design of the Park and Woods and ensure any loss to the soft landscape is appropriately replaced. Planting and landscape design (including detailing of the linear defences) to soften the effects: to include screening planting if required. Close and long-distance views to be determined as part of an LVIA.
Ecology	Possible impact on protected species using the River Aire corridor, within close proximity to the flood control structure at Calverley and localised widening	Further ecological assessment and protected species surveys to be undertaken to inform the design and required mitigation. Wetland habitat including scrapes have been included as enhancement at this location.
Historic Environment	The works around Armley Mills has a high potential for a significant negative effect upon the Armley Mills Conservation Area and upon the setting of the Grade II* Listed 'Armley Mill Main Range' and the associated complex of Grade II Listed buildings. There is also potential for a negative impact on to the Grade II Listed weir to the west of Armley Mills. The construction of a wall across the Armley Mill head race carries a further significant risk of physical impact upon the Grade II Listed sluice gates, for which listed building consent would be required.	Due to the significance and sensitivity of the heritage assets and the high level of potential impact by the scheme, it is recommended that a full assessment is carried out to establish the full extent of the impacts, and that heritage input is sought during detailed design in coordination with the landscape team to ensure sympathetic finishes in keeping with the conservation area and character of the area.
	There is the potential for a negative impact on the setting of the main range and other listed buildings	This impact could be mitigated with sympathetic design and appropriate cladding of the defence walls.
	The construction of the walls also has the potential for a severe negative impact to the setting in a potentially sensitive archaeological area with association both to the medieval Abbey and the later industrial landscape.	Due to the proximity to the scheduled monument and the significance of the heritage assets, it is advised that a full assessment is carried out to establish the extent of impact and appropriate mitigation measures.
Water Environment	Changes in hydromorphology of the River Aire through the construction of temporary defences (e.g. coffer dam) or permanent piled defences (i.e. flood wall) on the channel side resulting in increased scour and damage to the channel bed.	Construct defences from channel side where possible. Ensure temporary defences do not result in excessive velocities through narrowed channel.
	Changes in hydromorphology of the River Aire due to the embankment and control structure of the FSA, resulting in potential shallow flow or reduced velocities, disruption to existing sedimentation processes.	Geomorphological assessment of reach downstream of FSA to identify risk of change to sedimentation processes and if necessary, suggest mitigation.

Summary of Shortlisting Assessment

3.4.19 The assessment of the short list of options from a technical and environmental perspective concluded with the selection of 6 options to be taken forward to the economical appraisal.

3.4.20 *Table 17* provides a short summary options, the standard of protection and a description of the key components of the each.

Table 17: Shortlist of options

	Option	Standard of Protection	Description
1	Do nothing	n/a	The baseline against which all other options are appraised. This scenario assumes that all capital and maintenance investment would cease.
2	Do minimum	n/a	Considers the current maintenance regime continuing but does not include replacing the existing defences at the end of their design life.
3a	Linear defences plus removal of obstructions and corridor improvements	1.33% AEP to beyond 2070	Linear defences within the scheme boundary to provide continuity of defence including removal of Milford Place Footbridge and Armley Mills Rail Bridge, plus river corridor improvements upstream of Wellington Bridge
3b	Linear defences plus removal of obstructions and corridor improvements plus natural flood management	1.0% AEP to 2069	On-line defences; removal of Milford Place Footbridge and Armley Mills Rail Bridge; and diversion of flow through Kirkstall Goit; and corridor improvements upstream of Wellington Bridge with Natural Flood Management measures.
4	Option 3b plus attenuation at Rodley	0.5% AEP to 2069	**Option discounted** - The proposal for the creation of a storage reservoir at Rodley (Option 4) was excluded due to the sensitivity of environmental receptors within the impacted area and following initial consultation and engagement with local stakeholders
5	Option 3b plus attenuation at Calverley	0.5% AEP to 2069	On-line Defences; removal of Milford Place Footbridge and Armley Mills Rail Bridge; and diversion of flow through Kirkstall Goit; and corridor improvements upstream of Wellington Bridge with Natural Flood Management Measures

3.4.21 Option 3a is a linear defences only solution which is the most economical method of achieving the 1.33% AEP standard of protection. For target Standards of Protection (SoP) up to and including the 1.33% AEP return period, a “Linear Defences Only” scheme with only minor complementary conveyance improvement works provides the most cost effective approach to protecting the target area. This option also provides the greatest certainty in terms of:

- timeframe for delivery,
- ability to deliver due to the relatively limited geographic extent and specific locations of the required measures, and
- robust understanding of the flood risk performance of the proposed measures.

3.4.22 This option also provides the target protection immediately once construction is completed.

3.4.23 However, throughout the reach, options for linear defences to provide a greater SoP are limited by the deliverability of higher linear defences due to aesthetic and amenity considerations. In addition, any fixed defences must not have a detrimental affect on the Phase 1 reach.

3.4.24 Therefore to achieve a SoP of 1.0% AEP plus climate change to 2069 and greater, additional works in combination with linear defences set to a maximum height are required. A SoP of 1.0% AEP plus climate change to 2069 may be delivered by an option

of maximised linear defences, complementary conveyance improvements works and a catchment wide NFM approach.

3.4.25 The NFM approach is incorporated where more traditional engineering solutions cannot reach the required SoPcost-effectively .

3.4.26 Option 3b and subsequent options incorporate NFM as an active measure to increase the climate change resilience for both Phase 1 and Phase 2.

3.4.27 Option 5 achieves a 0.5% AEP plus climate change to 2069, across both Phase 1 and Phase 2, with an engineered upstream storage solution at Calverley in combination with the maximised linear defences, complementary conveyance improvements works and a catchment wide NFM approach.

3.4.28 Option 5 represents the highest SoP which can be achieved with flood storage at Calverley. No feasible alternative options were identified to deliver a standard of protection greater than the 0.5% AEP SoP.

3.5 Economic appraisal

3.5.1 The shortlisted options 3a, 3b and 5 plus the 'Do Nothing' and 'Do Minimum' were assessed in accordance with the FCERM-AG.

Appraisal Period

3.5.2 The appraisal period for all options is 100 years irrespective of the standard of protection of the option, and this is reflected within calculations of whole life costs and benefits.

3.5.3 While options may be 'badged' with a climate change allowance specific to a particular year or epoch, this does not place a limit on the appraisal period. The impact of climate change in reducing the standards of protection of different options is reflected in the calculations of benefits for each option, and is also reflected in the calculation of OM2 properties within the PFC Reference should be made to Appendix F for full details of the Economic Appraisal.

Benefits

3.5.4 Hydraulic modelling outputs were derived for the 1 in 5, 10, 20, 30, 50, 75, 100, 200, 500 and 1,000 return period flood events for all options. This was done for the present day and future epochs (2039, 2069, and beyond 2070) to account for climate change. The modelling also took account of the impacts of the maintenance regime associated with each option. Annual average damages (AADs) were calculated for each epoch. The relevant AADs for each epoch were applied to each year of the 100 year appraisal period. These annualised damages were then discounted at the rates required by current appraisal guidance to provide the net present value (NPV) of the flood damages associated with each option. The modelling assumptions also accounted for the additional downstream benefits that would be achieved by attenuation/storage. These benefits are derived from the residual damages associated with LFAS1 to avoid double counting.

3.5.5 The following damages have been calculated:

- residential and commercial property damages, ensuring that the damage contributed by an individual property does not exceed its market value;
- risk to life damages have been assessed in accordance with the Flood Risks to People guidance (March 2006) and the Supplementary Note to Operating Authorities (May 2008);
- vehicle damages;

- emergency services (assumed at 5.6% of direct damages);
- utilities damages (assumed at 5% of direct damages);
- rail disruption;
- traffic disruption was examined but not assessed further as the frequency and extent of disruption was unlikely to produce significant or proportionate damages; and
- intangible health benefits have been calculated for all positive options.

3.5.6 The eligibility for this scheme to claim OM4 benefits is predicated on the Water Framework Directive requirements as identified in the River Basin Management Plan.

- A proportion of these benefits are associated with the works at Calverley. The eligibility for these benefits are outlined in Appendix Q;
- The remainder are claimed under the NFM programme for works and the elibility for these benefits are outlined in Appendix W.

3.5.7 However, the 125ha of OM4a currently identified to be delivered by the scheme is the current best estimate of the design team. The exact amount of OM4a to be delivered will be detailed and confirmed, including a more robust justification, within the subsequent submission of the full business case (FBC). At present no OM4a is included in the Economically Preferred Scheme (1.33% AEP SoP) so we do not envisage that this will alter the schemes eligibility for GiA.

3.5.8 There is a need to understand which NFM benefits would only be realised as a result of the investment made through this scheme.

3.5.9 This is particularly relevant when considering the potential carbon sequestration benefit of the proposed NFM programme of works. In order to assess this, the following questions are posed:

1. Would the carbon be sequestered by other means?

2. What would happen at the planting locations in the absence of the NFM measures. Is it reasonable to assume that these areas would remain in their current state?

3.5.10 The combination of FCERM GiA and Defra Booster Funding and contribution from the Woodlands Trust will be used to fund the NFM programme.

3.5.11 In answer to question 1, it is reasonable to assume that the Woodlands Trust contribution could be used to fund similar works and bring about similar benefits elsewhere. However, LFAS2 provides a tangible means for delivery of these measures and resulting benefits on a scale of which is currently lacking.

3.5.12 Sensitivity tests have also been undertaken and reported in *Table 21* of Appendix F, which demonstrates that the preferred option remains unchanged even when the benefits of the Woodlands Trust contributions are removed.

3.5.13 In answer to question 2 it is highly likely that the sites identified would not have NFM measures installed and therfore it is reasonable to asssume that they would remain in their current condition.

Costs

3.5.14 The construction cost estimate has been generated by BMMjv Cost Team and verified by cost manager using the Environment Agency's Project Cost Tool benchmarked against the actual costs from the Leeds FAS Phase 1 over the past 36 months and information related to similar schemes completed elsewhere. The cost of the storage area has also been benchmarked against the project cost tool. These are presented in detail in Appendix H.

3.5.15 Costs for ECC Project Manager, cost consultant and LCC's staff costs were developed by the project team and benchmarked against LFAS1.

3.5.16 Compensation costs were developed by the project team with input from Regional Estates staff, using cost data from other similar schemes.

3.5.17 Inspection and maintenance costs have been developed in consultation with the LCC operations staff and the Environment Agency to ensure that the recommended inspection and maintenance regime is achievable. Maintenance costs include the cost of periodically repairing the new assets.

3.5.18 Costs for flood warning have not been included in the appraisal process. As the scheme proposes to use the existing flood warning service, the costs of providing the service are negligible, with reference to the total scheme, and would have no impact on the business case.

3.5.19 Optimism bias of 50% has been included on all options for the purposes of option comparison and the economic appraisal.

Table 18: Present value costs (£k) incorporating optimism bias and future maintenance costs

Option	**3a**	**3b**	**5**
Description	**Linear defences, conveyance and river corridor improvements**	**Linear defences, conveyance and river corridor improvements and NFM**	**As option 3b plus Calverley Flood Storage Area**
SoP	**1.33% AEP beyond 2070**	**1.0% AEP to 2069**	**0.5% AEP to 2069**
Staff costs	2,547	2,552	2,552
Consultant fees (including cost consultant, site investigation & survey costs)	2,047	2,176	3,246
Contractors' fees	652	652	652
Construction	33,890	33,182	48,132
Natural Flood Management	0	13,154	13,154
Environmental enhancements & mitigation	0	1,284	4,668
Optimism bias	19,223	19,620	29,688
Subtotal	**58,359**	**72,620**	**102,092**
Future costs (construction and maintenance)	2,513	2,513	5,027
Optimism bias	1,257	1,257	2,514
Project total (PV) costs	**62,129**	**76,390**	**109,632**

3.5.20 The present value benefits, associated with existing property and assets, of options affording a range of standards of protection are presented in Table 19 below.

Table 19: Present value damages and benefits (£) over a 100-year appraisal period

Option		Damage (PVd)	Damage avoided	Benefits (PVb)
1	Do nothing	162,805,958	Nil	Nil
2	Do minimum	153,780,361	9,025,597	9,223,505
3a	1.33% AEP to beyond 2070	35,389,254	127,416,704	128,044,613
3b	1.0% AEP to 2069	34,299,508	128,506,450	224,450,878#1#2
5	0.5% AEP to beyond 2069 (Calverley)	25,549,753	137,256,205	252,793,726#1#2

#1 Benefits include OM4 and Ecosystems services benefits from NFM and Habitat creation.

#2 Benefits include intangible health benefits and Leeds FAS Phase 1 benefits from storage.

3.6 Option ranking & conclusion regarding FCERM GiA eligibility

Stage 1 Test for Benefits Exceeding Costs and Stage 2 Identification of the leading option

3.6.1 Application of Stage 1 of the FCERM-AG Decision Rule identified that all shortlisted options had an average cost benefit ratio greater than 1. The option with the highest benefit cost ratio is the "Do Minimum" scenario.

3.6.2 Stage 2 of the Decision Rule requires options to be assessed according to their Incremental Cost Benefit Ratio (iBCR) and standard of protection.

3.6.3 *Table 21* shows that the do minimum and all do something options have average benefit cost ratios (BCRs) greater than 1. The 'do minimum' has the highest benefit to cost ratio.

Table 20: FCERM-AG: BCR and IBCR (Flood Risk and NFM Benefits)

Option		Present value costs (£'000)	Present value damages (£'000)	Present value – Flood Risk benefits (£'000)	Present value – NFM benefits (£'000)	Total Present value benefits (£'000)	Average benefit: cost ratio (BCR)	Incremental benefit: cost ratio (IBCR)	Option for incremental calculation
1	Do nothing	0	162,806	0	0	0	0.0	0.0	0
2	Do minimum	1,000	153,780	9,224	0	9,224	9.2	0.0	0
3a	1.33% AEP to beyond 2070	62,129	35,389	128,045	0	128,045	2.1	1.9	2
3b	1.0% AEP to 2069	76,390	34,300	129,166	95,285	224,451	2.9	6.8	3a
5	0.5% AEP to 2069 (Calverley)	109,632	25,550	152,353	100,441	252,794	2.3	0.9	3b

3.6.4 Under Stage 2 of the decision rules the BCR and iBCR of each option is assessed. The incremental benefit cost ratio of the next highest option (3a) is above 1 and the SoP is 1.33% AEP; there is therefore a case to move up to option 3a.

3.6.5 The incremental cost benefit ratio for option 3b, the next highest option is robustly greater than 3 if the wider non-FCERM benefits are included.

3.6.6 However, the specific flood reduction benefits are considered by Defra as set out in a policy decision to be insufficient to support an increase of investment to the 1.0% AEP scheme. The remainder of the benefits are derived from non- specific-FCERM benefits i.e. carbon sequestration associated with tree planting, as illustrated in *Table 21* below.

Table 21: FCERM-AG: BCR and IBCR (Flood Risk Benefits Only)

Option		Present value costs (£'000)	Total Present value damages (£'000)	Damages of which are Non - Residential damages (£'000)	Damages of which are Residential damages (£'000)	Total Present value – Flood Risk benefits (£'000)	Average benefit: cost ratio (BCR)	Incremental benefit: cost ratio (IBCR)	Option for incremental calculation
1	Do nothing	0	162,806	*8,212*	*68,704*	0	0.0	0.0	0
2	Do minimum	1,000	153,780	*7,484*	*61,517*	9,224	9.2	0.0	0
3a	1.33% AEP to beyond 2070	62,129	35,389	*1,323*	*28,997*	128,045	2.1	1.9	2
3b	1.0% AEP to 2069	76,390	34,300	*1,275*	*28,065*	129,166	1.7	0.1	3a
5	0.5% AEP to 2069 (Calverley)	109,632	25,550	*961*	*20,516*	152,353	1.4	0.7	3b

3.6.7 The application of Stage 2 of the decision rules in FCERM-AG (excluding the wider benefits of natural flood management) indicates that the Leading option would be to carry out conveyance improvements and to construct linear defences where these are required along the reach to provide a 1.33% AEP standard of protection (SoP) to 2069, with a 20% peak flow uplift allowance for climate change impacts.

3.6.8 Application of the decision rules does not support the selection of the next option with a greater standard of protection, when the non-flood risk benefits of natural flood management are excluded from the 1.0% AEP option, as the iBCR is less than 3.0.

3.6.9 Application of the decision either including or excluding non-FCERM benefits does not support a case to move to the next increment, option (5), as the option has an incremental BCR significantly less than 3.

3.6.10 *Table 21* summarises the BCR and iBCR for all options from which the conclusion is drawn that FCERM-GiA should be capped at the 1.33% AEP SoP scheme, based on the project's relative contribution to national Outcome Measures and the FCERM-GIA should be capped at this scheme.

3.6.11 Therefore the Leading Option is confirmed as the Economically Preferred Scheme compliant with Defra/EA Appraisal Guidance and PF Rules (excluding the wider benefits of natural flood management). This has been used to calculate the FCERM GiA contribution.

3.6.12 This scheme is eligible for **£7.6m (£6.8m PV)** of FCERM GIA.

Stage 3 Contributions

3.6.13 We note that this Stage of the FCERM-AG has been superseded by the Partnership Funding however we have included this for completeness.

3.6.14 The indicative commitment of Defra Booster funding would be sufficient to fund the Economically Preferred Option (Option 3a).

3.6.15 To fund Option 3b an extension of funding would be required from the Minister by **£14.8m (£12.6m PV)** to **£79.8m (£70.8m PV).** This commitment would extend beyond 2021 with **£30m (£27.8m PV)** pre-2021 & **£44.8m (£38.6m PV)** post-2021. This does not increase the indicative allocation of funding in the current spending review period. *Table 22* below shows the BCR and iBCR for the shortlisted options less contributions. The table highlights the case for considering the Option (5) as a Leading Option as the iBCR is greater than 3.

Table 22 FCERM-AG BCR and IBCR for the shortlisted options less contributions

Option		Present value costs (£'000)	Contributions (£'000)	PV Costs Minus Contributions	Present value damages (£'000)	Present value benefits (£'000)	Average benefit: cost ratio (BCR)	Incremental benefit: cost ratio (IBCR)
1	Do nothing	0	0	0	162,806	0	0.0	0.0
2	Do minimum	1,000	0	1,000	153,780	9,224	9.2	0.0
3a	1.33% AEP to beyond 2070	62,129	0	62,129	35,389	128,045	2.1	1.9
3b	1.0% AEP to 2069	76,390	6,035	70,355	34,300	224,451	3.2	11.7
5	0.5% AEP to beyond 2069 (Calverley)	109,632	25,642	83,991	25,550	252,794	3.0	2.1

3.6.16 Option 3b incorporates a contribution from the Woodlands Trust for **£6.9m (£6.0m PV)**.

3.6.17 Option 5 incorporates the contribution from the Woodlands Trust, plus all other commitments from Leeds City Council which are linked to a 0.5% AEP SoP. Details of the investment requirements and value of the contributions are explained in Section 5.2.

3.6.18 Taking account of these contributions (subtracting non-FCERM funding from the option costs), the 'Leading Option' under the decision process would not change as the iBCR for Option 5 would not reach the required threshold.

Stage 4 Uncertainty

3.6.19 We have carried out sensitivity testing to determine the impact on options selection for the Leading Option (Option 3a).

3.6.20 Option 3a would need to increase in cost by **£57.7m** to lead to an iBCR less than 1.

3.6.21 A decrease in the benefits of **£57.7m** would reduce its iBCR relative to Option 2 to less than 1.

3.6.22 Option 3b would need to increase in cost by **£17.8m** to lead to an iBCR less than 3.

3.6.23 A decrease in the benefits of **£53.6m** would reduce its iBCR relative to Option 3a to less than 3.

3.6.24 Option 5 would need to achieve **£71m** greater benefits or **£23.8m** additional partnership contributions (or **£23.8m** reduction in costs) for it to become the Leading option by changing its iBCR to be greater than **3**.

3.6.25 A 1.33% AEP Standard of Protection scheme, with an allowance for climate change to 2069 is equivalent to a 132 year return period standard in 2019. This standard declines over time, such that by the end of the appraisal period (2118), the residual standard of protection is a 75 year return period. This standard of protection means that properties benefitting from the scheme's protection are moved into the "medium risk" band in the Partnership Funding Calculator "Outcome measure 2" score.

3.6.26 From our sensitivity testing we can conclude that uncertainty would not affect our choice of the leading option.

3.6.27 The 1.33% AEP scheme (Option 3a) is defined as the *Economically Preferred Scheme compliant with Defra/EA Appraisal Guidance and PF Rules* (excluding the wider benefits of natural flood management) forthwith.

Stage 5 Wider Objectives

3.6.28 Providing a 0.5% AEP standard of protection for Leeds is critical to the delivery of several of the ambitions within Leeds City Council's Best Council Plan, most notably 'Supporting communities and tackling poverty' and 'Promoting sustainable and inclusive economic growth'.

3.6.29 The Economically Preferred Scheme would not provide protection to residents and businesses against a flood of the magnitude experienced in December 2015.

3.6.30 The Economically Preferred Scheme (1.33% AEP) does not satisfy the ambition set out in the Environment Agency's Upper Aire Flood Risk Management Strategy to deliver a 0.5% AEP standard of protection for Leeds. The Economically Preferred Scheme (1.33% AEP) would provide a lower standard than is currently provided to the Phase 1 area, and does not meet all of the critical success factors for reducing flood risk in the city. Furthermore, it would leave an unacceptable level of residual risk post implementation which would negate the investment in a flood event of a magnitude greater than 1.33% AEP.

3.6.31 The standard of protection offered by the economically preferred option (1.33% AEP) derived through application of appraisal guidance and partnership funding rules and the Defra policy decision on excluding non-FCERM benefits is not acceptable to LCC and there is arguably a strong economic case for Government to support the 1.0% AEP scheme as the economically preferred solution. LCC consider that a total contribution of circa £83.6m FCERM-GIA is a sound economic investment with a single BCR of 2.9.

3.6.32 Further consideration was given by Leeds City Council to the next incremental options to provide a higher standard of protection to Phase 2 in accordance with Stage 5 of the FCERM guidance.

3.6.33 The 1.0% AEP SoP with climate change to 2069 would also not provide protection residents and businesses against a flood of the magnitude experienced in December 2015. It also does not satisfy the ambition set out in the Environment Agency's Upper Aire Flood Risk Management Strategy to deliver a 0.5% AEP standard of protection for Leeds.

3.6.34 Leeds City Council do not consider therefore, that the 1.0% AEP scheme delivers a good standard of protection for the residents, businesses and the community along the reach. It does not meet all of the critical success factors for reducing flood risk in the city. Furthermore, it would leave an unacceptable level of residual risk post implementation which would negate the investment in a flood event of a magnitude greater than 1.0% AEP.

3.6.35 Due to the physical constraints of the catchment and to ensure that Phase 2 does not adversely impact on Phase 1, the highest SoP which can be achieved is a 0.5% AEP standard of protection with climate change allowance to 2069.

3.6.36 The 0.5% AEP year SoP with climate change to 2069 offers an equivalent 270 year standard of protection in 2019 and an equivalent standard of protection at the end of the appraisal perion in 2118 of 160 years.

3.6.37 Therefore, there is a strong rationale for delivering Option 5, the Best Alternative Option, which would deliver the strategic objectives of the Leeds City Council and Environment Agency. In accordance with Stage 5, the wider objectives of this option were investigated.

Contribution of the Alternative Option to Wider Objectives

3.6.38 Option 5 includes flood storage, which would increase the standard of protection to Leeds FAS Phase 1, as well as to Phase 2. It would deliver a consistent level of protection across the Leeds FAS Phase 1 and Phase 2 reaches. This would deliver the ambition set out in Environment Agency's Upper Aire Flood Risk Management Strategy and deliver Phase 2 and Phase 3 concurrently and it would meet Leed City Council's critical success factors.

3.6.39 The capital value of Option 5 (0.5% AEP scheme) is **£112.1m (£99.7m PV)**. This delivers a BCR of **2.3** and an iBCR of **0.9**. It is noted that the iBCR is not greater than 3 and therefore does not change the outcome of Stage 2 of the Decision rule.

3.6.40 This option incorporates flood storage upstream of the reach. This storage enables the heights of the walls to be reduced throughout the reach, reducing the impact of the proposals on riparian residents, businesses and the local community and does not sever the connection between the river and the urban realm. This will enable the waterfront to be a core part of the city's regeneration and so keeping the river open for future generations to enjoy.

3.6.41 This option would introduce new wetland and woodland habitat within the reach. Improved access would be created for local communities. This would provide social well-being, health and education benefits.

3.6.42 It would support the recent National Infrastructure Commission recommendation that all properties should where feasible benefit from a minimum 0.5% AEP standard of protection or greater for large urban areas and cities.

3.6.43 The proposals include the provision of new access bridges and tracks to improve connectivity between communities and will provide new walking and cycling routes which connect to existing routes.

Economic appraisal – including future growth benefits

3.6.44 Future growth benefits would be generated by all the shortlisted options. The future growth benefits do not contribute to the calculation of the FCERM-GiA. However these future growth benefits align with the HM Treasury Green Book Approach and in order to provide a robust justification for the investment of Defra FCERM Booster funds they have been included and presented in *Table 23*.

3.6.45 These benefits have been calculated using Mott MacDonald's tool, TEAM, which is designed to calculate the economic impact of proposed infrastructure interventions and policy measures. It has been designed by experts in economics, economic development and regeneration and is in-line with HM Treasury Green Book principles and the Homes and Communities Agency (HCA, now Homes England) Additionality Guidelines.

3.6.46 The net economic gain to Leeds as a result of land use changes from the sites potentially unlocked by the increase in protection from the risk of flooding through this scheme is captured by adjusting the gross impacts for additionality, that is "*the net, rather than the gross impact of an intervention after making allowances for what would have happened in the absence of the intervention*"[3]. The assessment therefore adjusts the gross impacts by considering the following additionality assumptions:

- **Deadweight:** the level of economic activity that would have occurred without the intervention.
- **Leakage:** the level of benefits (i.e. jobs on these sites) that are likely to go to residents outside of Leeds who in-commute.
- **Displacement:** the proportion of economic benefits that are displaced from elsewhere in the borough (e.g. through relocation of business activities to sites potentially unlocked by the Leeds FAS2 scheme).
- **Multiplier impacts:** additional impacts within the economy from supply linkages due to purchases made as a result of the intervention and further purchases with linked firms along the supply chain (indirect effects) and income effects associated with local expenditure as a result of those who derive incomes form the direct and supply linkage impacts (induced effects).

[3] The Green Book, HM Treasury, p.52.

3.6.47 In this stage we have appraised the short-list of options, using a mix of quantitative and qualitative analysis to determine how each option delivers against the scheme objectives as set out above. Full detail of all benefits assessed and methodology applied in assessing each one is set out in Appendix H (wider economic and social benefits) and Appendix M (environmental benefits), with the results presented in *Table **24*** on following page.

3.6.48 The findings of this assessment show that options incorporating flood storage at Calverley provides a significantly greater level of wider economic benefits in comparison to a linear defences only scheme. For an additional investment of £24.2m, the scheme would enable:

- full mitigation of the impacts of using linear defences along the study reach on downstream peak flows and flood levels;
- an enhanced standard of protection in the LFAS1 benefit area; and

  £105m of additional PV future growth benefits (compared to option 3a).

Table 23: FCERM-AG BCR and IBCR for the shortlisted options, taking account of GVA benefits (and ignoring the impact of contributions)

	Option	Present value costs (£'000)	Present value benefits (£'000)	GVA Benefits (£'000)	Average benefit: cost ratio (BCR)	Incremental benefit: cost ratio (iBCR)	Option for incremental calculation
1	"Do nothing"	0	0	0	0.0	0.0	0
2	"Do Minimum"	1,000	9,224	0	0.0	0.0	0
3a	1.33% AEP to beyond 2070	62,129	128,045	669,800	12.8	12.9	2
3b	1.0% AEP to 2069	76,390	224,451	669,800	11.7	6.8	3a
5	0.5% AEP to 2069 (Calverley)	109,632	252,794	774,400	9.4	4.0	3b

3.6.49 The above benefit calculations are based purely on the additional developed or formerly developed areas within the study reach protected by the 'with storage' schemes relative to those protected by the linear defences-only solution. No allowance is made for the fact that options which provide a higher SoP than 1.0% AEP plus climate change are far more likely to increase investor confidence and to enable regeneration in the reach.

Table 24: Wider benefits summary

Benefit Measure	Option 3a	Option 3b	Option 5
	Walls only (exc. Kirkstall Road shelf)	**Walls only**	**Walls plus Calverley attenuation**
	1.33% AEP	**1.0% AEP 2069**	**0.5% AEP 2069**
Average / max reduction in wall height vs walls only	N/A	N/A	140mm / 290mm
Enhancement to Phase 1	None	None	Standard improved to just under 1:200 present day by storage alone; up to 1:200 cc2039 by target level of NFM £14m of residual phase 1 damage avoided
Impact on the environment	None of the ecological and carbon sequestration benefits associated with the NFM programme would be achieved.	Wall heights slightly higher and a concern in a number of locations for visual impact. Ecological and carbon sequestration benefits associated with the NFM programme would be achieved.	Wall heights slightly lower, but still high enough for the impacts to be of concern in few locations. Higher grade habitat with much lower impact on rare and/or protected species. Opportunity to create additional wetland or other habitat as part of the development.
Stakeholder impact	Increased likelihood that future scheme will be required to increase the SoP or adapt for climate change, leading to increased disruption in the Phase 2 reach. No benefit to SoP downstream of Phase 2, increased likelihood further construction work would be required within Phase 1 reach in the future, creating further disruption.	Increased likelihood that future scheme will be required to increase the SoP or adapt for climate change, leading to increased disruption in the Phase 2 reach. No benefit to SoP downstream of Phase 2, increased likelihood further construction work would be required within Phase 1 reach in the future, creating further disruption.	Very limited opposition expressed to date. Further discussions required with Woodhouse Grove School regarding potential impact on playing fields. Further discussions required with Network Rail.
Reduced impact on community and social facilities: Educational facilities	Direct protection of **2** educational facilities including: • Liberty Park student accommodation Bright Horizons day nursery		
Reduced impact on community and social facilities: Leisure facilities	Direct protection of **3** leisure facilities including: • Kirkstall training ground used by Leeds Rhinos and Yorkshire Carnegie • Kirkstall Industrial Park Kirkstall bridge shopping park	Direct protection of **4** leisure facilities including: • Kirkstall training ground used by Leeds Rhinos and Yorkshire Carnegie • Kirkstall Industrial Park Kirkstall bridge shopping park	Direct protection of **5** leisure facilities including: • Kirkstall training ground used by Leeds Rhinos and Yorkshire Carnegie • Kirkstall Industrial Park • Kirkstall bridge shopping park • Leeds Schools Athletic Association Cardigan Fields Leisure Park
Reduced impact on	Direct protection of **2** places of worship including:		

community and social facilities: Places of worship	• The Leeds Chinese Church Redeemed Christian Church of God		
Reduced impact on community and social facilities: Tourist attractions	Direct protection of the **Leeds Industrial Museum,** and indirect protection to other key tourist attractions within the city centre and along the A65 corridor through protected access, including (but not limited to): • Kirkstall Abbey • Abbey House Museum • The Royal Armouries • Leeds City Museum • Leeds Art Gallery •		
Stimulates job growth	Additional **1,509** Net Jobs Additional **£44.2m** Net GVA pa Additional **£669.8m** GVA NPV (10 years)		Additional **1,669** Net Jobs Additional **£88.2m** Net GVA pa Additional **£774.4m** GVA NPV (10 years)
Stimulates housing growth	**1,563** new dwellings		**1,613** new dwellings
Increase area of developable employment land protected from the risk of flooding	**9 hectares**		**9.3 hectares**
Increase in property and land use related taxes from development of land protected from the risk of flooding	**£1.74m** additional annual council tax **£5.5m** additional annual business rates		**£1.79m** additional annual council tax **£6.11m** additional annual business rates
Reduced risk of flooding to businesses	**97** businesses would be protected from risk of flooding	**117** businesses would be protected from risk of flooding	**370** businesses would be protected from risk of flooding.
Reduced risk of flooding to critical infrastructure	**4** Telecommunications masts and switch exchanges - including additional protection for the Vodafone communication hub **10** Electricity sub-stations	**4** Telecommunications masts and switch exchanges - including additional protection for the Vodafone communication hub **13** Electricity sub-stations.	**9** Telecommunications masts and switch exchanges - including additional protection for the Vodafone communication hub **28** Electricity sub-stations – including additional protection for Redcote Lane
Reduced risk of flooding to the rail network	**Airedale and Wharfedale lines** flood risk reduced		Enhanced flood resilience to **Airedale and Wharfedale lines** flood risk reduced. New station would be protected
Reduced risk of flooding to the highway network	**A65 prevented from flooding**	**A65 prevented from flooding**. **Whitehall Road** to the North and **Water Lane** to the South of Leeds train station protected from risk of flooding	

3.7 Selection of the Alternative option

3.7.1 The application of Stage 2 of the decision rules in FCERM-AG identified that the Economically Preferred Option compliant with Defra/EA Appraisal Guidance and PF Rules would be to carry out conveyance improvements, to construct linear defences where these are required along the study reach, to provide a 1.33% AEP standard of protection (SoP) to 2069. This option has an iBCR of 1.9.

3.7.2 The FCERM- Grant in Aid should be capped at the 1.33% AEP SoP scheme, based on the project's relative contribution to national Outcome Measures.

3.7.3 The application of Stage 2 of the decision rules in FCERM-AG including non-FCERM benefits would support the selection of the next shortlisted option (Option 3b) with a 1.0% AEP standard of protection and an iBCR of 6.8.

3.7.4 A 1.0% AEP Standard of Protection scheme, with an allowance for climate change to 2069 is equivalent to a 140 year return period standard in 2019.

3.7.5 When contributions towards the options are considered the Economically Preferred Scheme compliant with Defra/EA Appraisal Guidance and PF Rules (1.33% AEP) would not change.

3.7.6 However, consideration was given to the implementation of the Best Alternative Option, Option 5 (Hereafter known as the Local Choice Preferred Scheme), as this option would meet the critical success factors of the Leeds City Council by delivering a 0.5% AEP standard of protection to both Leeds Phase 1 and Leeds Phase 2.

3.7.7 To assist in funding this Local Choice Preferred Scheme LCC will provide a capital contribution of £10m and will underwrite additional capital contributions to a value of £18.5m.

3.7.8 Assessment of the wider benefits of the shortlisted options during Stage 5 identified that this option has significant wider benefits (social, environmental and economic) which satisfy the objectives of Leeds City Council.

3.7.9 Option 5 incorporates enhancements which will improve the environmental and ecological value of the River Aire. In addition, it will also provide health, well-being and educational benefits for local communities by creating and enhancing connectivity to existing amenities along the river corridor.

3.7.10 The outcome measures for the Local Choice Preferred Scheme are identified in *Table 25* below

Table 25: Contributions to outcome measures

Contributions to outcome measures	
Outcome 1 − Ratio of whole-life benefits to costs	
Present value benefits (£'000)	252,794
Present value costs (£'000)	109,632
Benefit: Cost ratio	2.3
Outcome 2 − Households at reduced risk	
2a – Households moved to a lower risk category (number – nr)	77
2b – Households moved from very significant or significant risk to moderate or low risk (nr)	77
Outcome 4 – Water framework directive	
4a – Hectares of water-dependent habitat created or improved (ha)	125
4c – Kilometres of river protected (km)	0

3.7.11 The capital value of the Local Choice Preferred Scheme is **£112.1m**.

3.7.12 Following consideration of the benefits and costs Option 5 is being promoted in this Outline Business Case as the Local Choice Preferred Scheme.

3.8 Local Choice Preferred Scheme summary

3.8.1 The Local Choice Preferred Scheme consists of:

- The removal of redundant bridges at Armley Mills to improve conveyance in flood conditions;
- Raising of Milford Place footbridge to remove the potential for flow restriction in flood events;
- The removal of the under-hanging structure at Redcote Lane bridge;
- The local widening of the channel adjacent to the A65;
- Construction of linear defences, built to a level which matches those required to ultimately provide 0.5% AEP SoP with climate change to 2039 assuming attenuation is also provided. These walls are compatible with maximum desirable wall heights under environmental, planning and landscaping constraints, typically averaging 1.2m to 1.5m in height,with localised sections up to 2.5m;
- Construction of new flood storage facility at Calverley. The volume of storage which could be mobilised is 0.7M cubic metres and has potential to reduce flood flows 5%;
- Advanced works to include flood protection at Stourton Industrial Estate;
- In order to maximise future economic regeneration benefits, provision of access improvements along the corridor and woodland creation a programme of NFM works is also delivered over the next 6 years with the aim for raising the standard of protection in the face of climate change over the next 30 years. Details of the NFM proposals are contained in Appendix W.

3.8.2 The Present Value Cost of the Local Choice Preferred Scheme to provide 0.5% AEP SoP to 2069 is £109.8m. These numbers are inclusive of optimism bias and take into account the differing extents of wall required. They are also inclusive of LCC Staff and Technical Advisor costs.

3.8.3 This Local Choice Preferred Scheme would also increase the Phase 1 SoP to a 0.5% AEP standard with allowance for climate change to 2069 and so meets the Leeds City Council's strategic objectives. The combined works have a benefit to cost ratio, in flood risk reduction terms (excluding wider benefits) of 2.3 overall, and so satisfies HM Treasury Green Book criteria for publicly-funded schemes, even before the regeneration benefits are factored into the analysis.

3.8.4 The Local Choice Preferred Scheme would have significant wider economic benefits in terms of regeneration. Implementing this option would enable the creation of an additional **1,669** jobs, an annual GVA benefit of **£88.2m**, which would result in additional net present value GVA benefits of **£774m** (10 years).

3.8.5 The benefit cost ratio including GVA would be **9.4**.

3.9 Sensitivity analysis

3.9.1 We have carried out sensitivity testing to determine the impact on the option selection.

3.9.2 The cost of the Local Choice Preferred Scheme would need to increase by around £143m (including optimism bias and future maintenance), for the benefit cost ratio to be lower than 1 (excluding wider GVA benefits), and so change the option selection. This would represent a 131% increase in the existing capital cost estimate.

3.9.3 The benefits associated with the Local Choice Preferred Scheme (excluding wider GVA benefits) would need to reduce by £143m for the benefit cost ratio to be lower than 1, and so change the option selection. This would represent a 57% reduction in the existing benefit calculation.

3.9.4 Although higher SoP linear defence options were ruled out technically and environmentally, they would in theory be cheaper ways of achieving the higher SoP. The question may be asked if the jump in SoP to the Local Choice Preferred Scheme is economically optimum. To give additional confidence, we have tested this by assessing the 0.5% AEP linear defence option against the 1.0% AEP linear defence option. This option would not have a sufficient incremental benefits to justify going above the 1.0% AEP option.

3.9.5 Similarly, a comprehensive sensitivity analysis has been undertaken on the assumptions underpinning the NFM benefits assessment. From these, selected 'envelope defining' scenarios are summarised below in *Table 26*. Sensitivity is assessed against the following combinations of:

- Non-carbon valuation profile (low, medium or high benefit valuation) including water quality improvement, recreation (non-consumptive), biodiversity and aesthetic amenity,
- Carbon sequestration potential rates / Ha for wetland and moorland restoration,
- Woodland planting density (project mean defined target based on Woodlands for Water Design Guidance and lowest acceptable density) and resulting carbon sequestration profiles;
- and Non traded price of carbon and sensitivities for appraisal, DECC.

3.9.6 For the 'Most Likely' benefit scenario, the central, medium and 'target planting density' profiles have been applied to all relevant parameters. The 6 tests presented below demonstrate the sensitivity of the calculated NFM benefits to varying the parameters identified above between their lower and higher profiles for the different NFM measure groups in combination. As highlighted in Appendix W, the majority of the NFM non-flood benefits are derived from calculated carbon sequestration potential. Consequently, the derived overall NFM benefits are most sensitive to the NTPC profile applied, as illustrated in Sensitivity Tests 2 and 3 in *Table 26*.

3.9.7 These scenarios demonstrate that for the majority of tests, the derived NFM benefits provide the full proposed scheme with an iBCR of 3 or greater when moving from Option 3a to 3b (1.33% AEP + CC to 1.0% AEP + CC scheme option). All scenarios clearly and robustly demonstrate a cost-beneficial scheme.

Table 26: NFM Non-Flood Sensitivity Summary

Ref	Description	Non Carbon Valuation Profile (all)	Carbon Sequestration Profile	Woodland Planting Density	Non Traded Price of Carbon Profile	NFM present value benefits (Option 3b) (£'000)	Leading scheme present value benefits (£'000)	Incremental benefit cost ratio (iBCR) – Option 3a to 3b
		All	All	Woodland	All			
ML	Most likely, all central profiles	Medium	Medium	Target	Central	£95,285	£224,451	6.8
S1	Most likely, low performance profiles	Low	Low	Target	Central	£89,572	£218,738	6.4
S2	Most likely, low carbon price profiles	Medium	Medium	Target	Lower	£41,019	£170,185	3.0
S3	Most likely, all low profiles	Low	Low	Low	Lower	£25,761	£154,927	1.9
S4	Most likely, high performance profiles	High	High	Target	Central	£106,736	£235,903	7.6
S5	Most likely, high carbon price profiles	Medium	Medium	Target	Upper	£149,543	£278,710	10.6
S6	Most likely, all high profiles	High	High	Target	Upper	£162,426	£291,593	11.5
S7	S1 profile, minus Woodland Trust contributions	Medium	Medium	Target	Central	£46,427	£178,019	3.5

3.9.8 From our sensitivity testing we can conclude that uncertainty does not affect the inclusion of NFM as a measure within the Economic Preferred Scheme or our choice of the Local Choice Preferred Scheme.

3.9.9 Additional details of the nfm programme, including measures, can be located in Appendix W.

4 Commercial case

4.1 Introduction and procurement strategy

Introduction

4.1.1 The LFAS2 proposals look beyond the Leeds boundary and includes upper catchment attenuation, city reach attenuation, conveyance improvements, the residual defence heights equired and advanced works and Natural Flood Management (NFM).

4.1.2 The Feasibility and Preliminary Design professional services contract was awarded September 2016 to BMM JV (BAM Nuttall and Mott MacDonald joint venture) and tendered through Lot 4 of the WEM Framework.

4.1.3 The contact includes a clause to enable instruction of the Specimen Design, through the compensation event procedure, subject to satisfactory performance of the Appraisal Stage. Also included is a further clause to enable the instruction of Technical Advisory Services. This would be utilised in the event of the Main Works design and build contract being awarded to a different organisation to that of the Feasibility and Preliminary Design thereby ensuring continuity throughout the project.

4.1.4 The contact was tendered in accordance with LCC's Contract Procedure Rules (CPR). The CPRs state every procurement undertaken by the Council will comply with the Public Contracts Regulations and all relevant guidance and statutory provisions in addition to the Council's Finance Procedure Rules, the Council's strategic objectives and policies and the Council's Constitution. The CPRs also outline the responsibilities of Authorised Officers in relation to ensuring that a fair, transparent and non-discriminatory process is followed during the procurement, and when entering into the contract.

4.1.5 The form of contract used is the New Engineering Contract 3 (NEC) Professional Services Contract using Main Option C; Target Cost with Activity Schedule. Tenders were assessed using a three-stage assessment process comprising a quality assessment, a price assessment and a combined quality/price assessment. All tenders that complied with the quality threshold requirements were then financially assessed including an appraisal of the prices and percentages. The quality and financial scores were then weighted 60% Quality and 40% Price before being combined.

4.1.6 The Main Works design and build contract will also be tendered through WEM Lot 4 Design and Build framework. The NEC3 Engineering Construction Contract (ECC) will be the form of contract used and again, tenders will undergo a three-stage assessment of quality, price and a combined quality/price assessment. It is expected the scores will be weighted 60% Quality and 40% Price.

4.1.7 Should a separate Technical Advisory Services contract be required; it is likely this will be tendered through Lot 3 of the WEM framework for Engineering Related Services. The form of contract used will the NEC3 PSC. The decision to proceed this this tender will be undertaken following the Main Works design and build procurement.

Procurement strategy

4.1.8 The procurement strategy utilises Lot 4 of the Environment Agency (EA) Water and Environment Management (WEM) framework twice, by combining all of the pre design and build work packages together as a single procurement and then procuring again within the same Lot once a design and build tender has been formulated as shown on the diagram below. With this approach, the aim is to reduce the overall programme whilst introducing early contractor involvement from the beginning and provide the same team throughout, comprising of consultants and contractors, with the team either later taking on the role of technical advisor under a project support role, or continuing as a contractor subject to successfully winning a design and build tender.

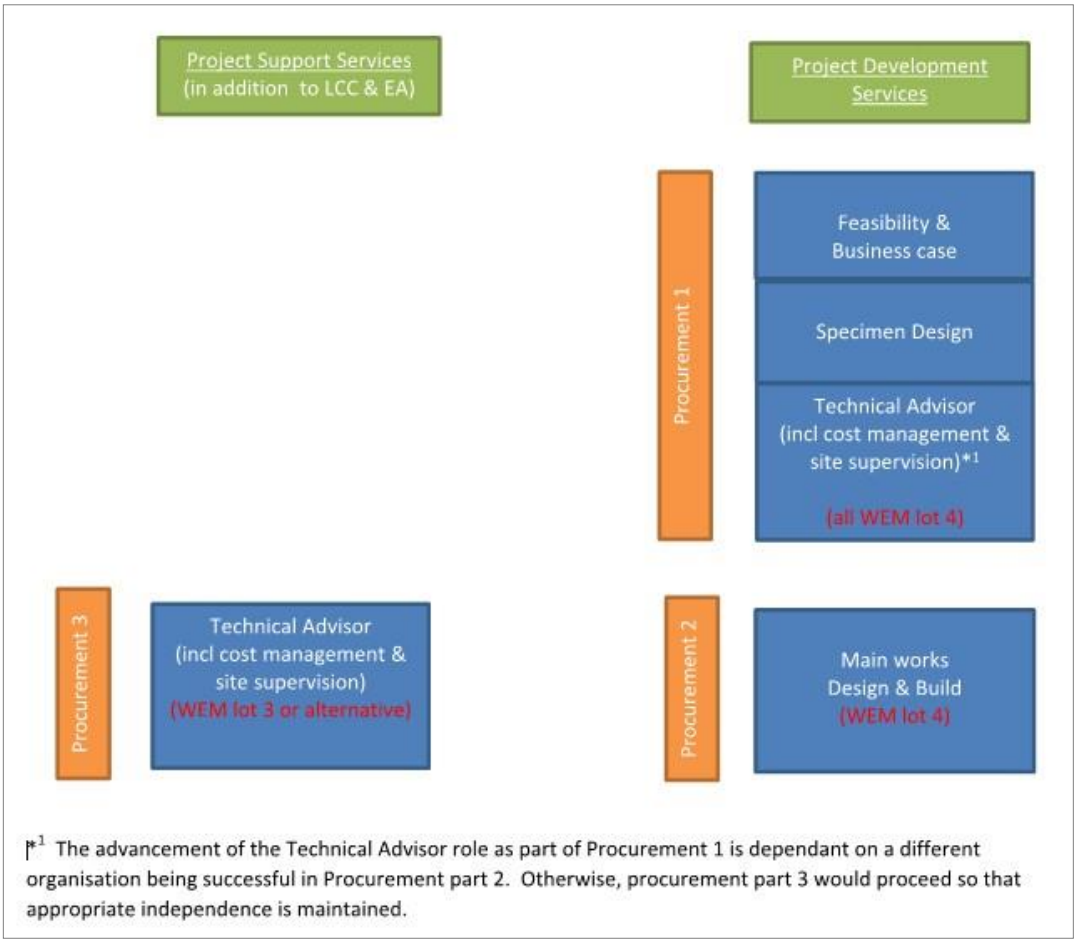

Figure 1: Proposed Procurement Structure

4.1.9 Further details can be found in the attached procurement strategy in Appendix Y.

4.2 Key contractual terms & risk allocation

4.2.1 The Feasibility and Preliminary Design works have been procured as a professional services contract through the Environment Agency Water and Environment Management (WEM) framework. The 4th Lot of this framework has specifically been established for large scale flood alleviation projects.

4.2.2 The construction works will be procured through a competitive tender process using the WEM Lot 4 Framework Contract provisions to determine a Target Cost with the key contract terms summarised below:-

4.2.3 Use of EA standard Z Clauses with applied lessons learned from administering the Phase 1 contract over 36 months.

4.2.4 Ground conditions and condition of existing structures risk to reside with the Employer unless sufficient survey information can be provided with the tender documents to allow risk quantification and pricing by the tenderers. Ground investigation works are currently underway and will be provided to the successful tenderer.

4.2.5 Protection for the Employer including maximum pain share exposure capped at 107.5% of the Target Cost, based on the Contractor taking 100% pain if the defined cost exceeds 115% of the Target. Delay damages for late completion and 5% retention provision.

4.2.6 In the collaborative spirit of the Contract, the Employer's willingness to review value engineering proposals from the Contractor is specifically recognised and, where proposals are accepted, the saving shared by both parties.

4.2.7 The allocation of risk will recognise where the project resides in the design development process and allocate risks according to how well quantified the risks are and which party is best placed to manage them. At the time of writing this report, the key commercial risks and proposed mitigations are as set out below:

Table 27: Key commercial risks

Ref	Risk	Mitigation
1	Errors in construction cost estimate lead to tender returns higher than budget.	Benchmarking costs against Phase 1 with due provision for inflation and design development
2	Programme and overall project duration is longer than forecast	Early recognition of constraints such as ecology calendar.
3	Approval of funding takes longer than forecast.	Working with BMM Planner to assess activity durations with suitable time risk allowances to reflect prevailing conditions based on known Phase 1 outputs. Ongoing review as design develops.
4	Acquisition of land and associated compensation payments delay the project.	Ongoing review of costs and benefits with EA. Set realistic programme commensurate with historic timescales based on level of funding required.
5	Unforeseen ground conditions	Early engagement with land owners and local developers to investigate mutually beneficial solutions.
6	Scope definition and detailed design development	Specimen design to highlight key areas or potential hotspots as per the Risk Register. Risk Register highlights specific areas where the design and / or specification should be developed e.g. specialist barriers to allow tenderers to price with confidence.

4.2.8 A detailed Risk Register has been compiled by representatives from all disciplines in the project team and this is included as Appendix K.

4.2.9 The risk register recognises our exposure to planning risk and the mitigation strategy through the Specimen design phase to develop the design in sensitive areas to provide a pallet of materials with greater design detailing. Combining this with early engagement with the local authority planners will allow us to appropriately pass the risk of discharging the planning condition to the Contactor with confidence.

4.3 Procurement route and timescales

4.3.1 The following table sets out the procurement milestones and timescales.

Table 28: Procurement milestones and timescales

Activity	Start Date	End Date
Specimen Design Phase		
Specimen Design	January 2018	July 2018
Environmental Impact Assessment	January 2018	July 2018
Full Planning Application	July 2018	October 2018
Advanced works on site	January 2018	October 2018
Main Works		
Tender Period	October 2018	January 2019
Full Business Case Submission	January 2019	
Contract award	February 2019	
Undertake detailed design	February 2019	
Construction works (subject to FBC Approval)	June 2019	August 2022
Technical Advisory Services (if required)		
Tender Period	January 2019	March 2019
Contract award	March 2019	

4.4 Efficiencies and commercial issues

4.4.1 The co-located team developing the scope and Specimen Design for Phase 2 comprises of representatives from all parties who delivered the Phase 1 design and construction works with additional specialist flood modelling and NFM support. Efficiencies delivered by this collaborative arrangement include:-

- Efficient design development benefitting from ECI and lessons learned from Phase 1.
- Coordination of activities such as key stakeholder engagement.
- Planning events such as public consultation and preparing a consistent and clear message about the proposed works and standard of protection.
- Development of a comprehensive risk and opportunities register.
- Swift resolution of issues with improved face-to-face communications minimising email correspondence.
- Early engagement with planners and ward councillors.

4.4.2 A Register of efficiencies captured to date is included as Appendix S.

4.4.3 Future opportunities will be realised through the development of the Specimen Design and thereafter in the procurement and delivery process through the Lot 4 Framework. Commercial efficiencies will be realised through:

- A competitive tender process for the construction works.
- Payment for people at prescribed Lot 4 rates.

4.4.4 Highlighting and implementing the contract provisions encouraging value engineering proposals from the delivery contractor with the savings shared equally between Contractor and Employer.

4.4.5 Collaborative working and appropriate management of the NEC Option C Contract seeking savings and efficiencies to reduce the defined cost of the work.

5 Financial case

5.1 Introduction

5.1.1 The Government has currently committed £65m towards a scheme for Leeds. LCC have committed **£28.5m (£25.8m PV).** There is a residual shortfall of **£18.6m (£15.8m PV)** against the Locally Preferred Scheme (0.5% AEP).

5.1.2 The Leader of LCC, with full support from all parties within the council, cross party support from all eight Members of Parliament for Leeds, the Chambers of Commerce and the Chief Executive, is currently seeking confirmation of funding from the Floods Minister.

5.1.3 If this scheme is supported, LCC will provide, or fund locally through contributions, the investment required to deliver the Local Choice Preferred Scheme.

5.1.4 To do this, LCC are contributing **£10m (£8.9m PV)** capital funding, actively seeking and underwriting primary contributions of **£18.5m (£16.7m PV**) including the contribution from the Woodland Trust. LCC are underwriting the risk of the scheme above the approval value of £112.1m and will lead on the operation and maintenance valued at £7m PV. LCC are actively seeking contributions to close the funding shortfall of **£3.8m (£3.2m PV)** including securing other funding sources and completing a competitive tendering exercise.

5.1.5 Details of the Economically Preferred scheme compliant with Defra/EA Appraisal Guidance and PF Rules (1.33% AEP) is presented Section 5.2. Section 5.3 contains details of the economically preferred scheme with non-FCERM benefits (1.0% AEP), whilst details of the Local Choice Preferred Scheme (0.5% AEP) are presented in Section 5.4. All options have been assessed against an appraisal period of 100 years irrespective of the standard of protection of the option. This is reflected within calculations of whole life costs and benefits.

5.2 Financial Summary for Economically Preferred Scheme compliant with Defra/EA Appraisal Guidance and PF Rules (1.33% AEP)

Overview

5.2.1 The total capital value of this scheme option is **£62.8m (£56.2m PV**).

5.2.2 While this option mitigates against climate change to 2069, this does not place a limit on the appraisal period. The impact of climate change in reducing the standard of protection of this option is reflected in the calculations of benefits, and is also reflected in the calculation of OM2 properties within the PFC.

5.2.3 For reference, *Table 29* below provides a summary of the origin of the costs which have been incorporated into this financial case.

Table 29: Summary of Cost Origins

	£m	Costs to OBC	Construction Cost	Inflation	50% Optimism Bias	Monte Carlo Risk Allowance	Future Maintenance
1.33% AEP to 2069							
Capital Cost Approval Value	62.8	3.2	40.3	1.6		17.7	
Present Value	56.2	3.0	36.2	1.4		15.7	
Whole Life Cost	77.7	3.2	40.3		21.5		12.6
Present Value Cost for Economic Assessment	62.1	3.2	35.9		19.2		3.8

FCERM-GIA Partnership Funding Calculation

5.2.4 The indicative allocation comprises: £5m FCRM GiA and £30m Defra Booster pre-2021; and £30m Defra Booster post 2021 as represented in the consented Capital Investment Programme and pipeline post 2021 **(£65m (£58.4m PV))**.

5.2.5 Therefore the FCERM-GiA for the Economically Preferred Scheme has been calculated using the Partnership Funding Calculator (PFC) and the following contributions:

- PV Public Contributions secured to date: None.
- PV Funding from other Environment Agency Functions: The **£60m (£53.8m PV)** Booster Allocation in the Consented Programme and Indicative Allocation has been included as secured.

5.2.6 The indicative funding strategy includes FCERM-GIA, calculated as **£7.6m (£6.8m PV)** based on the Partnership Funding Calculator.

5.2.7 The 1.33% AEP scheme cost is **£62.8m (£62.1m PV)** inclusive of the FCERM-GIA. This is less than the Defra Allocation in the Consented Programme of **£65m.**

5.2.8 A copy of the PFC calculation is included in Appendix B.

Funding sources for Economically Preferred Scheme compliant with Defra/EA Appraisal Guidance and PF Rules (1.33% AEP)

5.2.9 Details of the funding sources are provided in *Table 30*. This summarises the value of the proposed primary funding sources and the corresponding present value based on the proposed construction programme.

5.2.10 The Funding Strategy for the Economically Preferred Scheme can be summarised as follows:

- Primary Funding Sources – FCERM-GIA and Defra Booster funding.

5.2.11 This scheme is eligible for **£7.6m (£6.8m PV)** of FCERM GIA **(£5m (£4.6m PV)** pre-2021**; £2.6m (£2.2m PV)** post-2021).

Table 30: Primary Funding Sources: Cash Cost and Present Value Cost for Option 3a (1.33% AEP with climate change to 2069)

Primary Funding Sources	Cash Cost (£m)	Present Value (£m)
Scheme value	62.8	56.2
Total Contribution from Defra		
FCERM-GIA	7.6	6.8
Defra Booster	55.2	49.5
Local Contributions		
Woodlands Trust	0.0	0.0
Total	62.8	56.3
Indicative Allocation in FCERM Consented Programme to 2021		
FCERM-GIA	5.0	4.6
Defra Booster	29.1	27.0
Sub-total	34.1	31.6
Indicative Allocation in FCERM Consented Programme to 2021		
FCERM-GIA	2.6	2.2
Defra	26.2	22.4
Sub-total	28.7	24.6
Funding Required in addition to the indicative allocations in the consented programme (post 2021)		
FCERM-GIA	0.0	0.0
Defra Booster	0.0	0.0
Sub-total	0.0	0.0
Adjusted Partnership Funding Score (PF)	100%	100%

5.3 Financial Summary for Economically Preferred Scheme including Non-FCERM benefits (1.0% AEP)

Overview

5.3.1 The total capital value of this scheme option is **£86.7m (£76.4m PV**).

5.3.2 While this option mitigates against climate change to 2069, this does not place a limit on the appraisal period. The impact of climate change in reducing the standard of protection of this option is reflected in the calculations of benefits, and is also reflected in the calculation of OM2 properties within the PFC.

5.3.3 For reference, *Table 34* below provides a summary of the origin of the costs which have been incorporated into this financial case.

Table 31: Summary of Cost Origins

	£m	Costs to OBC	Construction Cost	Inflation	50% Optimism Bias	Monte Carlo Risk Allowance	Future Maintenance
1.0% AEP to 2069							
Capital Cost Approval Value	86.7	3.2	56.3	1.7		25.5	
Present Value	77.1	3.0	50	1.5		22.6	
Whole Life Cost	94.2	3.2	56.3		22.1		12.6
Present Value Cost for Economic Assessment	76.4	3.2	49.8		19.6		3.8

Funding sources for Economically Preferred Scheme with Non FCERM benefits (1.0% AEP)

5.3.4 Details of the funding sources are provided in *Table 35*. This summarises the value of the proposed primary funding sources and the corresponding present value based on the proposed construction programme.

5.3.5 The Funding Strategy for the Economically Preferred Scheme can be summarised as follows:

- Primary Funding Sources – FCERM-GIA, Defra Booster funding, and WT.

5.3.6 Taking account of the primary funding sources and the indicative allocation, there is a current funding gap of **£14.8m (£12.6m PV)** for the Economically Preferred Scheme with non FCERM benefits (1.0% AEP).

5.3.7 This scheme is eligible for **£7.6m (£6.8m PV)** of FCERM GIA **(£5m (£4.6m PV)** pre-2021**; £2.6m (£2.2m PV)** post-2021) and has attracted a contribution of **£6.9m (£6m PV**) from the Woodlands Trust. Should this option be supported by the Minister the indicative commitment of Defra Booster funding would be increased by **£14.8m (£12.5m PV)** to **£79.8m (£70.8m PV).**

Table 32: Primary Funding Sources: Cash Cost and Present Value Cost for the 1.0% AEP Scheme.

Primary Funding Sources	**Cash Cost (£m)**	**Present Value (£m)**
Scheme value	86.7	77.1
Total Contribution from Defra		
FCERM-GIA	14.5	12.7
Defra Booster	65.3	58.3
Local Contributions		
Woodlands Trust	6.9	6.0
Total	***86.7***	***77.1***
Indicative Allocation in FCERM Consented Programme to 2021		
FCERM-GIA	5.0	4.6
Defra Booster	30.0	27.9
Sub-total	***35.0***	***32.5***
Indicative Allocation in FCERM Consented Programme to 2021		
FCERM-GIA	0.0	0.0
Defra	30.0	25.9
Sub-total	***30.0***	***25.9***
Funding Required in addition to the indicative allocations in the consented programme (post 2021)		
FCERM-GIA	9.5	8.1
Defra Booster	5.3	4.5
Sub-total	**14.8**	**12.6**
Adjusted Partnership Funding Score (PF)	***83%***	***84%***[4]

[4] Refer to Appendix B PFC Calculation Version 2.

5.4 Financial Case for the Local Choice Preferred Scheme including additional Phase 1 Benefits (0.5% AEP)

Overview

5.4.1 The Local Choice Preferred Scheme is the 0.5% AEP SoP with Climate Change allowance to 2069. The cost breakdown of the Local Choice Preferred Scheme is set out in *Table 34* overleaf. The total capital cost of the project is **£112.1m**.

5.4.2 While this option mitigates against climate change allowance specific to a 2069, this does not place a limit on the appraisal period. The impact of climate change in reducing the standard of protection of this option is reflected in the calculations of benefits, and is also reflected in the calculation of OM2 properties within the PFC.

5.4.3 For reference, *Table 33* below provides a summary of the origin of the costs which have been incorporated into this financial case.

Table 33: Summary of Cost Origins for the Local Choice Preferred Scheme

	£m	Costs to OBC	Construction Cost	Inflation	50% Optimism Bias	Monte Carlo Risk Allowance	Future Maintenance
0.5% AEP to 2069							
Capital Cost Approval Value	112.1	3.2	78.1	2.5		28.2	
Approval Present Value	99.7	2.8	69.6			25.0	
Whole Life Cost	140.0	3.2	78.1		33.4		25.2
Present Value cost for Economic Assessment	109.6	3.2	69.2		29.7		7.5

Table 34: Local Choice Preferred Scheme Costs

Costs (£'000)	Cost for economic appraisal (PV)	Whole-life cash cost	Total project cost (approval)
Costs to OBC:			Exc previous app
Existing staff costs	1,073	1,073	1,073
Further staff costs[5]	-	-	-
Site investigation and survey	215	215	215
Consultant fees (includes cost consultant, site investigation and surveyor costs)	500	500	500
Contractors' fees	204	204	204
Subtotal	**1,991**	**1,991**	**1,991**
OBC to construction:			
Existing staff costs	459	475	475
Further staff costs	-	-	-
Consultant fees (includes cost consultant, site investigation and surveyor costs)	101	105	105
Contractors' fees	652	675	675
Subtotal	**1,212**	**1,255**	**1,255**
Construction:			
Construction costs	43,649	49,039	49,039
Inflation allowance for * months			2,505
Stourton Advanced Works	1,363	1,408	1,408
Advanced Works	639	690	690
Natural Flood Management	13,154	15,000	15,000
Environmental enhancement & mitigation	4,668	5,523	5,523
Existing staff costs	2,481	2,807	2,807
Further staff costs			
Consultant fees (includes cost consultant, site investigation and surveyor costs)	3,246	3,672	3,672
Subtotal	**69,200**	**78,139**	**80,644**
Risk contingency:			
Optimism Bias (50%)	29,688	33,397	
Risk - Monte Carlo 95% or similar			26,635
Risk - Monte Carlo 50% or similar[6]			
Risk – Calverley Flood Storage Reservoir[7]			1,585
Future costs:			
Maintenance & Future construction	5,027	16,818	
Optimism Bias (on future costs)	2,514	8,409	
Project total costs	**109,632**	**140,010**	**112,110**

5.5 Funding sources for Local Choice Preferred Scheme

5.5.1 This section sets out the current funding strategy for Leeds FAS2 and provides an up to date position for each funding source at the point of the OBC being submitted.

5.5.2 The Government has currently committed £65m towards a scheme for Leeds. LCC have committed £28.5m (£25.8m PV). There is a residual shortfall of £18.6m (£15.8m PV) against the Locally Preferred Scheme (0.5% AEP).

5.5.3 The Leader of LCC, with full support from all parties within the council, cross party support from all eight Members of Parliament for Leeds, the Chambers of Commerce and the Chief Executive, is currently seeking confirmation of funding from the Floods Minister.

[5] No additional staff costs are anticipated.
[6] For the purpose of calculating the net present value for the economic appraisal and whole life costs, an optimism bias value was applied at 50%, rather than applying a risk value based on Monte Carlo simulation.
[7] An additional risk allocation of 15% of the capital costs for Calverley has been included based on Environment Agency experience delivering reservoirs on other national flood schemes.

5.5.4 If this scheme is supported, LCC will provide, or fund locally through contributions, the investment required to deliver the Local Choice Preferred Scheme.

5.5.5 To do this, LCC are contributing **£10m (£8.9m PV**) capital funding, actively seeking and underwriting primary contributions of **£18.5m (£16.7m PV**) including the contribution from the Woodland Trust. LCC are underwriting the risk of the scheme above the approval value of £112.1m and will lead on the operation and maintenance valued at **£7m PV.** LCC are actively seeking contributions to close the funding shortfall of **£3.8m (£3.2m PV)** including securing other funding sources and completing a competitive tendering exercise.

5.5.6 *Table 35* summarises the value of the proposed primary funding sources and the corresponding present value based on the proposed construction programme. Refer to *Table 40* for the annualised spend profile.

Table 35: Primary Funding Sources: Cash Cost and Present Value Cost

Primary Funding Sources	**Cash Cost (£m)**	**(£m)**
Scheme value	112.1	99.7
Total Contribution from Defra		
FCERM-GIA	7.6	6.8
Defra Booster	72.3	64.0
Sub-total	**79.8**	**70.8**
Of which, the following is in addition to the current indicative allocations		
FCERM-GIA (Post 2021)	2.6	2.2
Defra Booster (Post 2021)	12.3	10.3
Sub-total	**14.9**	**12.6**
Local Contributions		
Leeds City Council Contributions	10.0	8.9
Woodland Trust	6.9	6.0
Primary funding sources identified and underwritten by LCC	11.6	10.7
Sub-total	**28.5**	**25.6**
Current Funding Shortfall		
To be secured by LCC	**3.8**	**3.2**

5.5.7 The Funding Sources are summarised as follows:

- Primary Funding Sources – FCERM-GIA, Defra Booster funding, LCC, ESIF, LGF, and WT.
- Secondary Funding Sources – Local funding and third party e.g. Community Infrastructure Levy, additional LGF, Network Rail, HS2, Highways England, Yorkshire Water.
- Maintenance Funding Sources – Leeds City Council will maintain the scheme for the proposed life cycle.

5.5.8 The following sections summarises the status of each of the known funding sources as part of both the Primary and Secondary sources.

Primary funding sources

Table 36: Leeds FAS 2 Primary Funding Sources

Name of Fund/Source	Objectives of funding source	Status	Amount
Environment Agency Flood Defence Grant in Aid (FCERM-GIA)	Allocated based on scheme achieving EA's defined Output Measures to reduce the risk of flooding to households and avoid the cost of damages associated with flooding to households, businesses, agriculture, local government, communications, infrastructure, utilities and public health.	Allocation and confirmation subject to business case being produced and approved. Calculated using Partnership Funding Calculator (see Appendix B).	£5.0m
Defra FCERM Booster Funding	Government funding, provided by Defra to schemes for specific cities and communities that were devastated by the floods of December 2015. The purpose of the funding is to enable them to be progressed and delivered at an accelerated pace.	£30m in funding allocated by Defra to Leeds FAS2 up to 2021 for a 1 in 100-year SOP including EA FCERM-GIA of £5m. Of the £30m, £3m has been secured and awarded to LCC for development work including the preparation of the OBC. Indicative funding allocation of £30m post 2021 dependant on level of work programmed long term.	£30m in consented programme £30m indicative allocation post-2021 £14.8m Additional Funding Request
Leeds City Council Capital Contribution	Capital investment to a 'good' level of protection of 0.5% AEPs to comprise of a catchment wide approach to flood risk management in the River Aire Catchment.	Confirmed contribution by Leeds City Council in February 2018.	£10.0m
Leeds City Council – Underwriting	LCC will underwrite Contributions to the value of £18.5m comprising: ESIF £7.7m LGF £3.9m and Secondary Sources £6.9m		£18.5m
EU Structural Investment Funds (ESIF) – Stourton	Funding awarded based on scheme's fit to Priority Axis (PA): PA5 – Promoting climate change adaptation, risk prevention and management	Full funding approval awarded December 2017.	Included above
EU Structural Investment Funds (ESIF) – Kirkstall Road Corridor	PA 6 – Preserving and protecting the environment and promoting resource efficiency	Outline application submitted September 2017.	Included above
Leeds City Region Local Growth Fund (LGF)	LGF provides support for projects that benefit the local area and economy, in this case the region. Local priorities are identified in a Strategic Economic Plan (SEP). Relevant Priority Areas (PA) within SEP that FAS2 meets include: • PA 3 – Clean Energy and Environmental Resilience • PA 4 – Infrastructure Growth	The latest Growth Deals were announced on 23rd January 2017 included £20m allocated to flood alleviation schemes in Leeds City Region. £3.9m is allocated to FAS2. A Full Business Case is required to be submitted to the West Yorkshire Combined Authority in order to gain full approval for this funding. This will be developed and submitted in conjunction with the main OBC being prepared for the FAS2.	Included above
Woodlands Trust	To provide financial and practical woodland creation support in West Yorkshire. Including the support of farmers by boosting production, improving sustainability and strengthening landscape resilience through tree planting.	A Woodlands Trust scheme assessment is required to determine suitability of project for funding and to design a support package. The funding being sought will be for the NFM elements of FAS2.	Included above
Current Funding Shortfall at OBC	Current funding shortfall (LCC are actively seeking contributions to close this by securing other funding sources and completing a competitive tendering exercise).		£3.8m
TOTAL			**£112.1m**

Secondary funding sources

5.5.9 A Benefits Manager has been appointed with the specific task enhancing engagement with potential funders and to agree funding availability for the scheme.

Table 37: Leeds FAS 2 Secondary Funding Sources

Name of Fund/Source	Objectives of funding source	Status	Amount
Leeds Community Infrastructure Levy (CIL)	CIL allows local authorities in England and Wales to raise funds from developers undertaking new building projects in their area. The money can be used to fund a wide range of infrastructure that is needed as a result of development.	Leeds FAS is one of the schemes specifically mentioned on the Regulation 123 list. LCC to confirm amount allocated/available for Leeds FAS2	Tbc
Leeds City Region Local Growth Fund (LGF)	LGF provides support for projects that benefit the local area and economy, in this case the region. Local priorities are identified in a Strategic Economic Plan (SEP). Relevant Priority Areas (PA) within SEP that FAS2 meets include: • PA 3 – Clean Energy and Environmental Resilience • PA 4 – Infrastructure Growth	The current £20m allocation to flood alleviation schemes in Leeds City Region includes £1.7m for Natural Flood Management (NFM) measures across the region. An OBC for how the £1.7m NFM programme will be spent across the region was submitted to West Yorkshire Combined Authority in December 2017.	Tbc
Network Rail Control Period 6 (CP6)	CP6 includes £9.5bn worth of enhancements between 2019-24. Work to protect the line at Kirkstall is likely to be eligible for support to prevent it being cut off by future flooding events, resulting in significant costs being incurred.	Initial discussions with Network Rail have been held. Network Rail interested in exploring the level of intervention they could fund, but with no firm commitment.	Tbc
Yorkshire Water Price Review 19 (PR19)	Under PR19 Yorkshire Water is committed to supporting flood alleviation schemes, to the extent that this impacts on their activities.	Initial discussions with Yorkshire Water have taken place. However, no specific budget allocation has yet been made for Leeds FAS2	Tbc
Highways England Environmental Designated Fund (EDF)	The objective of EDF is to fund projects that help achieve environmental benefits for a combination of topic areas, including flooding, with the specific aim of addressing flooding caused from highway runoff, as well as improving the resilience of the Strategic Road Network.	Highways England have looked at the current FAS2 proposals and whilst they believe there could be a couple of locations that could discharge to the river, further investigation would be required to determine this. Given the impact that the Motorway may have is considered low, any contribution would be modest.	Tbc
HS2	A new station for HS2 is to be constructed downstream of the Leeds Station in Leeds South Bank. This station entrance and its surrounding public realm would be afforded enhanced flood protection	Initial discussions with HS2 to be progressed during the next phase of the project development.	TBC

5.5.10 The FAS team is currently working with developers in the Leeds FAS Phase 2 area to ensure development proposals are compatible with our project works to reduce flood risk in the area. Where possible and subject to timescales LCC are seeking developer contributions.

5.6 Annualised funding profile for the Local Choice Preferred Scheme

5.6.1 *Table 38* sets out the proposed draw down of the funding over the life of the project and is reflective of the Capital Cost Spend Profile.

5.6.2 The funding profile takes into account the timing constraints with regards to when funding from different sources is required to have been drawn down:

- FCERM-GIA – an allocation of £5m pre-2021
- Defra Booster funding – indicative contribution of £30m pre-2021
- ESIF – must have begun draw down within 3 months of formal approval, and fully claimed within 3 years
- Local Growth Fund – must be drawn down by 2021

Table 38: LFAS 2 primary funding sources for the Local Choice Preferred Scheme

Funding Source (£k)	Yr 0: 2017	Yr 1: 2018	Yr 2: 2019	Yr 3: 2020	Yr 4: 2021	Yr 5+	Total
FCERM-GIA							
Consented Programme to 2021	-	-	2,400	2,600			5,000
Allocation required post 2021					1,261	1,305	2,566
Sub-total	**-**	**-**	**2,400**	**2,600**	**1,261**	**1,305**	**7,566**
DEFRA Booster							
Consented Programme to 2021	2,095	4,121	9,462	14,323			30,000
Indicative allocation of £30m				-	18,278	9,156	27,434
Funding Request post 2021	-	-	-	-	1,261	13,571	14,832
Subtotal	***2,095***	***4,121***	***9,462***	***14,323***	**19,539**	**22,727**	**72,266**
Plus: Contributions							
Leeds City Council			2,400	3,328	1,773	2,500	10,000
Primary Funding Sources underwritten by LCC	-	1,034	5,291	5,290	-	-	11,615
Woodlands Trust	-	-	700	1,595	2,245	2,360	6,900
Sub-total	**-**	***1,034***	***8,391***	***10,213***	***4,018***	***4,860***	***28,515***
Current Funding Shortfall					2,592	1,170	3,763
Subtotal	**-**	**-**	**-**	**-**	***2,592***	***1,170***	***3,763***
Total	**2,095**	**5,154**	**20,253**	**27,135**	**27,410**	**30,063**	**112,110**

Note: The figures used in this table are to the nearest thousand (k) and as such incur some minor variation through rounding, however this does not effect the totals.

Table 39: Present Value LFAS 2 primary funding sources for the Local Choice Preferred Scheme

Funding Source (£k)	Yr 0: 2017	Yr 1: 2018	Yr 2: 2019	Yr 3: 2020	Yr 4: 2021	Yr 5+	Total
FCERM-GIA							
Consented Programme to 2021	-	-	2,240	2,345	-	-	4,585
Allocation required post 2021	-	-	-	-	1,099	1,099	2,198
Sub-total	**-**	**-**	***2,240***	***2,345***	**1,099**	**1,099**	**6,783**
DEFRA Booster							
Consented Programme to 2021	2,095	3,981	8,832	12,917	-	-	27,826
Indicative allocation of £30m	-	-	-	-	15,928	7,709	23,637
Funding Request post 2021	-	-	-	-	1,099	11,427	12,526
Subtotal	***2,095***	***3,981***	***8,832***	***12,917***	**17,027**	**19,136**	**63,989**
Plus: Contributions							
Leeds City Council	-	-	2,240	3,001	1,545	2,105	8,891
Primary Funding Sources underwritten by LCC	-	999	4,939	4,771	-	-	10,709
Woodlands Trust	-	-	653	1,439	1,956	1,987	6,035
Sub-total	**-**	***999***	***7,833***	***9,211***	***3,501***	***4,092***	***25,636***
Current Funding Shortfall	-	-	-	-	2,259	985	3,244
Subtotal	**-**	**-**	**-**	**-**	***2,259***	***985***	***3,244***
Total	**2,095**	**4,980**	**18,906**	**24,473**	**23,885**	**25,313**	**99,652**

Note: The figures used in this table are to the nearest thousand (k) and as such incur some minor variation through rounding, however this does not effect the totals..

5.7 State Aid Considerations

5.7.1 It is not anticipated that Leeds FAS2 has any State Aid implications. LCC will be using any funding it receives in furtherance of its statutory functions to provide public infrastructure which will not be commercially exploited. In addition, the infrastructure will not specifically benefit any particular organisation other than that it will protect approximately 370 businesses who currently own or occupy premises in the area of land proposed to directly benefit from an increase in flood protection.

5.8 Impact on revenue and balance sheet

5.8.1 The proposed scheme will incur an increase in revenue costs. The new assets will require visual inspection, together with activities to maintain and/or replace movement joints, seals, flap valves and mechanical, electrical components on any moveable flood structures at prescribed intervals.

5.8.2 The inspections and maintenance works will be delivered efficiently by integrating the Phase 1 and Phase 2 maintenance activities to be undertaken by the LCC Flood Risk Management team.

5.8.3 All revenue costs relating to Leeds FAS2 will be underwritten by LCC.

5.8.4 Leeds City Council is increasing its ability to deliver a flood risk asset management service, and this is now moving toward an expansion which will inevitably influence wider regional flood risk management thinking over the coming decades.

5.8.5 It is clear that the necessary long term or life cycle investment on the River Aire and its associated catchment will be a continual and ongoing requirement, and one which shall be considered and safeguarded alongside the extensive programme of revenue investment Leeds City Council continues to successfully deliver across the city.

5.8.6 It is the intention of the authority to ensure that once protected to an appropriate level of flood event from the River Aire, that policy acknowledgement and protection of any

standard is not permitted to be reduced over time, whether this is afforded by increased revenue or local capital investment.

5.9 Overall affordability

5.9.1 The overall affordability of the Local Choice Preferred Scheme is shown in the annualised spend profile in *Table 40* below. The total scheme cost of **£112.1m (£99.7m PV)** is considered affordable based on successfully securing funding from the identified primary funding sources.

5.9.2 LCC are also actively seeking contributions to close the identified funding shortfall by securing other funding sources and completing a competitive tendering exercise.

5.9.3 The project team are expediting the delivery of the scheme at pace with an anticipated start on site in Summer 2019. A delay in the approval, or related funding commitment from the Floods Minister represents a significant risk to the programme spend, and the confidence of other funders. This could jepordise time limited primary funding sources already identified which in turn may significantly affect the affordability of the scheme.

5.9.4 The following aims to clarify different scenarios in relation to any under or over spend of the total project cost, currently estimated at **£112.1m (£99.7m PV)** for the preferred scheme (0.5% AEP to 2069):

- In the event of the total project cost being less than or equal to the agreed contribution from government, the £10M Leeds City Council contribution will still be applied and funds leftover returned to government.
- In the event of the total project cost being more than the agreed contribution from government but less than or equal to the agreed contribution from government plus the £10M Leeds City Council contribution, a mechanism would then be derived to ensure impartiality over distribution of the remaining funds back to government.
- In the event of the total project cost being more than the agreed contribution from government plus the £10M Leeds City Council contribution, any funds leftover or additional funds required will be the responsibility of Leeds City Council.

5.9.5 As Lead Local Flood Authority LCC have aspired to achieve 0.5% AEP standard of flood protection (with allowance for future climate change) for river flooding from the River Aire since 2012. This catchment-wide approach used to develop this scheme is in line with the aspirations of the Defra 25-year plan. The standard of protection meets LCC's critical success factors and is complementary to the Leeds City Region LEP and other government supported initiatives to nurture city centre Leeds as a hub of commerce, retail, trade, manufacturing and logistics as well as for residential activity.

5.9.6 LCC have demonstrated considerable commitment to this aspiration: Phase 1 of the Flood Alleviation Scheme has been successfully realised, with LCC contributing **£10m** towards the construction and taking on the operation and maintenance of an active defence system – an innovation chosen to enable flood risk to be cost-effectively reduced whilst minimising the physical impact on the city centre.

5.9.7 The impacts of recent flooding have demonstrated just how real and relevant the need for better protection is - the direct impact on the communities and businesses in Kirkstall, and the direct loss of jobs and employment following the Boxing Day 2015 flood has been considerable. LCC do not believe that asking their residents, businesses and workforce to live with the risk of this happening again is acceptable. LCC also recognise the importance of its role in realising the inclusive growth aspirations across the Leeds City Region economy and the creation of new jobs. Therefore hard choices have been made and, despite the austerity which features across all council services**, £28.5m** has been allocated to enable the Local Choice Preferred Scheme to be delivered at pace. LCC are also taking on all risk over the approval value **(£112.1m; £99.1m PV)** should costs escalate, and are extending their commitment to lead on operating and maintaining Phase 2.

5.9.8 The location of the city and the nature of the catchment mean that there are few technically feasible options to provide the city with a 0.5% AEP standard of protection and the Local Choice Preferred Scheme presented in this business case is, following intense scrutiny and analysis through the appraisal process, the best option.

5.9.9 LCC are clear on the political commitments made to them with regards to ensuring that the city has a good standard of protection and that, whilst welcome, the figure of £65m was an indicative allocation made based on a historic estimate provided in the aftermath of a major incident. It was made in full recognition that work was needed to develop a scheme proposal afresh, taking a catchment-wide approach and an ambitious timetable was set by the Defra SoS. This OBC is the culmination of this work.

5.9.10 Should the request to increase the allocation by **£14.8m (£12.6m PV)** not be successful, it would be unreasonable to assume that the **£28.5m** allocation underwritten by LCC to provide for a 0.5% AEP scheme is guaranteed. The programme for delivery is likely to be impacted and there is potential that promotion of Leeds FAS Phase 2 will stall. There is significant concern that the failure to provide protection against a repeat of the Boxing Day flood means the west of the city, including the city centre area around the new HS2 station, will be unattractive for developers and investors and so the benefits of other significant investments, not least the expected creation of new jobs and a stronger economy will not be maximised. The goodwill and support of the Planners, of stakeholders and the wider public may be lost, and the knowledge and understanding of Council officers and their counterparts at the Environment Agency will be dissipated. The new opportunities promised by Leeds FAS Ph2 and Ph3 will not be realised, and existing employment and residential properties and the city infrastructure will continue to be vulnerable to the flooding witnessed in December 2015.

5.9.11 Time is critical as Leeds remains exposed to the same risk as it did before the Boxing Day floods. Any scheme that provides a standard of protection lower than 0.5% AEP is simply illogical and would not prevent a reoccurrence of recent floods. With local commitments, a holistic, catchment wide scheme which aligns strongly with Defra's policy on sustainable flood management, natural flood management and supporting economic growth has been developed. The scheme is on schedule to progress to a construction contract once government commitments are confirmed and approvals received.

Table 40: Annualised Spend Profile of Local Choice Preferred Option

Annualised spend profile (£k)	Yr 0: 2017	Yr 1: 2018	Yr 2: 2019	Yr 3: 2020	Yr 4: 2021	Yr 5+: 2022+	Approval Value
Staff costs	1,073	475	555	749	758	745	4,354
External fees	704	780	726	980	991	975	5,155
Construction:	229	1,087	10,656	13,949	13,953	9,381	49,254
Stourton	85	1,323	-	-	-	-	1,408
Advance Works	-	252	-	438	-	-	690
Natural Flood Management	-	187	2,450	3,100	3,100	6,163	15,000
Environmental enhancement & mitigation	-	-	-	-	598	4,925	5,523
Risk contingency	-	911	5,086	6,866	6,945	6,827	26,635
Risk – Calverley Flood Storage Reservoir	-	54	303	409	413	406	1,585
Inflation (state rate)	4	86	477	645	652	641	2,505
Project total costs	**2,095**	**5,154**	**20,253**	**27,135**	**27,410**	**30,063**	**112,110**
Less: Costs not eligible	-	-	-	-	-	-	-
Less: Contributions	-	-	-	-	-	-	
Defra Booster	2,095	4,121	9,462	14,323	-	-	30,000
LCC Contribution	-	-	2,400	3,328	1,773	2,500	10,000
Primary Funding Sources underwritten by LCC	-	1,034	5,291	5,290	-	-	11,615
Woodlands Trust	-	-	700	1,595	2,245	2,360	6,900
Less: Local Levy being claimed	-	-	-	-	-	-	-
Capital grant claim (FCERM-GIA)	-	-	-	-	-	-	-
Consented Programme to 2021	-	-	2,400	2,600	-	-	5,000
Contribution sub-total	***2,095***	***5,154***	***20,253***	***27,135***	***4,018***	***4,860***	***63,514***
Grant rate	***0.0%***	***0.0%***	***2.1%***	***2.3%***	***0.0%***	***0.0%***	***4.5%***
Funding Requested Post 2021	-	-	-	-	-	-	
FCERM-GIA Requested post 2021	-	-	-	-	1,261	1,305	2,566
Defra Booster requested post 2021	-	-	-	-	19,539	22,727	42,267
Subtotal	-	-	-	-	***20,800***	***24,032***	**44,833**
Current Funding Shortfall	-	-	-	-	2,592	1,170	3,763
Subtotal	-	-	-	-	2,592	1,170	3,763
Funding Total	**-**	**-**	**-**	**-**	**25,985**	**26,373**	**48,595**

Note: The figures used in this table are to the nearest thousand (k) and as such incur some minor variation through rounding, however this does not effect the totals.

Table 41: Annualised Spend Profile of Local Choice Preferred Option in Present Value

Annualised spend profile (£k)	Yr 0: 2017	Yr 1: 2018	Yr 2: 2019	Yr 3: 2020	Yr 4: 2021	Yr 5+: 2022+	PV Total
Staff costs	1,073	459	518	676	660	627	4,013
External fees	704	753	678	884	864	821	4,703
Construction:	229	1,050	9,947	12,580	12,159	7,898	43,864
Stourton	85	1,278	-	-	-	-	1,363
Advance Works	-	243	-	395	-	-	639
Natural Flood Management	-	181	2,287	2,796	2,701	5,189	13,154
Environmental enhancement & mitigation	-	-	-	-	521	4,147	4,668
Risk contingency	-	880	4,747	6,193	6,052	5,749	23,621
Risk – Calverley Flood Storage Reservoir	-	52	283	369	360	342	1,406
Inflation (state rate)	4	83	446	581	568	540	2,222
Project total costs	2,095	4,980	18,906	24,473	23,885	25,313	99,652
Less: Costs not eligible	-	-	-	-	-	-	-
Less: Contributions	-	-	-	-	-	-	
Defra Booster	2,095	3,981	8,832	12,917	-	-	27,826
LCC Contribution	-	-	2,240	3,001	1,545	2,105	8,891
Primary Funding Sources underwritten by LCC	-	999	4,939	4,771	-	-	10,709
Woodlands Trust	**-**	**-**	**653**	**1,439**	**1,956**	**1,987**	**6,035**
Less: Local Levy being claimed	-	-	-	-	-	-	-
Capital grant claim (FCERM-GIA)	-	-	-	-	-	-	-
Consented Programme to 2021	-	-	2,240	2,345	-	-	4,585
Contribution sub-total	**2,095**	**4,980**	**18,906**	**24,473**	**3,501**	**4,092**	**58,047**
Grant rate	-	-	0.12	0.09	0.01	-	4.6%
Indicative Allocation Post 2021	-	-	-	-	-	-	
FCERM-GIA	-	-	-	-	1,099	1,099	2,198
DEFRA Booster	-	-	-	-	17,027	19,136	36,163
Additional Funding Required	-	-	-	-	2,259	985	3,244
Subtotal	**-**	**-**	**-**	**-**	***18,125***	***20,235***	***38,361***
Additional Funding Required	-	-	-	-	2,259	985	3,244
Funding Total	**-**	**-**	**-**	**-**	**22,643**	**22,206**	**41,605**

Note: The figures used in this table are to nearest thousand (k) and as such incur some minor variation through rounding, however this does not effect the totals.

6 Management case

6.1.1 In accordance with the Integrated Assurance & Approvals Plan (IAAP) (included in appendix AB), there are three lines of assurance embedded in the structure and governance of the scheme.

6.1.2 The first line of assurance is the 'Frontline' – this is carried out by the Project Team, Project Director, Project Board and Programme Board. The second line of assurance is 'Management Overview and Compliance'. The third line of assurance is 'Independent Assurance'.

6.2 Project management

6.2.1 LCC, as the Lead Local Flood Authority (LLFA), is set up to lead on and manage flood risk within Leeds.

6.2.2 The Leeds FAS Client Project Team was set up in 2013 to ensure the successful delivery of the FAS. Much of the same team from LFAS1 is working on LFAS2 and strong project governance mechanisms have been established and are operating efficiently.

6.2.3 The delivery team for FAS2 is led by LCC's Project Director with support from four other members of staff from LCC's Civil Engineering Team. Working daily alongside LCC are staff from the Environment Agency offering specialist advice and expertise, in addition to expert cost management services being delivered from LCCs strategic partner WSP.

6.2.4 Furthermore, the BAM Nuttall and Mott MacDonald joint venture (BMMJV), supported by Thomas MacKay, is contracted to undertake the Feasibility and Preliminary Design, and complete the delivery team.

6.2.5 A programme board governs the scheme and provides the overall direction, management and control of each project board. Project boards exist for the main works, advanced works, river stewardship and for natural flood management. The programme board comprises of representatives from LCC and external partners such as the Environment Agency, Yorkshire Water, Network Rail and the Yorkshire Wildlife Trust. The external partners are key consultees with vested interests in the scheme and therefore their inclusion on the programme board is beneficial for ensuring effective project delivery. See Appendix N for further details on roles and responsibilities.

6.2.6 The current Feasibility and Preliminary Design contract for LFAS2 is managed through the NEC form of contract, as will the Main Works design and build contract. In addition, the scheme is being managed through LCC's mandatory Project Management System for complex projects. As a coporate member of the Association of Project Management (AMP), LCC has set up this approach based upon that advocated by the AMP. This methodology is used throughout the Council and creates a 'check and challenge' approach to project work, whilst providing a supportive structure for those using it. The methodology requires that projects must pass gateway approvals to ensure that the aims of the project continue to be aligned with evolving business needs, that the project continues to be aligned with the Councils vision and strategic outcomes and that crucially the business case is still valid, including benefits realisation.

6.2.7 The natural flood management works will be managed by the Environment Agency national capital programme management service (ncpms) and delivered through separate contracts procured under the WEM framework.

6.3 Project structure and governance

6.3.1 In accordance with the Integrated Assurance & Approvals Plan (IAAP), there are three lines of assurance embedded the structure and governance of the scheme.

6.3.2 The first line of assurance is the 'Frontline' – this is carried out by the Project Team, Project Director, Project Board and Programme Board who will ensure quality standards are being followed. The principle of "getting it right first time" is being adopted for all aspects of the project including planning, risk management, reporting and governance. Formal checks will include:

- Project Board reviews. The Project Board will check that the business case complies with the objectives and project controls.
- Stakeholder consultation. Internal and external stakeholders will be consulted on the objectives and recommendations of the business case.
- Consultant Quality Assurance procedures. Suppliers are to provide evidence that their products comply with their internal QA arrangements.
- Peer review. Prior to the submission of any business cases for approval a peer review will be undertaken by project management team staff in accordance with the necessary procedures.

6.3.3 The second line of assurance is 'Management Overview and Compliance' – this is carried out to ensure that the frontline controls are working, and operating standards are being complied with.

6.3.4 The third line of assurance is 'Independent Assurance' – carried out by people totally independent of project/programme delivery. It checks that both the frontline and management overview compliance assurance is working.

6.3.5 A streamlined process for major project assurance and approval has been successfully trialled within the Defra group recently. It brought together what would have been a series of separate reviews into the Environment Agency Large Projects Review Group. Support is then gained via the Flood and Coastal Risk Management Committee of the Environment Agency Board and Defra's Executive Committee (Ex Co) before being submitted to HMT for approval. The LFAS2 is seeking to make best use of public resources and enable accelerated delivery.

6.3.6 Recognising that early engagement and involvement in the scheme assurance process will help enable a streamlined approvals process, the project team have offered a place on the Programme Board to the Infrastructure Projects Authority (IPA). This will also aid in assurance throughout the life-cycle of the project and liaisons with wider organisations and stakeholders.

6.4 Project roles and responsibilities

6.4.1 The Programme Board supports the Senior Responsible Owner in discharging their accountability for the Scheme providing strategic direction and ensuring proposals continue to be aligned with their organisation's strategic priorities.

6.4.2 The Project Board supports the Project Director in driving forward the programme to deliver the outcomes and benefits within the tolerances set by the Programme Board. Members of the Programme Board are able to commit resources from their organisations to support the project as required. These groups help to provide ongoing oversight and challenge to the project team and are integral part to the overall assurance process applied to the project.

6.4.3 The following tables (Table 42 and Table 43**)** present the responsibilities for each role within the assurance and approvals plan and all groups who have an input into the governance of the LFAS2.

Table 42: Roles and Responsibilities

Individual / Groups	Responsibilities
HM Treasury	To review the LFAS2 business case and provide final investment approval.
Defra Executive Committee	To review the LFAS2 business case and agree the submission to HM Treasury.
Environment Agency FCRM Committee	To review the LFAS2 business case and agree the submission to Defra.
Environment Agency Chief Executive & Executive Director of Operations	To provide strategic guidance on the project. To act individually or jointly as required by the financial scheme of delegation.
Environment Agency Investment & Delivery Assurance Team	To provide an assurance review of the business case against the Accounting Officer tests prior to presentation of the business case at the Executive Committee.
Environment Agency Large Projects Review Group (LRPG)	To provide an assurance review of business case submissions for compliance with Defra policy, Treasury guidance and flood risk appraisal guidance. Recommend the business case for submission to approval groups.
Senior Responsible Owner (SRO)	Accountable for the delivery of the project.
Project Sponsor (LCC)	Promoting the project to Directors and members, ensuring alignment with LCC objectives.
Project Sponsor (EA)	Promoting the project to Directors and ensuring alignment with EA objectives.
Programme Board	Agree objectives and provide strategic direction for the project. Advise on issues raised within the Programme Board's tolerances. Secure high level partnership funding approaches for the project. Endorse and support the project business case through approval gateways. Facilitate partnership and collaborative working to deliver the scheme. Act as critical friends as required internally to ensure the project remains robust throughout its delivery. Champion the project: leading by example, communicating the benefits to all stakeholders, and gaining local support and political will to progress the scheme. Providing continued commitment and endorsement in support of the project objectives at executive and community events. Providing a recommendation to the SRO for project closure when required. The Programme Board meet quarterly.
Project Board	Advising the Programme Board on issues that exceed the Project Board tolerances. Provide direction on issues raised within the Project Board tolerances. Advising the project on reputation and political risks for consideration in decision making. Ensuring high priority red risks are being actively managed. Endorsing partnership and collaborative working to deliver the scheme. Endorsing and supporting the project through approval gateways. The Project Board meet monthly.
Project Team	To manage project issues and risks within tolerances set by the Project Board. The Project team meet monthly and is chaired by the Project Director or Project Manager.
Project Director	Responsible for the alignment of the technical requirements with the Sponsor's aims and objectives. Responsible for communications and engagement on the project. Leadership of the project delivery team.
Shadow Project Executive	Provides Project Executive role from the EA to the Project Director at LCC. o Responsible for the alignment of the requirements with the EA sponsor's aims and objectives; and for EA communications and engagement on the project o Leadership of the EA members of project delivery team.
Project Manager	Day to day management of the project including programme and costs via the Project Managers and external consultants providing specialist skills.
Shadow Project Manager	Provides Project Management support from the EA to the Project Director and Project Manager at LCC.

	Has a particular focus on appraisal and assurance for the scope of this IAAP.
Assurance and Approvals Manager	Manages the process and procedure defined in this Integrated Assurance and Approvals Plan, supported by the Shadow Project Manager and the Project Team.
Senior User	Defines Leeds City Council flood risk business need.
Senior Supplier	Directs supplier resources.

Table 43: Roles, Officers and Names

Role	Name	Title
Senior Responsible Officer (LCC)	Martin Farrington	Director of City Development
Project Sponsor (LCC)	Gary Bartlett	Chief Officer
Quality Assurance (LCC)	Oliver Priestley	Head of Civil Engineering
Project Sponsor (EA)	Adrian Gill	Flood Risk Manager
Project Director (LCC)	Richard Dennis	Civil Engineering Manager
Shadow Project Exec and Assurance and Approvals Manager (EA)	Rosa Foster	Strategic Projects and Partnerships Manager
Project Manager (LCC)	Mark Garford	Leeds FAS Project Manager
Shadow Project Manager (EA)	Chris Milburn	Project Manager
Senior User (LCC)	Jonathan Moxon	Flood Risk Manager
Senior Supplier	Varies depending on stage of project	

6.5 Project plan

6.5.1 A project plan is included in Appendix N.

6.6 Communications and stakeholder engagement

6.6.1 A dedicated team of officers, working on behalf of the partnership, is leading on a programme of communications and engagement activities throughout the design and delivery stages of Phase 2. A detailed communications and engagement plan can be found in Appendix L.

6.6.2 Communication with those affected by the December 2015 floods, and who will directly benefit from the second phase of the Leeds FAS, began in December 2016 with the opening of the flood information centre in Kirkstall. Since that time a quarterly newsletter has been produced in addition to other opportunities to engage and inform all stakeholders. A dedicated Leeds FAS website is in place and updated regularly as new information becomes available. Our project team responds to queries from the general public through a dedicated email account as well as having a strong social media presence.

6.6.3 Relationships have been strengthened through attendance at a variety of meetings and engagement events including community business resilience networks, door knocking with affected residents/businesses and council meetings to ensure all stakeholders are well sighted.

6.6.4 Due to the catchment-wide approach being adopted in Phase 2, and the benefits this will provide to neighbouring areas, not only does the engagement strategy look to inform those within the study area, but also identifies the need for keeping those in neighbouring areas and in central government updated as plans for the scheme progress.

6.6.5 Engagement with key stakeholders including councillors, statutory consultees, landowners and tenants took place ahead of a series of public consultation drop-in events between September and October. Letters and emails were sent to affected landowners inviting early discussions prior to the public consultation events. The consultation was designed to update all interested parties on options being considered and allow people the opportunity to provide feedback. These events were used to not only gauge peoples' reactions to the options, but to also manage expectations and gather valuable information. A leaflet was produced to support the consultation with a tear-off questionnaire to allow people to provide their thoughts if not attending an event. A copy of this leaflet can be found in Appendix L.

6.6.6 A common theme occurring was concern for loss of habitat and wildlife in areas where we are proposing flood storage. This was of particular concern for Rodley Nature Reserve, but these concerns did not apply throughout the whole catchment. Another common view is that the scheme is taking too long, this comes from people directly affected by the 2015 floods. On the whole, feedback from the consultation events show people are supportive of flood defences in Leeds City Centre; provided we work with business and communities to deliver a scheme which works for all. Many people hope that enhancements delivered as part of the scheme will be proportionate to the size of the scheme.

6.6.7 Engagement with statutory consultees is ongoing. A face-to-face meeting has been held with Historic England who is supportive of the scheme and will be engaged with throughout the design process. Communication is ongoing with Natural England and a face-to-face meeting is in the process of being organised.

6.6.8 Communications and engagement officers have taken every opportunity to explain the process and the length of time needed to developing a scheme, with the aim of managing expectations around scheme completion. We held a workshop to review all feedback received throughout the consultation period to ensure the feedback has been considered and incorporated into the design process where appropriate.

6.6.9 In recognising the length of time a scheme can take to come to fruition, proactive communications around the programme of advanced works have been undertaken in order to provide confidence that measures are being put in place to mitigate flood risk. This has included direct engagement with landowners and business owners in the Stourton area. Regular contact has been kept with these stakeholders to ensure we keep positive working relationships.

6.6.10 The project team will work to address concerns raised through the consultation events and other engagement activities and will use the newsletter and further events to provide feedback and keep people updated.

6.6.11 The project team will team will continue to take an open and transparent approach to communication and engagement as plans for the scheme progress. Every opportunity to communicate key milestones with all interested stakeholders will be taken using all relevant media channels.

6.7 Change management

6.7.1 LCC's mandatory project management methodology for complex projects, will be used for reporting and managing change.

6.7.2 Tolerances will be managed in accordance with the Council's standing orders for capital schemes and, in particular, the controls for essential and non-essential variations.

6.7.3 The Project Director is permitted to issue variations up to the value of £25,000. Instructions above this amount will be reported to the Senior Responsible Officer before they are issued. All project variances will be reported to the Project Board at the next available meeting and will need to be within the Executive Board approved budget for the delivery of the scheme. Furthermore, the NEC conditions of contract provide a robust mechanism for reporting and mitigating risks associated with changes to the project through the early warning and risk reduction meeting procedures.

6.8 Benefits realisation

6.8.1 The outcomes would be realised in year 5 of delivery as indicated in *Table 44*.

Table 44: Outcome measures

Outcome Measure (OM)	Yr 5+ 2023	Total
OM2a Households moved to a lower risk category (number- nr)	77	77
OM2b Households moved from very significant or significant risk to moderate or low (nr)	77	77
OM4a Hectares of habitat created (ha)	125	125
OM4c Kilometres of river protected (km)	0	0

6.9 Risk management

6.9.1 Our approach to the management of risk accords with EA Guidance for FCRM Investment and Delivery Assurance for the Quantification of Risk in FCRM Capital Projects.

6.9.2 A detailed evaluation of the strategic and delivery risks has been completed through a Risk and Opportunity Workshop with the co-located project team, the outputs of which are captured in a detailed Risk and Opportunity Register attached as Appendix K to this Report.

6.9.3 The results from the Risk workshop have been modelled using @Risk to inform the risk provision in the project budget. The Risk Register will become a key control document and underpin the change control process which we followed in Phase 1 with regular updates as the work progressed on site and the outputs included in Project Board Papers.

6.9.4 The Risk and Opportunity Register is the primary means of recording risk information and monitoring risk exposure. It contains inter alia risk descriptions, assessments and agreed mitigation measures. It also indicates the status of all risks.

Key Principles

6.9.5 Our approach to identification of risk is to encourage an open dialogue ignoring contractual ownership. Ultimately the risk profile presented the Register is being used to inform mitigation strategies and key areas of focus for design development and survey work.

6.9.6 The balance of risks at the point when we are seeking tenders will influence the structure of the contract documents and allocate risks to those parties best able to manage and control the impact avoiding inappropriate transfer through onerous contract conditions.

6.9.7 The flowchart below illustrates our risk management strategy. It includes the essential elements within the management systems approach to risk, namely identification, assessment, control, monitoring and review, and reporting. Each of these elements is explained briefly below. The emphasis placed on each will vary as the contract proceeds.

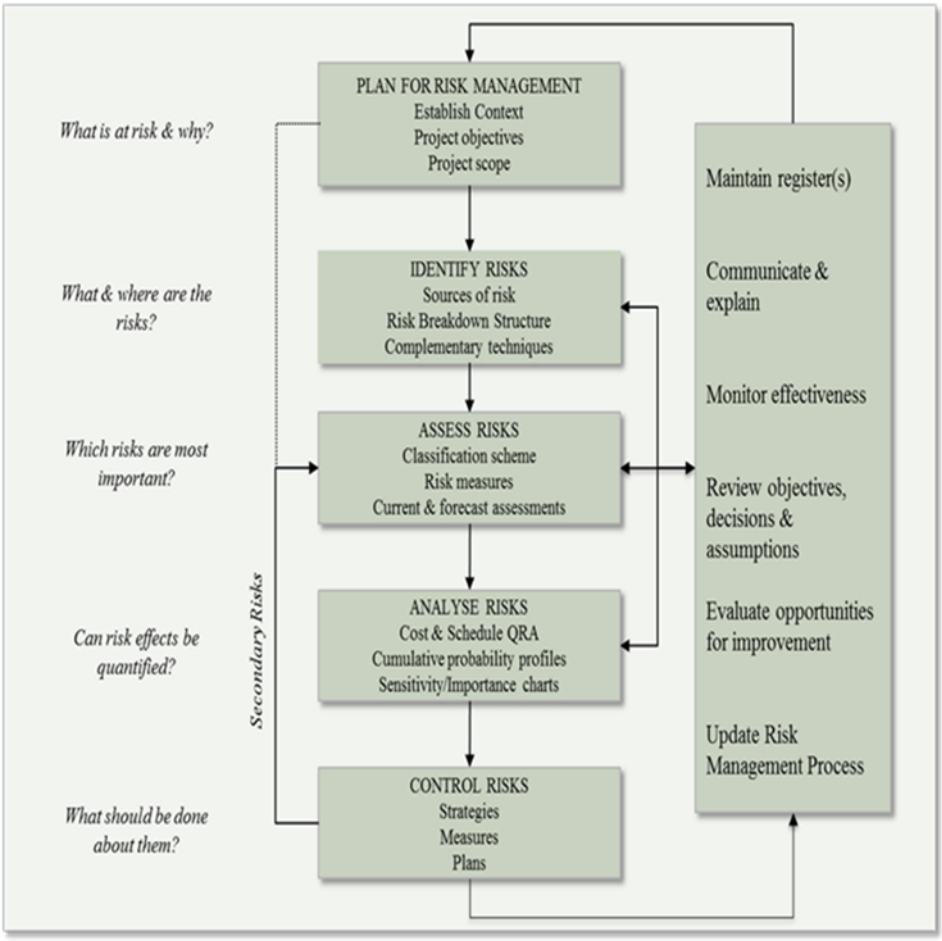

Figure 2: Risk management process

Risk identification

6.9.8 The aim is to identify a comprehensive list of strategic and delivery risks. To do so we will use complementary risk identification methods:

- Review of current and historical Phase 1 Risk Registers and Cost Reports
- Allocation of accountable and responsible owners to each risk;
- Continual review of assumptions and exclusions;
- Continual review of early warnings;
- Continual project team risk identification (ad hoc): all project team members are encouraged to identify risks and to communicate them to the project risk manager; and
- Project progress meetings.

Risk assessment process

6.9.9 Each identified risk will be assessed in terms of its probability and impact. Post-mitigated assessments will be included in the Risk Register and the cost of mitigation measures included in the baseline construction cost estimate.

6.9.10 Both cost and schedule risk will be captured within the Risk Register and quantified using Monte Carlo simulation. Schedule risks will be closely tracked against the project execution programme to assess the confidence levels of achieving key milestones. Cost

risks will be assessed against cost plan provisions during each design stage including OBC, throughout the Specimen Design Development Stage and Final Business Case.

Risk response planning

6.9.11 The responsibility for risk response planning rests with the Risk Manager who will delegate tasks to individual risk owners. Once the most appropriate risk response strategy (i.e. terminate, transfer, treat and tolerate) has been determined, the actual risk response measure, with which to realise the chosen strategy, will need to be agreed. Agreement will consider the cost of implementing the measure, including the introduction of any secondary risks, relative to its risk reduction potential. Judgements of cost-effectiveness will be recorded in the risk register.

Risk monitoring and review

6.9.12 The risk management process will continually monitor the project's risk profile and the risk response actions taken to manage it. Risk exposure is expected to change over time owing to:

- Implementation of risk response plans;
- Emergence of new risks (e.g. associated with design development);
- Occurrence of risk events;
- The passing of risk impact timeframes;
- Changes to base cost estimates; and
- Instructed changes.

Risk reviews

6.9.13 To provide the necessary assurance that assessments of the risk profiles are and remain reliable, there will be different vehicles for reviewing risk-related information. The time spent reviewing each risk will be commensurate with its associated risk exposure:

- Monthly project meetings: risk will be an agenda item for selected project meetings. Progress on risk response actions and the identification/ assessment of any new risks will be discussed at these meetings;
- Six-monthly team bottom-up risk reviews to test and verify assessments and assumptions;
- Quarterly risk reconciliation meetings with key representatives from the various organisations in the co-located delivery team.

Top 10 risks

6.9.14 An extract from the project Risk Register is provided below and shows the top 10 risks by cost:-

6.9.15 Estimating inaccuracy/ quantification of risk

- Securing funding allocations
- Programme duration
- Agreement with land-owners to locate defences away from the river

- Unexpected scope change
- Design Creep on Temporary works
- Unforeseen contamination
- Risk of additional works to existing formal flood defences
- Risk of flooding during construction
- Unknown buried services
- Geotechnical properties resulting in additional excavation works.

6.9.16 Further details of the above risks are provided in Risk Register in Appendix K.

6.10 Contract management

6.10.1 All procurements are undertaken in line with LCC's Contract Procedure Rules (CPRs). The CPRs state every procurement undertaken by the Council will comply with the Public Contracts Regulations and all relevant guidance and statutory provisions in addition to the Council's Finance Procedure Rules, the Council's strategic objectives and policies and the Council's Constitution. The CPRs also outline the responsibilities of Authorised Officers in relation to ensuring that a fair, transparent and non-discriminatory process is followed during the procurement, and when entering into the contract.

6.10.2 This project will be managed through the NEC form of contract. The Project Manager is responsible for the day to day management of the contracts which are in place to deliver the scheme. The Project Manager will be supported in this role by the Cost Manager and Site Supervisor.

6.10.3 The contracts already tendered and contracts to be procured include:

- Feasibility and Preliminary Design Professional Services Contract
- Main Works Engineering Construction Contract
- Technical Advisor Professional Services Contract

6.10.4 The Feasibility and Preliminary Design PSC is currently being managed by the Project Manager undertaking the role of Employer.

6.10.5 The Main Works Design and Build contract will be managed through the NEC ECC. Under the conditions of contract, two key roles associated with managing the contract include the NEC Project Manager and the NEC Supervisor.

6.10.6 The Project Manager will undertake the role of NEC Project Manager. Duties under this role include, but are not limited to:

- Impartially administering the contract
- Delegating responsibilities
- Instructing changes to the Works Information
- Managing Early Warnings and Compensation Events
- Programme acceptance

6.10.7 The role of NEC Supervisor is likely to be provided through the Technical Advisory PSC. Duties fulfilled by this role will include, but are not limited to:

- Carrying out tests and inspections
- Instructing searches
- Notifying defects
- Issue of Defects Certificate
- Additional duties delegated by *NEC Project Manager*.

6.10.8 On completion of the Main Works contract, LCC's Flood Risk Manager will be responsible for any contracts associated with the ongoing maintenance and operation of the scheme. Where appropriate, this will be done through existing contracts already in place to maintain FAS 1.

6.10.9 The Technical Advisor contract will be managed through an NEC PSC or West Yorkshire Combined Authority Framework, whereby the Project Manager will undertake the role of Employer.

6.11 Assurance

6.11.1 The Programme Board will set the direction for the LFAS2, and oversee the overall progress. This will also include a project assurance role which will be provided through the technical teams within the EA and the City Council's planning, regeneration, engineering and financial sections.

6.11.2 The Project Controls are in place to:

- Establish the level of control and reporting required by the Project Board;
- Develop controls that are consistent with the risks and complexity of the project; and
- Establish the day to day monitoring required to ensure that the project will be controlled in an effective and efficient manner.

6.11.3 Day to day issues will be managed accordingly through an issues log and risk register. Any changes to specification will be considered by the Project Board via exception reporting. Regular highlight reports will be presented to the Project Board.

6.11.4 The Programme Board will agree target budgets for each element of the project. Tolerances will be managed in accordance with the Council's standing orders for capital schemes and, in particular, the controls for essential and non-essential variations.

6.11.5 Gateway review process and approval points

- Internal project team/board decision gateways (as a minimum) include:
- Economic analysis technical appendix (to include asset condition assessment and Do nothing scenario and economic assessment);
- Options identification;
- Options appraisal technical appendix (to include economic, technical and environmental appraisal of shortlisted options);
- Environmental Scoping/Reporting external consultation.

6.11.6 These gateways are critical in managing project expenditure, programme and scope creep and shall be well considered and managed to ensure project remains on time and cost

6.11.7 In addition to the CPRs, LCC's Assurance Guide outlines the approach to Assurance Compliance and Governance for procurements and other projects, as well as officers' responsibilities regarding procurement documents retention – these must be kept, by law, for varying amounts of time.

6.11.8 The Assurance Guide also acknowledges that external funders have different document retention requirements which should also be adhered to. A clear audit trail will be developed to ensure that information is easily accessible for any audit or Freedom of Information requests.

6.11.9 Procurement documents are subject to a quality assurance check and each is formally approved before publishing. Staff ensure compliance with information governance policies, and are responsible for ensuring that all information is managed according to the council's Records Management Policy, as well as EU document retention requirements.

6.12 Post project evaluation

Lessons Learned

6.12.1 A lessons learned log will be maintained throughout the scheme which will be reviewed at key milestones and completed at the end stage of the project. Lessons learned from the LFAS1 scheme will be utilised to encourage the smooth delivery of the LFAS2 works.

Customer satisfaction surveys

6.12.2 As elements of the scheme are completed, customer satisfaction surveys will be circulated to obtain feedback on the construction works and identify any areas for improvement. This process is currently being undertaken on LFAS1 and the information received will be brought forward to enhance the level of service provided on FAS2.

KPI's

6.12.3 Where appropriate key performance indicators are included within tender documents, including targets relating to employment and skills. These look at measuring promotion of the scheme to schools and universities, providing work experience placements and engaging the local community.

6.12.4 The Environment Agency undertake performance reviews of contracts let under the WEM framework. As such information relating to health, safety and the environment, carbon and materials, and project satisfaction will be fed back to the EA over the course of the project. A carbon baseline report has been produced to allow the project team to review the carbon reduction performance of the project at future design stages (Appendix T).

CEEQUAL

6.12.5 Phase 1 of the FAS is currently undergoing a CEEQUAL assessment, the sustainability accreditation for civil engineering, and is on course to achieve an award of Excellence. LFAS2 will continue to strive for excellence submitting a whole team award. An early start in project planning and data collection during the appraisal stage has already commenced with existing team members collating the evidence required to give the optimum chance of the achieving a high level of CEEQUAL accreditation. A CEEQUAL strategy has been produced to aid the project team in pursuing a CEEQUAL excellent award (Appendix U).

Post-Project

6.12.6 The flood reduction benefits of the works will be captured on completion of the works. All the surveyed information and 'As Built' drawings will be received and processed by the Environment Agency. These will then be uploaded onto the EA publicly available mapping system, 'Risk of flooding from Rivers and the Sea Map' on the EA website: https://flood-warning-information.service.gov.uk/long-term-flood-risk which will illustrate the reduced risk of flooding provided by the scheme to Leeds. These maps are used as a standard dataset for determining categories of flood risk in the insurance industry and is key in implementing the Association of British Insurers (ABI) flood agreement with the government.

6.12.7 The Programme board will ensure a post-project review is scheduled and takes place.

6.13 Contingency plans

6.13.1 To ensure the successful delivery of the project, the Council has a robust Project Plan in place. Amongst others, this identifies a tailored procurement strategy, funding strategy and, communications and engagement strategy containing specific approvals and milestones. With the addition of utilising lessons learnt from LFAS1, this will all help to safeguard the delivery of the project.

6.13.2 LCC, as the LLFA, is set up to lead on and manage flood risk within Leeds. As is currently the case for LFAS1, on completion of LFAS2, LCC's Flood Risk Management department will take responsibility for the long-term day to day operation and maintenance of the scheme.

6.13.3 In the unlikely event of overspend, LCC will look to internal resource and the wider funding strategy to address any funding gaps.