MOTT MACDONALD

JBA consulting

Peebles Flood Study - Soonhope Burn **Appraisal Report**

Final Report

January 2019

Scottish Borders COUNCIL

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Contract

This report describes work commissioned by Duncan Morrison, on behalf of Scottish Borders Council, by a letter dated 16 January 2017. Scottish Borders Council's representative for the contract was Duncan Morrison). Barney Bedford, Tasmin Fletcher, Hannah Otton and Christina Kampanou of JBA Consulting carried out this work.

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Purpose

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Our work has followed accepted procedure in providing the services but given the residual risk associated with any prediction and the variability which can be experienced in flood conditions, we can take no liability for the consequences of flooding in relation to items outside our control or agreed scope of service.

Legislative framework

This flood study was commissioned in order to gain a greater understanding of the flood mechanisms in Peebles, improve upon SEPA's Flood Risk Management maps, and provide an appraisal of options which could reduce flood risk. In 2015, as part of the Flood Risk Management

(Scotland) Act 2009, the Scottish parts of the Tweed catchment were designated as the Tweed Local Plan District by SEPA. Flood risk must therefore be addressed by SEPA's Flood Risk Management Strategy (FRMS) and the local authorities' Local Flood Risk Management Plan (LFRMP). Of the 13 Potentially Vulnerable Areas (PVA) defined by SEPA within the Tweed catchment, the Peebles PVA (reference 13/04) includes Peebles and the surrounding communities of Eddleston, Innerleithen, Selkirk, Stow and Galashiels. According to this PVA, Peebles has a lengthy history of flooding and the potential for approximately £1,200,000 Annual Average Damages (AAD). A flood protection study is identified as one of the key actions to be taken as a means to reduce this risk and this report presents the findings of part of the study.

Acknowledgements

We would like to thank Scottish Borders Council, Turner Townsend and Mott MacDonald for the data, supporting information and reviews undertaken throughout the study. We would also like to thank members of SEPA for the review of the hydrological calculations and flood modelling methodologies.

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Soonhope Burn FRM Business Case

Context

Peebles in the Scottish Borders has a history of property flooding. JBA was commissioned in 2017 to carry out a review of past flood events, determine the likely risk to different properties and to propose a set of 'options' that may reduce the flood risk to an acceptable level. This report is the culmination of this work and aims to provide a detailed explanation of the various steps carried out to identify a preferred set of interventions that offer a sustainable method of flood protection whilst seeking to benefit the environment and the community of Peebles. This report focuses on the Soonhope Burn.

The Soonhope Burn is a tributary of the River Tweed, which runs north to south from an area of moorland into Peebles to the east of the main town centre. There are no records of flooding on the burn but there is expected to be a flood risk to nearby properties and previous broad scale mapping undertaken by SEPA has shown the area to be at risk.

A modelling exercise was carried out to estimate river levels and map flood extents on the Soonhope Burn. A range of possible flood events were modelled from the 2 year flood to a 1000 year flood. Increases due to predicted climate changes were included (using a 33% uplift) at the 30 year and 200 year floods.

It was found that 15 properties are at risk of flooding from the 200 year event and 19 are at risk for the same event with a climate change allowance. The modelling did not extend as far upstream as the temporary accommodation chalets located in the upper reach.

Risk metrics

The following risk metrics are provided to aid prioritisation by SEPA:

Properties at risk	15 at the 200 year flood (19 with climate change)
Non-residential properties at risk	1 at the 200 year flood (1 with climate change)
Key receptors at risk	Kerfield estate properties downstream of A72 road, the A72 road itself, and the Hydro cottages.

Flood Mitigation Options

A range of flood protection options have been reviewed and short listed based on their viability. The only viable option in Peebles capable of providing a 200 year standard of protection would be a direct defence and online storage option involving the construction of walls around the watercourse downstream of the A72 and a large embankment over 1km upstream to attenuate flood flows in the burn. However, such a high standard of protection would involve considerable land take and a 11m high embankment in the upper catchment. Alternative standards of protection were therefore sought, and direct defence schemes with a 10 or 75 year standard of protection were found to be cost-effective. The short listed options are as follows:

- Option 1 - direct defence (DD) option with a 10 year standard of protection
- Option 2 - direct defence (DD) option with a 75 year standard of protection
- Option 3 - storage with direct defences with a 200 year standard
- Option 4 - provision of property level protection with a 200 year standard

Improving public awareness and resilience

In addition to these short listed options a number of non-structural options and good practice FRM measures have been investigated and recommended for implementation by Scottish Borders Council. Some of these are already in place and others could be implemented either in the short term or alongside a Flood Protection Scheme. These include the following:

- Flood warning is not in place on the burn. As well as improving the community's ability to prepare for flood events a river gauge would aid future studies by providing a hydrometric record on which to base river flow estimates. This data could foreseeably reduce the uncertainty in river flow estimates and may mean that less severe flood protection measures are required (although this cannot be guaranteed).

- The Council's PLP discount scheme could be implemented for those properties identified as being at risk in advance of any possible Flood Protection Scheme.
- Flood action groups, in partnership with the Community Council should seek to establish a network of support between members of the community, Scottish Borders Council, Tweed Forum and emergency services. Community engagement should be continued to raise awareness of flood risk and potential short and longer-term solutions.
- Resilient Communities sandbag stores are available in Peebles. The Council should investigate if an additional store, specific to the Soonhope Burn needs to be provided. The Council should also consider the use of a flood 'pod' system. Community storage boxes, which contain flood sacks; purpose designed bags filled with absorbent material. The key advantage of this approach is that they can be distributed before a flood and are ideal for locations with limited warning or response times. It may also save the Council time in filling, distributing and delivering sandbags to communities when sandbag stores run out.
- Scottish Planning Policy should be leveraged to provide the potential for future implementation of other options that are currently not possible or to avoid unnecessary development on the floodplain in Peebles.

Expected benefits

A flood damage assessment has been undertaken for the present-day Do Nothing, Do Minimum and each of the above options. The Present Value flood damages calculated for the Do Nothing and Do Minimum scenario are estimated to be in the region of £590-760k. The damages avoided for each option are in the range of -£44-£490k (depending on the option assessed) and result from few properties flooding overall. The differences in the modelling carried out for the Do Nothing and Do Minimum options focus around the right bank wall upstream of the A72 and highlight unusual behaviour. In the Do Nothing modelled scenario this wall is not present, representing total degradation, and allows flows from the burn to easily flow west along the A72 and into Kerfield Park rather than southeast towards Kerfield House and surrounding properties. This means that in the Do Nothing scenario fewer properties are flooded reducing property flood damages relative to the Do Minimum scenario. This gives the Do Minimum scenario and Option 1 negative benefits, and the Do Nothing is economically preferable. Total damages avoided for each option are provided in the investment appraisal summary table.

Number of properties protected:

	Option 1 - 10 year DD	Option 2 - 75 year DD	Option 3 - 200 year Storage	PLP
Damages avoided (£k)	-44	357	484	490
Residential properties benefitting (% of Do Minimum)	5	7	14	14
Non-residential properties benefitting (% of Do Minimum)	0	0	1	1
Total no. properties benefitting	5	7	15	15

Working with natural processes

Natural Flood Management (NFM) is a method whereby wider catchment benefits could be achieved alongside potentially reducing flood flows on the Soonhope Burn. Opportunities within the upper catchment could to some extent counteract the effects of increasing river flows with climate change. Natural Flood Management opportunities should be progressed where feasible through engagement with land owners and other stakeholders. Should NFM be progressed as part of a scheme funding should be sought through the scheme itself but in the shorter term it may be possible to secure funding through other sources if the focus can be widened from flood risk management to catchment and land management benefit.

Other opportunities for improved RBMP morphological benefits are discussed below.

- Removal of existing low embankments on the River Tweed floodplain downstream of the confluence with the Soonhope Burn could lead to RBMP benefits and minor decreases in flood levels upstream. Further investigation is required to determine if these works and

possible wetland creation would help to offset any increase in flood levels as a result of the preferred options. This should be investigated further at the outline design stage.

Costs

Costs for each option have been estimated using the Environment Agency's Long Term Costing tool (2012). An optimism bias factor of 60% has been added to the total costs to allow for uncertainties in design at this stage and is typical for schemes at an early stage of appraisal. Whole life present value costs range from £0.2m to £6.7m. Total costs for each option are provided in the investment appraisal summary table.

Investment appraisal

The investment appraisal is provided below. The PLP option has the highest benefit-cost ratio of the options tested, with a ratio of 1.2 and a net present value of £66k. This is compared to the next best benefit-cost ratio of 0.2 and net present value of -£1,366k for the 75 year direct defences option. As the only cost-effective option and with a high standard of protection PLP is the best option identified for the Soonhope Burn and therefore could be put forward by the Council for funding.

Investment appraisal summary table:

	Do Nothing	Do Minimum	Option 1 - 10 year DD	Option 2 - 75 year DD	Option 3 - 200 year Storage	PLP
Total PV Costs (£k)	-	-	231	1,694	6,725	424
PV damage (£k)	590	758	635	233	107	8
PV damage avoided (£k)	-	-168	-44	357	484	490
Net present value (£k)	-	-168	-275	-1,336	-6,242	66
Benefit-cost ratio	-	-	-0.2	0.2	0.1	1.2

Residual risks and planning for future flooding

A number of measures could be implemented to reduce the residual risk brought by above design standard flood events, particularly likely with climate change:

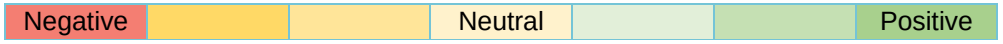
- Natural Flood Management (NFM) practices could aid in reducing flows in the Soonhope Burn and provide some resilience to climate change. A detailed NFM study should be carried out to attempt to quantify the benefits of these practices in the Tweed valley.
- Property Level Protection (PLP) utilising the Council discount scheme could provide protection from flooding in the short term either in advance of PLP being funded as part of a scheme or in case no funding is provided by the Council or government.
- The holiday chalets located in the middle reach of the burn on the side of the valley have not been assessed by this study. The Council should consider the recommendations for flood alerts on the watercourse and how these chalets should be alerted. The Council should periodically review the placing of chalets and the placement and condition of informal bridge crossings in this area to ensure that informal development is not increasing the risk to residents themselves, nor the risk of informal bridge crossings causing problems downstream if they are washed away at times of high flows.
- Bridge blockage on the watercourse is not known to be a major concern or historic problem. However, given the forestry upstream, the Council should consider the need for a suitably located coarse debris screen at the upstream extent of the urban reach to collect large and problematic woody debris.

Conclusions and recommendations

Flooding on the Soonhope Burn is rare. As a result, this appraisal study is proactive and the options to mitigate against the risk and the disruption involved may mean that residents affected are not receptive to the option proposed. In light of this, it is recommended that the Council or SEPA installs a gauge on the watercourse to record flood flows and improve the certainty in flood estimates for this currently ungauged catchment. This could also be combined with a simple flood alert system to provide advanced warning of rising water levels on the burn.

Direct defence options are not cost-effective on the Soonhope Burn and do not provide a high standard of protection for the investment required. The alternative and preferred approach is an automatic Property Level Protection scheme capable of providing a 0.5% AP (200 year) standard for a relatively small investment. This option should now be assessed by the Council and put forward for scheme funding if deemed appropriate.

Option (Standard of protection)	Properties protected	Environmental implications	Working with natural processes	Constraints/ limitations	Mitigating residual risks	Improved public awareness	Best use of public money	Wider benefits
Direct Defences (10% AP - 10 year)	5	Little degradation in RBMP condition in this engineered reach but also no improvement.	Removal of the embankment at the downstream extent of the burn. NFM measures likely to reduce river flows on the burn so should be incorporated regardless of the option progressed.	Small scale engineering works with limited risk and disruption.	NFM may protect to some level of additional risk without the need to increase defence heights. Improving availability of hydrometric data likely to improve accuracy of flow estimates which may mean there is less residual risk than expected.	Signage relating to blockage of the A72 and Kerfield Cottage culvert and notifying public about sand bag stores and work with Peebles residents alongside 'Resilient communities' programme. SEPA should procure a river level gauge to provide some warning of rising water levels in the burn.	Not cost effective (BCR -0.2)	Reduction in flooding to A72, affecting wider Peebles community. Reduced clean-up costs following flood events.
Direct Defences (1.33% AP - 75 year)	7	Minor RBMP impacts. In-channel works likely to be required upstream of A72. Arboricultural works required to mature trees to provide construction access (TPO's will need to be lifted).		Increased length of overall defence with greater disruption.			Not cost effective (BCR 0.2)	
Storage and Direct Defences (0.5% AP - 200 year)	15	Artificial storage area in semi-natural moorland, loss of habitat.		Extensive intervention with implications for community.	Storage embankment could be raised to protect against climate change. NFM not likely to contribute due to storage area.		Not cost effective (BCR 0.1)	
PLP (0.5% AP - 200 year)	15	Little to no impact		Relies on PLP at individual properties being maintained, possible issues with funding/ maintenance.	Little residual risk, only likely to be managed by construction of defences or abandonment.		Benefit cost ratio of 1.2, the only cost-effective option of those tested.	Minimal community disruption and change.
*Uncertainty in flow estimates means standard of protection may be higher than calculated.								



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Abbreviations

1D	One Dimensional (modelling)
2D	Two Dimensional (modelling)
BCR	Benefit-cost Ratio
CCTV	Closed Circuit Television
DTM	Digital Terrain Model
EA	Environment Agency
FCERM	Flood and Coastal Erosion Risk Management (R&D programme)
FEH	Flood Estimation Handbook

FPS	Flood Protection Scheme
FRM	Flood Risk Management
GIS	Geographical Information System
mAOD	metres Above Ordnance Datum
OS	Ordnance Survey
PLP	Property Level Protection
PV	Present Value
PVb	Present Value benefits
PVc	Present Value costs
QMED	Median Annual Flood (with return period 2 years)
Ramsar	The intergovernmental Convention on Wetlands, signed in Ramsar, Iran, in 1971
RBMP	River Basin Management Plan
SAC	Special Area of Conservation, protected under the EU Habitats Directive
SEPA	Scottish Environment Protection Agency
SPA	Special Protection Area for birds, protected under the EU Habitats Directive
SSSI	Site of Special Scientific Interest
TPO	Tree Preservation Order
TUFLOW	Two-dimensional Unsteady FLOW (a hydraulic model)

Return period and probability

For flood frequency analysis the probability of an event occurring is often expressed as a return period. A return period is the average interval (number of years) between two years containing one or more floods of a given magnitude or greater. As an example, the flood magnitude with a return period of 200 is referred to as the 200 year flood.

Another useful term closely linked to return period is a floods annual probability, AP. This is the probability of a flood greater than a given magnitude occurring in any year and calculates as the inverse of the return period. For example, there is a 1 in 200 chance of a flood exceeding the 200 year flood in any one year so the AP is calculated by 1/200 giving a 0.5% AP for the 200 year flood event.

Supporting Documents

Hydrology report - AEM-JBAU-PB-00-RP-A-0003-Peebles_Hydrology_Report-S4-P03.pdf

Asset condition assessment report - AEM-JBAU-PB-00-RP-A-0002-Asset_condition_assessme-nt-S0-P01.02.pdf

RBMP & NFM report - AEM-JBAU-PB-00-RP-E-0002-Peebles_NFM_Report-S4-P02.pdf

Preliminary Ecological Appraisal - AEM-JBAU-PB-00-RP-E-0001-PEA-S1-P01.pdf

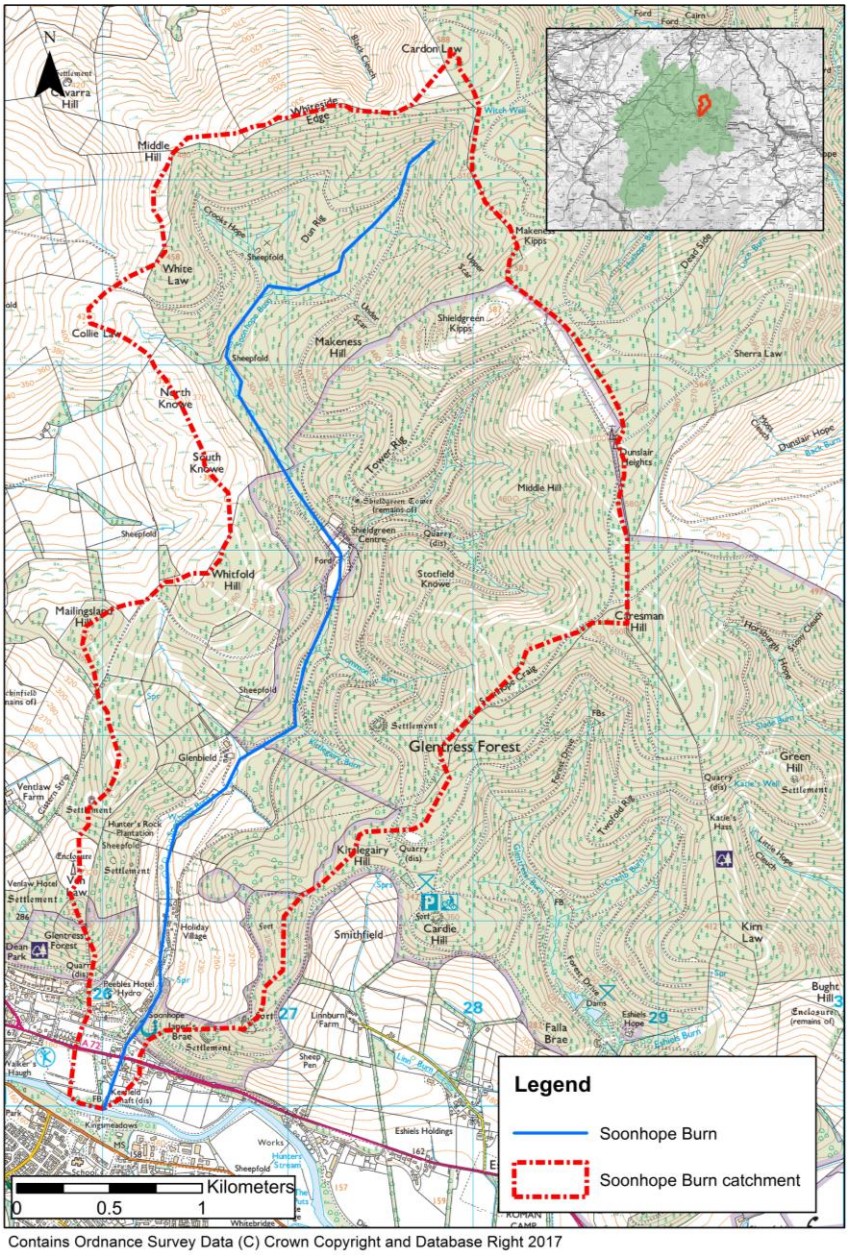
Modelling report - AEM-JBAU-PB-00-RP-A-0005-Soonhope_Modelling_Report-S4-P01.pdf

Flood maps - supplied as PDF's for return periods 2-1000 years including climate change runs and for the Do Nothing and Do Minimum scenarios.

1 Introduction

The Soonhope Burn is a tributary of the River Tweed that lies to the east of central Peebles, entering the town next to Peebles Hydro. It flows from a source in the hills bordering Glentress Forest and enters a straight channel before passing through two significant constrictions to pass beneath the A72 road between Peebles and Innerleithen and under a Listed property through a long culvert. It finally flows through open grazing land before discharging into the River Tweed. This agricultural land is shared floodplain between the burn and the River Tweed. The location of the watercourses is shown in Figure 1-1.

Figure 1-1: Study area and Soonhope Burn catchment



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The main reach addressed in this study is the populated reach from the first permanent dwellings at the top of Hydro Drive to the River Tweed. Properties are strung out along Hydro Drive and there is a group of properties around Kerfield House downstream of the A72. There are no reports of flooding from this burn but out of bank flows are likely to at least affect Hydro Drive and could affect properties in the future.

The upper catchment features moorland, forestry and grazing land with steep sided hills. Once the river flows into the lower populated reach the valley is narrow and steeply sided on the left bank but

wider on the right bank where the properties are positioned. The Soonhope Burn has a critical storm duration of 2.75 hours and a fast response to rainfall. Apart from its lower extents it behaves independently of the River Tweed. There are no flood defences present on the Soonhope Burn.

1.1 Flooding from the Soonhope Burn

There is no flood history for the Soonhope Burn and no study into flooding on the burn has previously been carried out. Despite this, SEPA's fluvial flood maps show that there is a risk to both Hydro Drive and adjacent properties and to the properties in the Kerfield area downstream of the A72. SEPA's maps show that the Kerfield properties may also be at low to medium likelihood flood risk from the River Tweed.

Properties at risk from the Soonhope Burn are included within the Peebles Potentially Vulnerable Area 13/04 and thus flooding from the River Tweed dominates the statistics making initial estimates of flood risk from the burn difficult.

Land use is not expected to change significantly with climate change and thus the relationship between the watercourse and surrounding land is not expected to vary to a major extent. Nevertheless, the increases in flows expected from climate change make good land management practices - potentially capable of influencing river levels - particularly important in this largely rural landscape.

1.1.1 Previous studies

No past studies dealing with flood risk from the Soonhope Burn are known to have been carried out. Flood Risk Assessments have addressed the flooding issues on Gytes Leisure Centre with respect to potential development of a 3G synthetic sports pitch, but the major source of flood risk was seen to be from the River Tweed rather than the Soonhope Burn.

1.1.2 Watercourse condition and catchment opportunities

The Soonhope catchment is only 9.5km^2 with the vast majority being of rural land use. SEPA's Natural Flood Management (NFM) maps do not highlight any potential opportunities for NFM likely due to the scale of investigation. Despite this, the catchment is likely to offer opportunities for natural means of runoff reduction.

The Soonhope Burn catchment was not included in SEPA's River Basin Management Plan (RBMP) 2014 study due to being under 10km^2 in size and does not therefore have a RBMP status.

The RBMP condition of the watercourse and opportunities for NFM have been assessed in more detail as part of this study and are summarised in sections 2.4 and 2.5.

1.2 Aims and objectives

The options appraisal seeks to provide information appropriate to Scottish Borders Council to inform their decision on the most sustainable catchment-wide strategy for flood risk management to the east of Peebles that contributes, where possible, to achieving RBMP objectives and is acceptable to key stakeholders and the community. This report describes the information used to form conclusions on the suitability, feasibility and economic viability of different options for flood risk mitigation.

Proposals and conceptual designs have been developed to:

a. Provide protection from a 0.5% AP (200 year) magnitude flood event if feasible or a lower magnitude event in other cases
b. Deliver multiple benefits to the wider Soonhope and River Tweed catchments and local communities
c. Highlight opportunities to reduce river flows through Natural Flood Management practices and quick wins.

2 Preliminary investigations

2.1 Flood history

A comprehensive review of historic flood events in Peebles has been carried out but no evidence of flooding from the Soonhope Burn was identified. The flood records identified relate to the River Tweed, Eddleston Burn, Edderston Burn and Haystoun Burn. For reference, this Peebles flood history is included in the Hydrology report referenced in the Supporting Documents section at the start of this report.

2.2 Flood estimation

The methodology used to derive flood estimates for the Soonhope Burn catchment is explained in the Hydrology report referenced in the Supporting Documents section at the start of this report.

Hydrological analysis was conducted to obtain information about flow characteristics on the Soonhope Burn. Due to the short reach of interest only one location for flow estimation was chosen. Analyses were based on the total catchment area of the Soonhope Burn at its confluence with the River Tweed.

As the Soonhope Burn catchment is ungauged the Flood Estimation Handbook (FEH) Rainfall-Runoff method was used to derive peak river flows for a range of Annual Probability events. As agreed with SEPA the hydrograph used in the modelling was generated using a ReFH unit, which was scaled to appropriate peak flows. The peak flow estimates for the Soonhope Burn at Peebles (National Grid Reference: NT 26006 39982) for a range of Annual Probability (AP) events are presented in Table 2-1.

Table 2-1: Peak flow estimates for the Soonhope Burn (FEH Rainfall Runoff)

Return Period (Years)	Annual Probability (AP) (%)	Soonhope Burn Flow (m^3/s)
2	50	4.04
5	20	5.75
10	10	6.82
30	3.33	8.82
50	2	10.12
75	1.33	10.99
100	1	11.74
200	0.5	13.67
1000	0.1	19.94
30+CC	3.33+CC	11.73
200+CC	0.5+CC	18.18

Since the Soonhope Burn is ungauged there is some uncertainty in the flow estimates produced. The Rainfall Runoff method was recommended by SEPA but takes a conservative approach. If the ReFH2 method were used this would result in a higher standard of protection in the Do Minimum scenario than is the case with the Rainfall Runoff method. Table 2-2 below shows the equivalent return periods with the ReFH2 and Rainfall Runoff methods. Using peak flows from the ReFH2 method would mean that an apparent 100 year event with the Rainfall Runoff method would equate to a 400+ year event. This means that, for example, flood defences designed to protect against the 100 year event in this report would actually be protecting to a 400 year event standard if the ReFH2 flows prove to be more accurate when more hydrometric data is available. This highlights a critical uncertainty in the flood flow estimates for this catchment.

Whilst a precautionary approach is recommended, due to this uncertainty in design flows, the ungauged catchment and the lack of flood records for the burn, it is recommended that SEPA or the Council install a flow gauge on the burn prior to undertaking any flood mitigation works so that an improved estimate of design flows can be investigated further.

Table 2-2: Comparison of return periods with the Rainfall Runoff method versus ReFH2 method

Return period using Rainfall Runoff method (Years)	Equivalent return period with ReFH2 method (Years)
2	12
5	39
10	68
30	160
50	253
75	332
100	414
200	687

2.2.1 Climate change

SEPA's summary report on Flood Risk Management and climate change concludes that climate change impacts are likely to vary spatially across Scotland. In summarising the different increases in river flows predicted by climate models as we move towards the 2080's a number of estimates for the River Tweed were provided. The high emissions scenario, 'unlikely to be exceeded' uplift estimate of 33% has been used to enable the impacts of climate change to be integrated into the overall assessment.

This uplift was applied to the 3.33% AP (30 year) and 0.5% AP (200 year) magnitude events only.

A 33% uplift in river flows by the year 2080 would mean that larger floods will be expected to occur more regularly. For example, a flood with an annual probability of 10% (likely to occur every 10 years) in the present day would increase to having a probability of 27% (likely to occur every 4 years) by 2080. For the larger magnitude events this is likely to be more concerning, with a present-day 1% AP (100 year) event, for example, being expected to occur with an annual probability of 3% (every 33 years) by 2080. These future changes are something that must be considered when designing flood protection measures and are explored further during the options appraisal later in the report.

2.3 Survey data

Topographic survey data from several previous modelling exercises in and around Peebles were made available for this study and primarily consisted of river cross section data for the River Tweed. No previous studies were known to have modelled the Soonhope Burn and therefore no survey data were available on which to base the model. To remedy this a topographic channel survey was conducted by JBA Consulting in March 2017 along the full study reach from the northern extent of Hydro Drive to the River Tweed. This information was combined with a LIDAR Digital Terrain Model (DTM) to provide ground levels across the study area. Combined, this data provides the physical basis for the hydraulic model.

Several site visits were conducted to provide context to the data, to photograph key areas and to provide an assessment of the condition of the watercourse, particularly at the bridges along the burn, as is summarised below.

2.3.1 Asset condition assessment

A full report into the condition of assets along the Soonhope Burn is provided in the Asset Condition Assessment report, referenced in the Supporting Documents section at the beginning of this report.

The condition of three key assets is summarised in the tables below. These tables show the culvert which passes beneath a property at Kerfield West Gardens, the A72 road bridge/culvert and the right bank wall upstream of the A72. The culverts have limited capacity and are not easily modified whilst the wall plays a key part in containing river flows within the river channel.

Culvert through Kerfield West Gardens

Culvert inlet

Type: Culvert
Grid Ref: Inlet - NT 26109 40225
Outlet - NT 26087 40200
Material: Masonry
Condition: Grade 2 (Good)
Comments:

- Stone arch culvert beneath listed property
- Culvert in good condition
- Inlet clear of debris and vegetation

Culvert under A72

Culvert inlet

Type: Culvert
Grid Ref: NT 26126 40269
Material: Masonry
Condition: Grade 2 (Good)
Comments:

- Steel soffit at culvert inlet in good condition but gives low bridge capacity
- Culvert is clear from debris and vegetation
- Minor vegetation growth through cracks in masonry

Wall along right bank/Hydro Drive upstream of A72

Concrete wall along right bank

Missing section under coping

Type: Wall
Bank: Right
Grid Ref: NT 26142 40337
Material: Concrete
Condition: Grade 4 (Poor)
Comments:

- Wall in locally poor condition due to missing material from section at upstream end of wall
- Condition improves closer to A72
- Vegetation growth through cracks
- Wall about 700mm high

2.4 River Basin Management plan – Summary

A full report into the condition of the watercourse is provided in the Natural Flood Risk Management and River Basin Management Plan report, referenced in the Supporting Documents section at the beginning of this report. The Soonhope Burn catchment is less than 10km^2, therefore the watercourse has not been classified within the RBMP.

During the site visit it was established that the Soonhope Burn catchment is relatively natural with few morphological constraints and the main suggestion to improve the status of the burn would be to introduce more natural morphological features into the channel near the Soonhope chalets.

2.5 Natural Flood Management – Summary

A full report into the NFM opportunities within the Tweed catchment is provided in the Natural Flood Risk Management and River Basin Management Plan report, referenced in the Supporting Documents section at the beginning of this report.

Based on a review of these two datasets and a walkover survey of the catchment, there are a number of NFM opportunities for the River Tweed catchment, as well as many recommendations within its sub-catchments that contribute a large proportion of flow to the watercourse. The findings and recommendations for the Soonhope Burn catchment are included in section 4.4.6.

2.6 Preliminary ecological appraisal – Summary

A full report into the presence and importance of different habitats along the River Tweed is provided in the Preliminary Ecological Appraisal report, referenced in the Supporting Documents section at the beginning of this report.

The Soonhope Burn is characterised as a Special Area of Conservation (SAC) as it discharges into the River Tweed which is host to Atlantic Salmon, Otters, Lamprey and invertebrate assemblages. A Habitat Regulation Appraisal (HRA) should be undertaken to identify any significant effects/impacts on the protected species. An Appropriate Assessment (AA) needs to be conducted if possible impacts are identified. There is an area of non-native invasive species Rhododendron near the confluence with the River Tweed and so measures need to be put in place to monitor the spread of this plant.

The proposed flood alleviation works are likely to be undertaken in-channel however the presence of Atlantic Salmon and Lamprey means that works should not be scheduled in the spawning season for these species which leaves the months of August and September as potential working windows for in-channel works. Night time working should be avoided as bats are most active at night and works on trees should be avoided between February and September when red squirrels' kits are born and dependant on their mother. A further Water Vole survey should be carried out if finalised works are likely to have an adverse impact on the banks of the tributaries, and an Otter Survey of the area may be necessary once the location of the works is known and the impact they may have on holt sites and resting places.

Peebles and the immediate surrounding area is a designated Conservation Area and all trees within it are designated with Tree Protection Orders (TPOs). If arboricultural works to trees cannot be avoided, it might be necessary to apply for the TPO to be lifted to allow for the works to proceed.

2.7 Hydraulic modelling

A hydraulic model was developed, informed by the above-mentioned datasets, to estimate water levels during simulated floods. Below is a summary of the models structure and the results used to generate flood maps and to calculate the flood damages in the later stages of the appraisal. Further details of the modelling approach, including calibration and sensitivity analysis, is provided in the Model Audit report referenced in the Supporting Documents section at the beginning of this report.

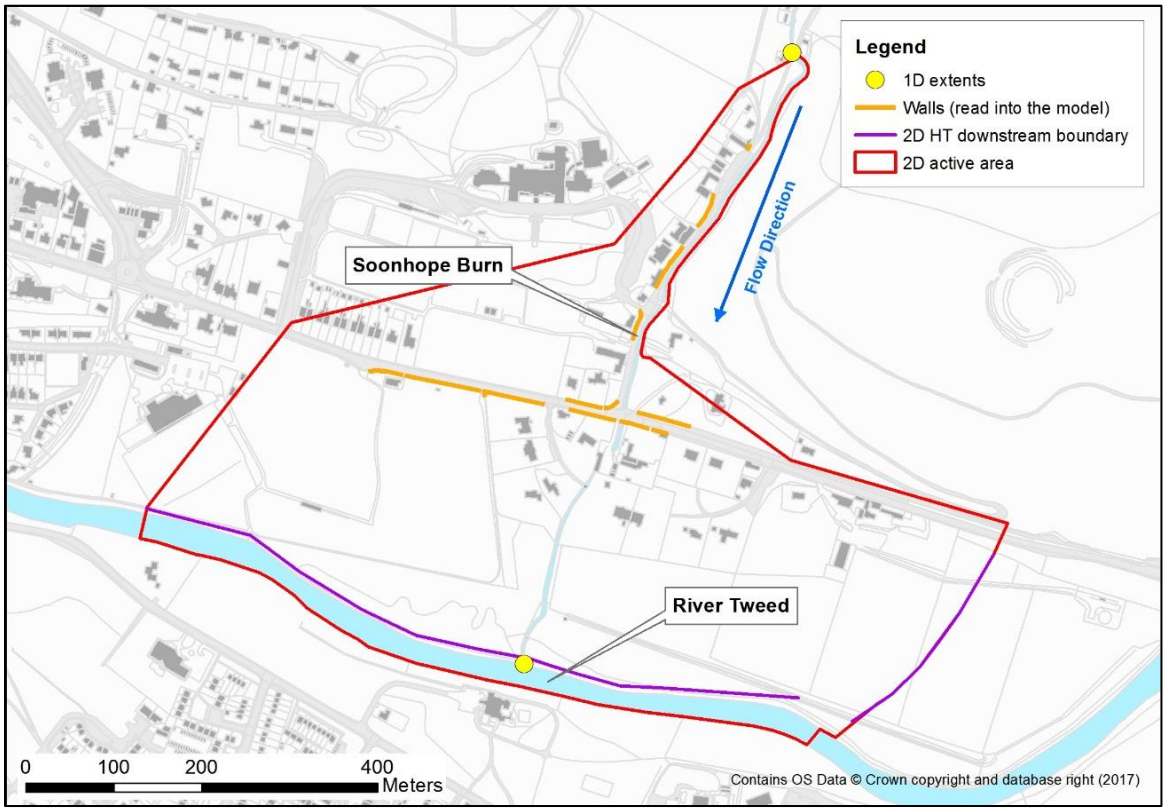
2.7.1 Model setup

The modelling package Flood Modeller-TUFLOW was used to develop the hydraulic model, offering the ability to create a 1D-2D model where the river channel is modelled in 1D and the floodplain in 2D. This approach allows for complex floodplain flow routing not possible with a simpler 1D only model. The model extends from the upstream extent of Hydro Drive to the Soonhope Burns' confluence with the River Tweed.

Survey data for the 1D model was collected in 2017 by JBA Consulting. No bank-top survey was available to inform the link between 1D and 2D model domains but there was enough combined confidence in the LIDAR and surveyed channel cross sections to give a good indication of the elevations at which water should pass from the channel onto the floodplains. The 2D floodplain was formed from 1m LIDAR, resampled to 2m by TUFLOW for increased simulation efficiency. The 2D model domain extended over the full study area. The right bank wall at the downstream extent of Hydro Drive was added to the DTM within the 2D domain for the Do Minimum scenario and other walls along the A72 were also added in an attempt to direct the shallow flood flows as they would be in reality.

The downstream boundary of the model was controlled by estimated river levels from a flood model of the River Tweed developed for this study and was applied using a 2D Head-Time (HT) boundary within TUFLOW. A 3.33% AP (30 year) flood event on the River Tweed was calculated to have a joint probability of occurring at the same time as the 0.5% AP (200 year) flood event on the Soonhope Burn. This flood event was used for all annual probability events on the Soonhope Burn as a conservative approach.

Figure 2-1: Soonhope Burn model overview schematic



Given the lack of flooding experienced on the Soonhope Burn no calibration data was available with which to prove the model. In place of this information the model results were interrogated to ensure sensible flow paths were simulated and the resulting flood maps appear realistic given the terrain.

2.7.2 Model scenarios

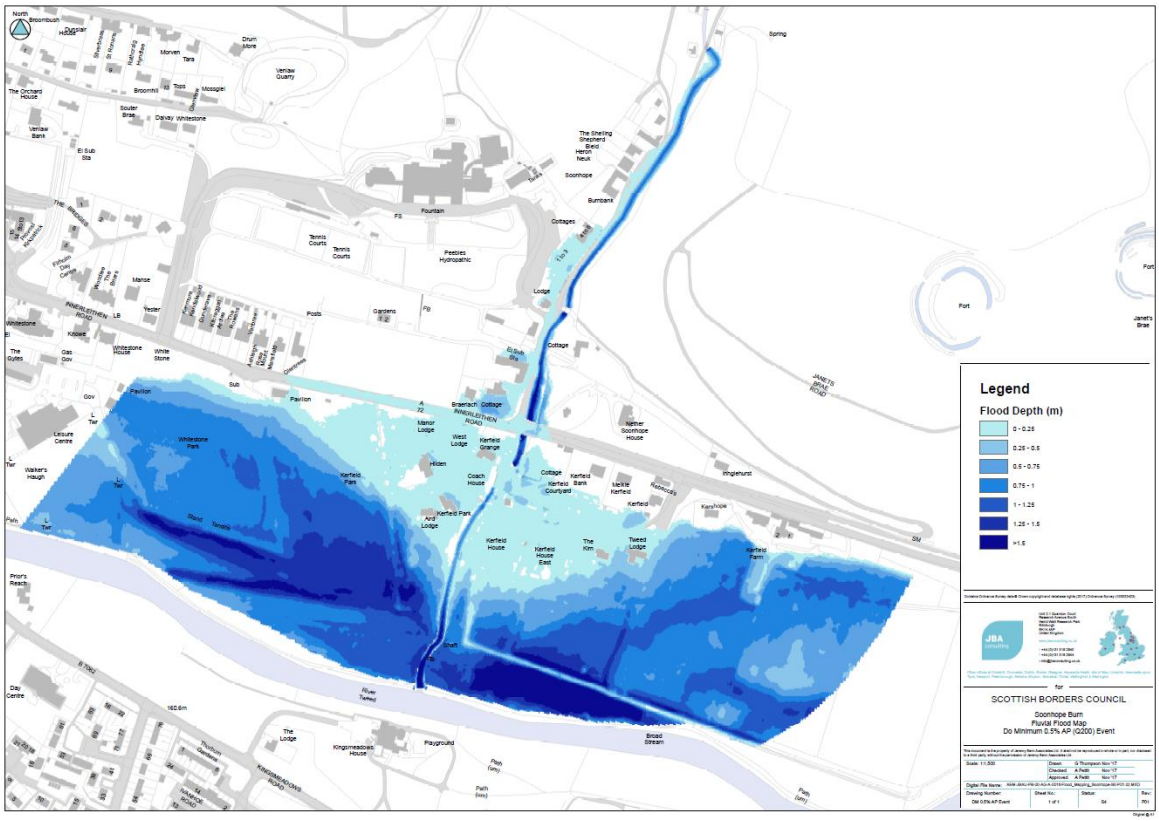
A full range of model simulations were performed covering the full range of AP events for a worst case 'Do Nothing' and present day 'Do Minimum' scenario, with the model being modified slightly between scenarios. A description of the differences between these model scenarios is provided in section 3 below. A full suite of sensitivity tests were also carried out to test the models response to changes in roughness, bridge blockage, inflow and downstream boundary conditions.

Additional model scenarios were used to test the feasibility and successes of different flood protection options that emerged during the options long-listing process described in section 4.5.

2.7.3 Model results

Figure 2-2 below shows the estimated flood depths for the 0.5% AP (200 year) flood event on the Soonhope Burn. The remaining flood depth maps are issued alongside this report.

Figure 2-2: 0.5% AP (200 year) flood depth map for the Do Minimum scenario



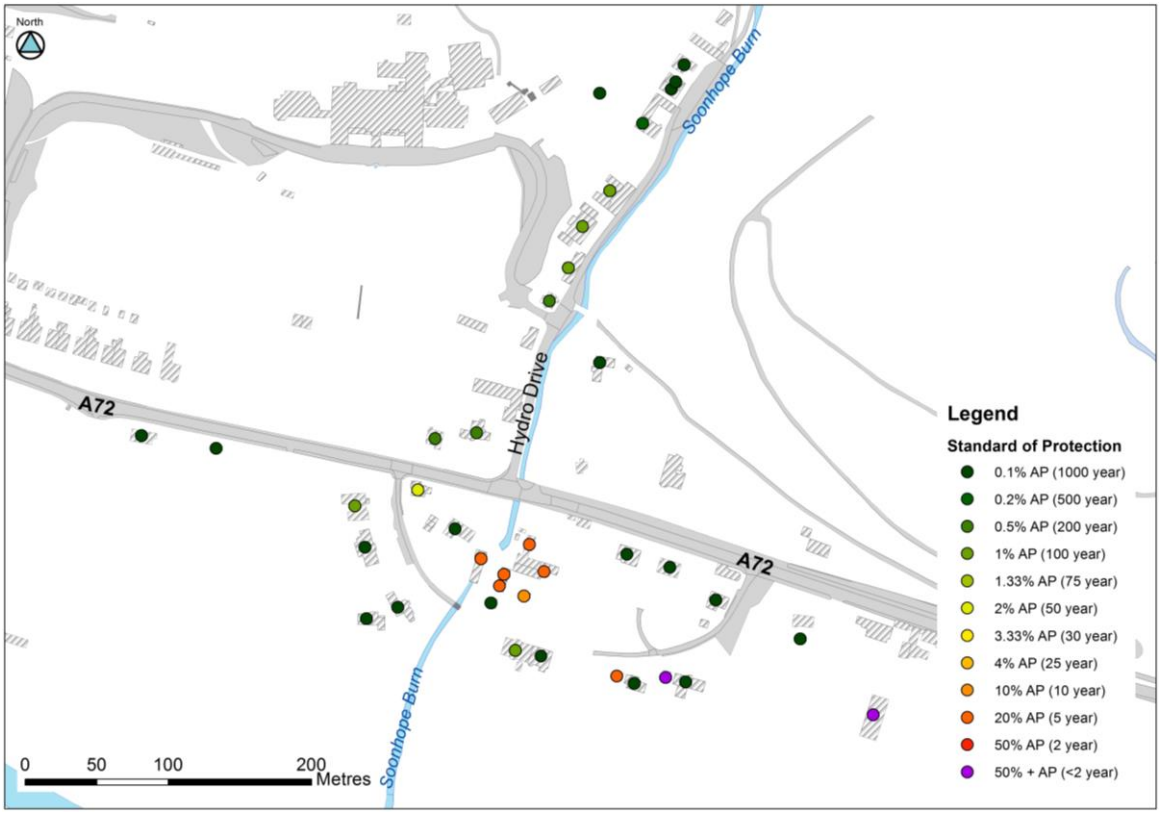
The populated reach of the Soonhope Burn can be split into two to describe its flood mechanisms. The upper reach is characterised by a low right river bank that extends to road level. High flows result in flooding of the road (Hydro Drive). Properties beside this road are not substantially raised above road level and therefore experience flooding when water leaves the bank and travels down the road. Towards the downstream extent of this upper reach, as the burn approaches the A72 a wall on the right bank contains flows but water that has left the burn further upstream continues to flow down the road, ponding in and around properties that border the A72. Flows also leave the burn on the left bank, entering the gardens of the property adjacent to the A72 and ultimately flowing onto the road if river levels rise sufficiently.

Downstream of the A72 water passes into properties in the Kerfield Grange area both from water leaving the burn prior to the culvert which passes underneath a property and from water passing over the A72 from Hydro Drive. Water can also pass west on the A72 and enter properties to the south before flowing towards Gytes leisure centre on the River Tweed floodplain. Beyond the culvert which passes beneath Kerfield Cottage water leaves the burn at low points and enters the floodplains around Kerfield Park before reaching the River Tweed. From low return periods the contribution of the Soonhope Burn combined with the River Tweed leads to flooding of properties surrounding Kerfield Farm.

2.7.4 Current standard of protection

The figures below show the present-day level of protection each property surrounding the Soonhope Burn has from flooding. 'Standard of protection' is the largest flood event which is not expected to cause flooding to a property, larger magnitude events would be expected to cause property flooding. For example, a property with a 4% AP (25 year) standard of protection would be expected to flood at the 3.33% AP (30 year) flood.

Figure 2-3: Standard of protection for the properties at risk in the Do Minimum scenario



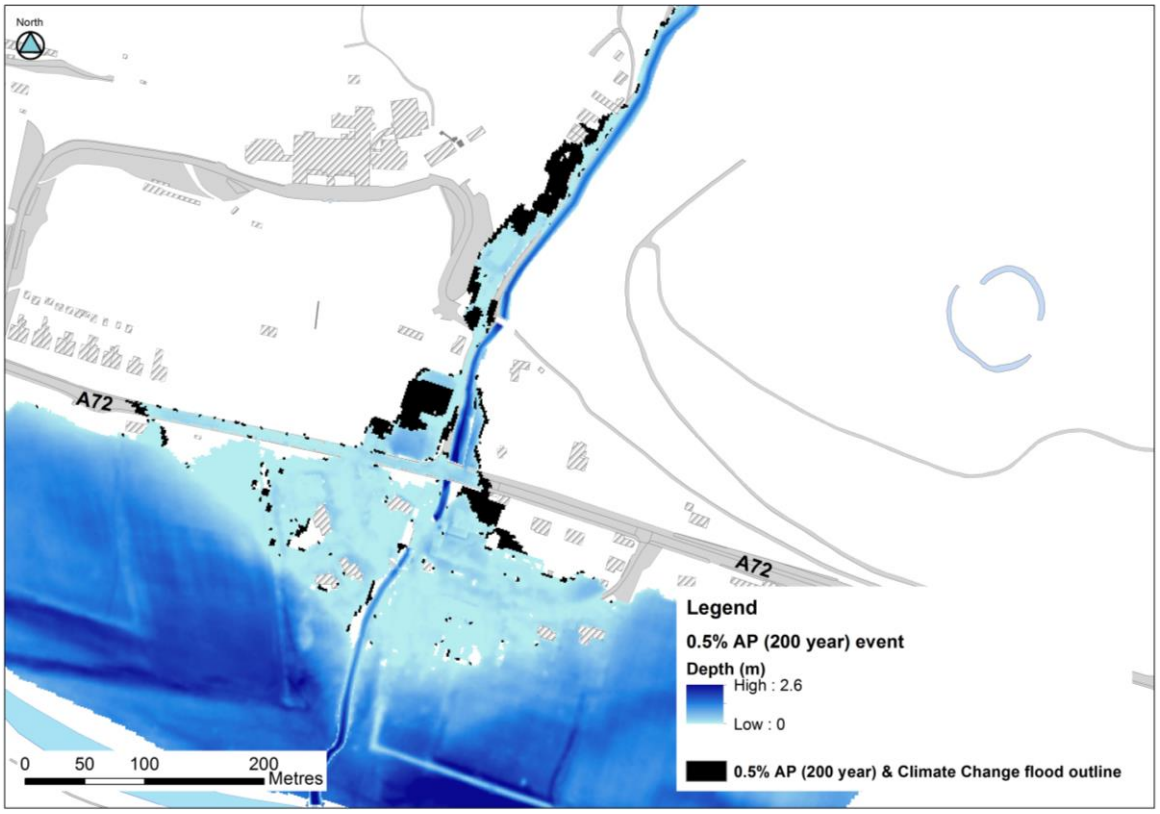
Overall properties at risk from the burn have a standard of protection up to the 10% AP (10 year) event. There are 2 properties that are shown to be at risk from the 50% AP (2 year) flood (coloured purple) but they are outlying and are mostly at risk from water on the River Tweed floodplain rather than direct flows from the burn itself. There is uncertainty in the downstream boundary of the Soonhope Burn model and so these properties will be excluded from the following analyses.

2.7.5 The effects of climate change on flood extents

Climate change is expected to increase the frequency of flood events which will mean that an event statistically expected to occur every 2 years at present might be expected to occur every 1 year, for example. Similarly, this might mean a flood currently expected to occur every 200 years flood might be expected to occur nearer to every 100 years in the future.

The 0.5% AP (200 year) event with a 33% increase for climate change produces a more extensive flood outline with greater flood depths. Figure 2-4 shows the difference between the present day 0.5% AP (200 year) flood outline and the flood depth map expected as a result of climate change. The climate change simulation results in a slightly enlarged flood extent and increased flood depths by up to 0.34m along Hydro Drive and in the gardens of Floors Cottage and Braeriach on the A72.

Figure 2-4: 0.5% AP (200 year) flood outlines with and without an allowance for climate change



3 Appraisal approach

3.1 Overview

The economic appraisal phase of the project requires analysis of the flood damages as calculated from the hydraulic modelling study and identification of problem areas. Through a long and short listing process flood risk management options for these areas are reviewed and ultimately a short list of viable options is proposed. Comparison of the flood damages with and without the proposed flood risk mitigation options gives the flood damage 'benefit' of that option. Engineering costs are applied to each of the proposed options and this allows calculation of the benefit-cost ratio (BCR). The next sections detail this process and present the findings.

3.2 Problem definition

There are 15 properties in Peebles at risk from the Soonhope Burn at the 0.5% AP (200 year) event. Flooding is estimated to begin at the 10% AP (10 year) flood event under existing conditions and can therefore be considered a frequent and serious problem (although this should be caveated by the lack of flood records and uncertainty in the hydrology). There are at present no defences in place along the burn and no properties are known to have purchased Property Level Protection (PLP) products.

3.2.1 Consequences of Doing Nothing

The starting point for a scheme appraisal is always to develop a suitable Do Nothing and Do Minimum option that can be used as a consistent baseline against which other options are compared. The Do Nothing represents the 'walk-away' option; cease all maintenance and repairs to existing defences and watercourse activities. This therefore represents a scenario with no intervention in the natural processes and serves as a baseline against which all other options are compared.

Assessing the level of risk for both the Do Nothing and Do Minimum options needs to consider how the watercourse will change and how any flow controlling assets or flood defences will react or deteriorate over the appraisal period. The following recommendations are therefore used for the Do Nothing and Do Minimum options:

3.2.2 Do Nothing - Soonhope Burn

Under the Do Nothing scenario the watercourses would not be maintained. This would lead to a gradual degradation of the banks and vegetation growth. The Do Nothing scenario is represented in the model as a 20% increase in Manning's 'n' roughness throughout the appraisal period.

There are a number of culverts within the reach. These are all single span culverts with no history of blockage. However, the main A72 Road Bridge has a low soffit and the catchment is wooded. Thus, blockage was recommended to be modelled at this location by a reduction in soffit level by 300mm.

Low soffit on A72 bridge

The wall along the right bank is in a poor condition and has a hole at the upstream end. This wall is assumed to degrade over the appraisal period and is assumed not to be present under the Do Nothing scenario.

Wall on right bank	Hole in wall
	

3.2.3 Do Minimum - Soonhope Burn

The Do Minimum scenario effectively represents the current scenario whereby the watercourse and all structures are maintained and replaced if they deteriorate to a point that is unacceptable. Manning's roughness represents current conditions.

The wall along the right bank, upstream of the A72 is assumed to be present, with repairs to the wall undertaken, inspected and maintained throughout the appraisal period.

3.2.4 Accounting for climate change

Under the Climate Change (Scotland) Act (2009) local authorities have a duty to use an evidence-based approach to develop means to reduce the impact of climate change through mitigation measures (reducing emissions), planning to adapt to a changing climate and acting sustainably. This project appraisal fulfils the ‘adaptation’ and ‘acting sustainably’ duties.

4 Flood risk management options

4.1 Critical success factors (objectives)

The long list of options has been assessed against a number of critical success factors:

1. Options whether in isolation or combination must reduce flood risk providing an appropriate level of protection to people, property, business, community assets and natural environment.
2. Option must be technically appropriate and feasible.
3. Option should help to deliver sustainable flood risk management (e.g. help contribute to amenity and urban regeneration, improve the environment and biodiversity and improve or reduce existing maintenance regimes).
4. Options should not have insurmountable or legal constraints (e.g. land ownership, health and safety or environmental protection constraints).
5. Options should represent best value for money and minimise the maintenance burden and costs as much as possible.
6. Desirable BCR when measured in parallel with other success criteria.
7. Should incorporate National, Regional and Local agendas/objectives.
8. Should be deliverable by 2028 or a future agreed funding period when assessed with other success criteria.

4.2 Guideline standard of protection

The Scottish Government do not specify design standards for flood protection schemes. However, the standard of protection against flooding typically used in Scotland is the 0.5% AP flood (1 in 200 year). This standard is the level of protection required for most types of residential and commercial/industrial development as defined by Scottish Planning Policy (SPP).

Whilst design standards are a useful tool in terms of engineering goals and useful benchmarks, as well as in clear communication to stakeholders and the public, there is a general move in Scotland away from design standards to a risk based approach. Restricting options to desired standards of protection can limit consideration of factors that influence defence effectiveness and can limit future responses to external factors.

It is expected that a variety of protection levels are considered during the design process including the 0.5% and 1% annual probabilities and in some cases a lesser level. The guidance also states that options should be tested against a 1% annual probability plus allowances for climate change. Ministerial guidance[1] recommends appraising against the 1% AP (100 year) standard with an allowance for climate change but where the 0.5% AP standard is not achievable the focus has been on appraising to an appropriate lower standard rather than specifically the 1% AP standard with an allowance for climate change.

Based on the above guidance the aim of the scheme will be to assess options up to the 0.5% AP (200 year) plus climate change flood if possible, but to test lower return period events if appropriate.

Based on the fact that other schemes within the Scottish Borders deliver a standard of protection in excess or to the 1:33% AP (75 year) plus climate change, it is not anticipated that a standard of protection less than this is deemed to be appropriate in terms of the critical success factors for this study.

4.3 Short term structural and maintenance recommendations and quick wins

Several measures or short term 'quick wins' have been identified that cover a range of aspects from maintenance to small scale works. These are summarised in Table 4-1.

1 Scottish Government (2011) Delivering sustainable flood risk management. Guidance document. Scottish Government, Edinburgh. http://www.gov.scot/Publications/2011/06/15150211/0

Table 4-1: Short term structural recommendations and quick wins for the Soonhope Burn

Problem	Actions	Photo
Left span is over left bank and burn flows under middle and right span. Debris caught in front of pier in middle of the burn.	Consider removal of vegetation under middle span. Debris removal and maintenance.	 ***Upstream face of bridge***
Potential for coarse debris to travel downstream and block small capacity structures	Consider in-channel coarse debris screen but placement and maintenance should be carefully considered.	 ***Example coarse debris screen***
Missing material from wall causing poor condition. Vegetation growth through cracks in wall.	Repair of wall and general vegetation maintenance.	 ***Missing section under coping***

Problem	Actions	Photo
Minor vegetation growth through cracks in masonry.	General vegetation management.	 ***Culvert inlet***
Outlet has small amount of debris on left side. Wall on left bank upstream of inlet is slightly deformed with loose stones. Vegetation growth through walls on both sides of bank upstream of culvert.	General vegetation maintenance and debris removal. Repair work to the loose stones on left bank upstream wall.	 ***Culvert inlet***  ***Face of culvert outlet***

4.4 Non-structural flood risk management recommendations

4.4.1 Flood warning

The Soonhope Burn does not benefit from a flood forecasting system. Whilst flood warning is a challenge for a small catchment there are feasible options that could provide some alerts for the community to warn of rising water levels. A level gauge could be procured by SEPA or the Council

and introduced on the burn. A gauge would also provide wider benefits by providing useable hydrometric data to improve hydrological estimates for future flood studies.

Alternatively, a third-party warning system could be procured and managed by either the Council or a local Flood Group. Some such systems monitor river levels and provide a text-based warning to key people within the community when levels reach a predefined point.

Installation of a gauge and recording of flood events when they occur would aid in the development of high flow ratings on the burn. Regardless of whether flood warning is implemented, flood levels should be recorded against stage boards and wrack marks should be surveyed whenever flood events occur to help build up a long-term flood record of events that can be used for future flood forecasting system calibration and general flood understanding.

4.4.2 Emergency action plans

The Council's Emergency Action Plan is the Severe Weather Plan which was updated in July 2018. This describes the Council's emergency response procedures, flood gate procedures and flood warning procedures. It has been designed to run as a standalone plan but can be run in conjunction with other emergency plans such as the Media & Communications Plan and the Care for People Plan. The emergency plan is initiated by Met Office weather warnings and SEPA flood warning information. The plan is coordinated through all Category 1 and Category 2 responders including Scottish Water, voluntary groups (Resilient Communities groups) and public utility companies through the Joint Agency Control Centre (Bunker) at Scottish Borders Council.

This emergency plan is updated regularly as new information becomes available. It is recommended, if it has not already been done, that this is updated with the findings of this study, in particular the revised flood mapping. Regular reviews and preparation of community level emergency plans may be necessary to ensure that the following are up to date:

- Flood maps,
- Properties at risk (and any protected by PLP),
- Safe access and egress routes,
- Flood warning actions and escalation plans,
- Locations of community sandbag stores,
- Dissemination roles and responsibilities,
- Evacuation procedures,
- Onsite and/or temporary refuge locations/planning, and
- Back-up planning.

Emergency planning should encourage communication at a community level to ensure good response rates during a flood. Examples of this include flood group leaders, flood wardens and buddy schemes that encourage communities to act together and to help provide assistance to those needing additional help (e.g. vulnerable residents).

4.4.3 Raising public awareness and community flood action groups

Responsible Authorities have a duty to raise public awareness of flood risk. Helping individuals understand the risks from which they are most vulnerable is the first step in this process.

Everyone is responsible for protecting themselves and their property from flooding. Property and business owners can take simple steps to reduce damage and disruption to their homes and businesses should flooding happen. This includes preparing a flood plan and flood kit, installing property level protection, signing up to the Resilient Communities Initiative, and ensuring that properties and businesses are insured against flood damage. Flood Action Groups are well known to assist with this awareness raising and resilience.

Scottish Borders Council have a well-established resilient communities programme, of which 43 of 70 community areas are signed up to in the Scottish Borders. These are resilience groups which operate during times of emergency, including flooding. A resilient community group is located in Peebles. As an ongoing action, Scottish Borders Council will continue to work closely with these resilient community groups, other local groups and members of the public to raise awareness of flood risk. It is recommended that the outputs from this study are shared with the resilience group to ensure that they are aware of the new flood maps and to assist with emergency procedures.

Council awareness raising activities are to be combined with on-going public meetings and consultation for proposed flood schemes as part of further developments associated with this study. Information from the Council is also expected to be disseminated through website, social media and other community engagement activity as appropriate.

4.4.4 Community sandbag stores

Scottish Borders Council continues to use community sandbag stores located at publicly accessible areas including fire stations and school grounds. Resilient Communities sandbag stores are now widely distributed across the Scottish Borders in areas that have signed up to the Resilient Communities Initiative - this includes Peebles which holds an estimated 300 sandbags. It is recommended that the location of these is reviewed in reference to the highlighted risks from the Soonhope Burn and whether a separate store should be provided to residents affected by this burn.

It is recommended that the Council considers the use of the flood 'pod' system. Community storage boxes, which contain flood sacks; purpose designed bags filled with absorbent material. The key advantage of this approach is that they can be distributed before a flood and are ideal for locations with limited warning or response times. It may also save the Council time in filling, distributing and delivering sandbags to communities when sandbag stores run out. Instead residents whose homes are at risk of flooding can access the boxes and can help themselves prior to and during a flood. Whilst careful review of the siting and number of these pods would be required, they may offer a useful approach in Peebles. This approach would need to be combined with the existing flood warning and flood awareness campaign provided by SEPA (i.e. flood alerts), but also a new Flood Warning system on the Soonhope Burn.

4.4.5 Property level protection (PLP)

Scottish Borders Council currently offer a discounted PLP scheme to properties at risk of flooding through a contribution of cost price products discounted by a capped council-funded subsidy. The scheme makes manual PLP products more affordable than they would otherwise be and there has been some uptake to date.

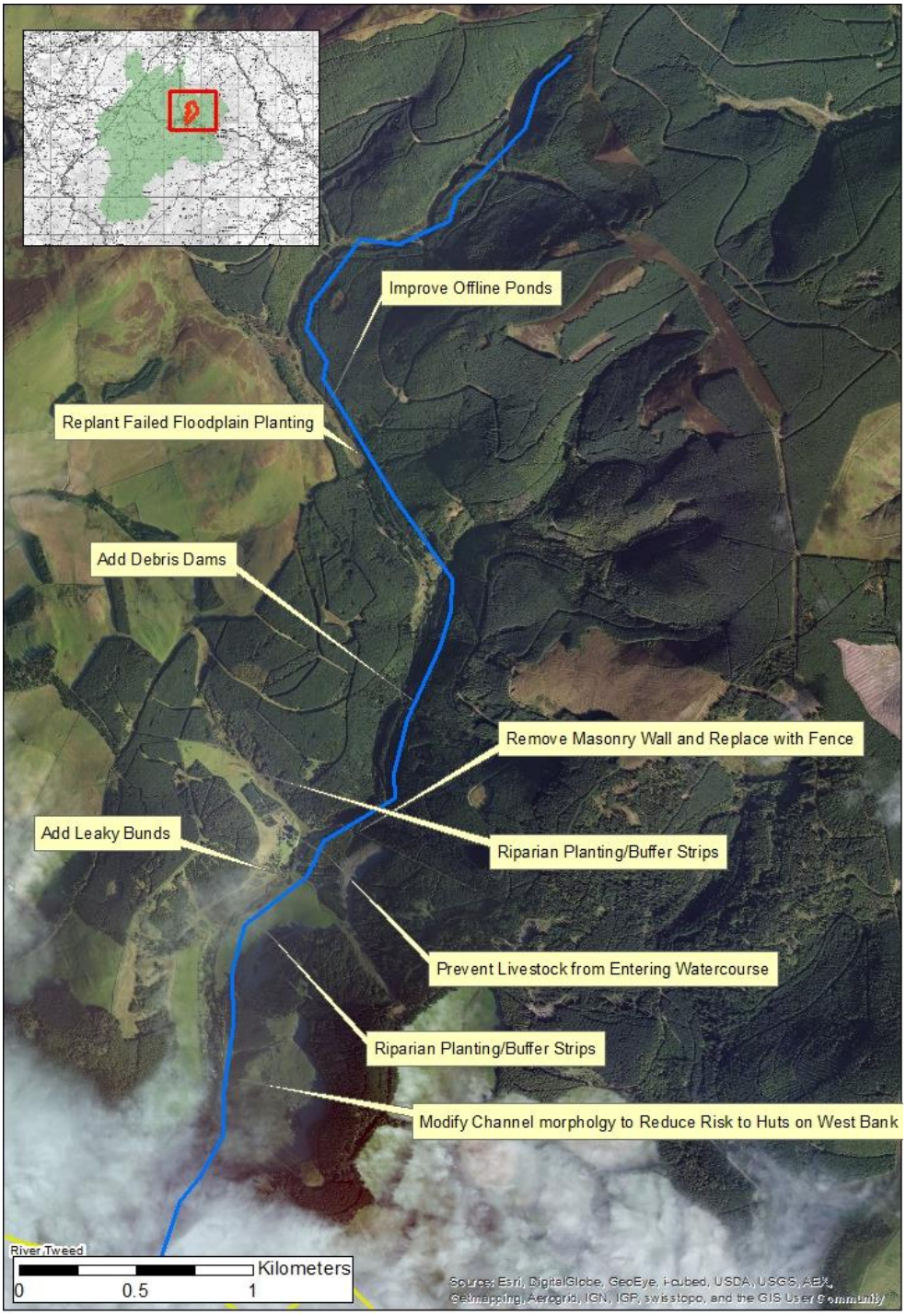
Due to the shallow flood depths, ideally suited to PLP, this could be a suitable option for properties near the Soonhope Burn since there are only 17 properties at risk from the 0.5% AP (200 year) flood event. A full PLP scheme will therefore be considered alongside the other options in the investment appraisal. Whether full funding would be provided through a flood protection scheme or if resident contributions would be sought is not considered at this stage.

4.4.6 Natural Flood Management

Capitalising on the opportunities for NFM in the Soonhope Burn catchment could provide some flood attenuation on the burn. Much of the upper catchment is forested so the clear-felling of this will need careful management in the future and the Council should discuss this with the Forestry Commission in due course. If wider NFM is considered, then care should be taken that delaying flood peaks in this sub-catchment of the Tweed does not align flood peaks with those on the Tweed and increase flooding. Whilst unlikely due to the differing time to peak, this is always a consideration that should be reviewed.

As summarised in section 2.5 a number of primary opportunities exist and may be considered by the Council in the future. Suggestions include planting buffer strips along fence lines in the lower catchment, and along the left bank of a watercourse that joins the channel downstream of Glenbield Farm (Figure 4-1). Replanting an area of failed oak planting with a more appropriate wetland species upstream of Shieldgreen Outdoor Centre is likely to reduce runoff as is the establishment of woody debris throughout the catchment. Additional measures such as the management of livestock are also recommended to maintain riparian vegetation and protect the river banks from erosion and soil compaction. Replacing drystone walling with a fence in the valley floor at the Glenbield confluence would open up the floodplain and increase overall storage.

Figure 4-1: Soonhope Burn NFM opportunities



4.4.7 Planning policy

The Scottish Government laid out several measures to promote sustainable flood risk management in the Scottish Planning Policy[2] published in 2014. The Policy aims to ensure that the planning system promotes a precautionary approach to flood risk from all sources, taking the likely impacts of climate change into account. Further, new developments must not reduce floodplain storage or conveyance, achieved by locating new developments outside of the functional floodplain and away from medium to high flood risk areas. Opportunities are expected to be sought for reducing flood magnitude such as through river restoration, enhancing flood storage capacity and reducing the length of culverted watercourses. New developments must comply with requirements for

2 Scottish Planning Policy, 2014, Scottish Government: https://www.gov.scot/Resource/0045/00453827.pdf

Sustainable Drainage Systems (SuDS) to ensure that surface runoff does not increase as a result of the increase in man-made surfaces common to developments.

Specifically, this means that future developments in Peebles should not increase the number of properties at risk from flooding. The flood maps produced and in particular the climate change mapping produced should be used when reviewing planning policies by the Council. The Council should also review any informal development in the holiday chalets in the upper catchment periodically to ensure that changes do not put additional residents at risk from flooding.

4.5 Long list of options

The following table provides an overview of potential flood alleviation options targeting flood risk from the River Tweed in Peebles. Those with the potential to alleviate flood risk from high magnitude flood events or which offer multiple catchment-wide benefits have been assessed further in the following sections.

Measure	Discussion
Relocation	**Technical**: Relocation or abandonment of properties not politically or socially viable. Option not cost-effective as purchase costs will be same as capped damages. **Environmental**: No significant environmental or RBMP benefits or impacts. **Constraints**: Multiple objections likely if carried out via a FPS. **Decision: Option discounted**
Flood warning	**Technical**: No FWA currently for Soonhope Burn. Would require gauge installation or monitoring in order to inform alert stages. Third party river level monitor could also be used. **Environmental**: No environmental or RBMP benefits or impacts. **Constraints**: None **Decision: Option to be taken forward alongside other options**
Resistance - means of reducing water ingress into a property to enable faster recovery	**Technical**: All Scottish Borders properties at risk of flooding are covered by the Flood Protection Products Discount scheme operated by the council. Further properties moving from reliance on the council emergency sandbag store in Peebles to retrofit Property Level Protection (PLP) products is likely to reduce property inundation during small floods. **Environmental**: No significant environmental or RBMP benefits or impacts. **Constraints**: May be difficult to promote measure as the community may not feel that the risk is high. **Decision: Viable option for most properties, option taken forward**
Resilience - means of reducing the impacts of flood water ingress on a property to enable faster recovery	**Technical**: Extremely costly retrofit for properties despite relatively small number of at risk. **Environmental**: No significant environmental or RBMP benefits or impacts. **Constraints**: Multiple objections likely if carried out via a FPS. **Decision: Unlikely to be economically viable at this stage. Option not progressed further.**
Watercourse maintenance	**Technical**: Maintenance unlikely to reduce flood risk to a useful degree but maintenance schedule should be adhered to. Could play a minor role in reducing flood risk if combined with more substantial options. **Environmental**: Channel maintenance may have minor negative impacts if spawning areas disrupted but these are unlikely to be significant. **Constraints**: Possible stretching of Council resources if further inspection/maintenance is proposed. **Decision: Option discounted**
Natural Flood Management (NFM)	Natural Flood Management options have been assessed as a standalone report.
Storage	**Technical:** Potential storage location upstream of the Soonhope Chalets, although this would require construction of an embankment to attenuate flows. Smaller scale storage in the upper catchment in tandem

Measure	Discussion
	with natural flood management options may be viable, see separate NFM report for details. **Environmental**: Special Area of Conservation (SAC) designations along Soonhope Burn as far as the former Shieldgreen Outdoor Centre. **Constraints:** Land ownership constraints likely to be encountered. **Decision: Option carried forward**
Control structures	**Technical:** Installation of new control structures is unlikely to significantly attenuate flood flows. No existing structures are present upstream. **Environmental:** Could provide wetland habitats but likely to impede movement of flora, fauna and sediment along the watercourse thus having a net negative impact on the watercourse. Soonhope Burn is a SAC as far as the Shieldgreen Outdoor Centre. **Constraints:** Unlikely to be cost-effective due to the lack of floodplain space for useful volumes of water to be held back, and potential objections from residents. **Decision: Option discounted**
Demountable defences	**Technical:** Lead time of flooding is very short making this option technically unviable. Ensuring constant availability of trained personnel capable of deploying defences may put excessive pressure on Council. Residents may be able to assist but reliability of defence deployment may be reduced. **Environmental:** No significant environmental or RBMP benefits or impacts although likely to be preferred from an environmental standpoint when compared to direct defences. **Constraints:** Not enough lead time for deployment on such a small watercourse with a fast time to peak. **Decision: Option discounted**
Direct defences	**Technical:** Direct defences may be feasible on the western bank of the watercourse upstream of the A72 road bridge, and between the downstream of the A72 road bridge and the culvert under Kerfield Cottage. Walls are more appropriate than embankments in both locations and should be made adaptable where possible to accommodate future storm intensification due to climate change. **Environmental:** Walls are already present on the watercourse so impacts likely to be minimal. Direct defences likely to have negative RBMP impact through increased morphological pressure on the watercourse. May also disconnect river from land for some species, especially if walls are constructed rather than embankments. **Constraints:** Some objections likely at public consultation but in general likely to be an acceptable option. **Decision: Option carried forward**
Channel modification	**Technical**: Channel deepening possible in some locations. This is unlikely to provide sufficient flood protection as an independent measure. **Environmental**: Considerable environmental impacts including destruction of sensitive habitats e.g. fish spawning grounds. No significant environmental benefits. **Constraints**: Soonhope Burn is a SAC therefore unlikely to be permissible. Dredging would be an ongoing maintenance burden. **Decision: Option discounted**
Diversion	**Technical**: No obvious diversion route around the area of risk. A potential for channel diversion flowing westwards from the old railway embankment upstream of the A72 road bridge. However, this would require large-scale groundworks and is likely to be costly. Other locations would provide no benefit if diversion channel installed. **Environmental**: May remove other valuable habitats in the short term but if bypass was naturalised then could provide RBMP benefits.

Measure	Discussion
	Constraints: Would require installation of a culvert under the A72, which may cause public objection. Land ownership constraints likely to be encountered. **Decision:** **Option discounted**
Structure modification	**Technical**: Potential to increase capacity of the culvert under Kerfield Cottage, which surcharges in the 10% AP event. Potential to improve the conveyance of the A72 road bridge, which surcharges in the 4% AP event. In both cases, this would incur substantial cost and disruption to local residents. **Environmental**: Net improvement in RMBP impacts likely if bridges are widened or raised but changes are unlikely to be significant. **Constraints**: Removal or modifications of bridges is likely to be objected to due to infrastructure value of these structures. The culvert under Kerfield Cottage is a listed building therefore modification unlikely to be acceptable. **Decision:** **Option discounted but reviewed further in Section 4.6.2**

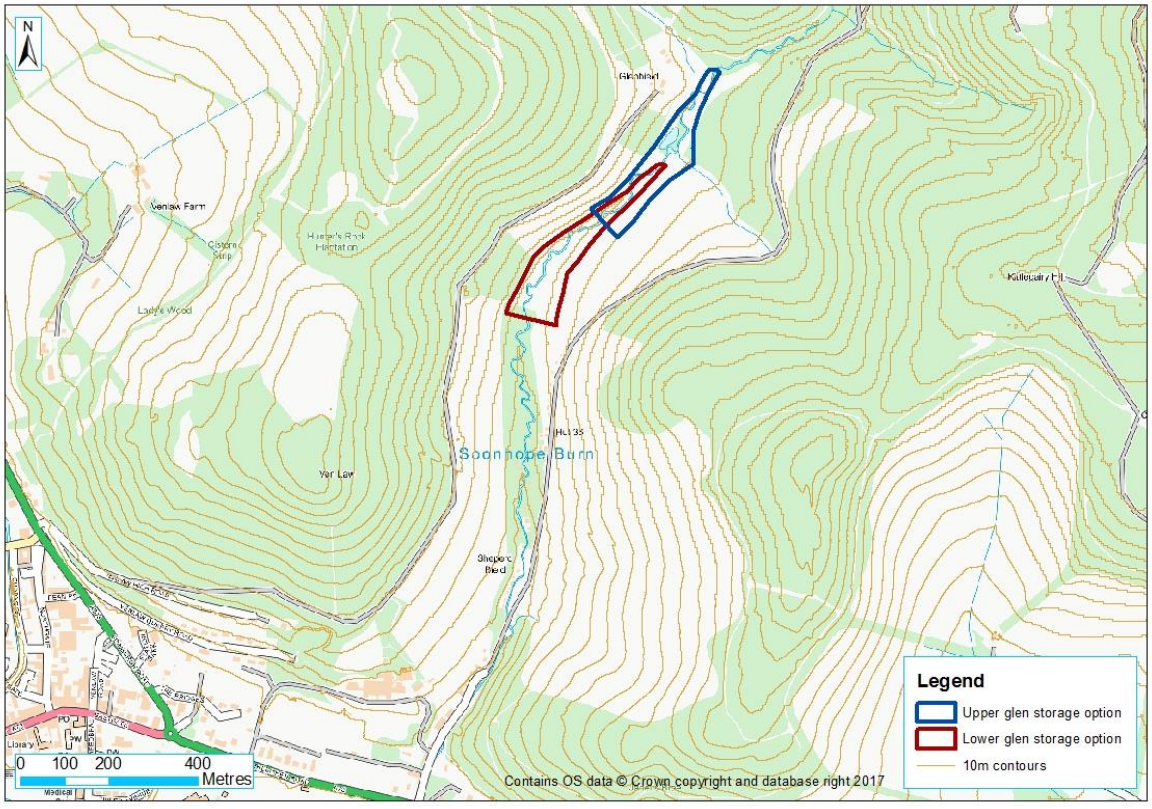
4.6 Feasibility study

A number of options were assessed further and in more detail using modelling to test the technical feasibility where applicable. These are discussed further below.

4.6.1 Storage analysis on the Soonhope Burn

The possibility of attenuating floodwater in the upper catchment was considered. Two locations were selected for testing, as shown in Figure 4-2.

Figure 4-2: Locations of storage areas tested on the Soonhope Burn



A basic Flood Modeller model was built to test the attenuation of flows at each location by creating an orifice opening and the storage behind a theoretical dam structure. The storage behind the dam was based on an area/elevation relationship extracted from 1m resolution LIDAR data.

The model was tested with an orifice area that limits flow to the 20% AP (5 year) flow (5.75m^3/s) in the downstream urban reach (equivalent to the flow that the current watercourse can convey before

out of bank flow occurs due to surcharging of the Kerfield Cottage Culvert). The two locations were tested with the 0.5% AP (200 year) magnitude flood event. An orifice area of 0.51m^2 was required in the lower glen scenario, resulting in a maximum water level in the storage area of 203.0mAOD (10.7m above bed level). For the upper glen location, an orifice area of 0.48m^2 was required, resulting in a maximum water level in the storage area of 209.9mAOD (12.0m above bed level).

The results suggest that a significant structure would be required to store and attenuate flood flows in the upper catchment. The lower glen location would be preferred as the height of the dam would be lower. However, in either scenario a large structure would be required which would have significant aesthetic implications. The occasional storage of large volumes of water directly upstream of an urbanised area would also represent a new risk and a critical maintenance burden for the Council. This option is not considered further as a standalone measure but it is considered as part of a combination option (see Section 4.8.3).

4.6.2 Structure modification on the Soonhope Burn

Modification of the structures on the Soonhope Burn was considered. There are three critical structures which are modelled to cause out of bank flow:

- A72 road bridge - modelled to surcharge in the 4% AEP event
- Kerfield Cottage culvert - modelled to surcharge in the 10% AEP event
- Kerfield House access road bridge - modelled to surcharge in the 4% AEP event

This option was tested by keeping the structures at the existing channel width but increasing the soffit of each structure to greater than the 0.5% AEP plus climate change water level. Modelling of this option suggests that the A72 culvert requires a minimum soffit height of 1.13m to convey the 0.5% AP plus climate change flow (current height 0.62m), and the Kerfield Cottage culvert requires a minimum soffit height of 1.51m to convey the 0.5% AP plus climate change flow (current height 0.82m). Because both of these structures carry road traffic, any modification would require an entire rebuild, with estimated costs around £150,000 per structure. Modification would be required on both structures in order to give a high standard of protection. This is unlikely to be cost-effective due to the comparatively small number of properties at risk. The A72 bridge also carries buried services that would be disrupted during any modification works. Surrounding roads would need to be raised and reprofiled following raising of the structures.

Perhaps a greater constraint however is the fact that the Kerfield Cottage culvert passes underneath a property and would not be possible to upgrade this culvert without removing the building itself or diverting the culvert.

Figure 4-3: Outlet of the Kerfield Cottage culvert

Both the Kerfield Cottage culvert and the Kerfield House bridge are Grade B listed structures so flood-related safety concerns would need to be presented in order to gain permission to make modifications.

Because of the likely expenditure, disruption whilst work is carried out and constraints of listed structure status, structure modification has been discounted as an option on the Soonhope Burn.

4.7 Short list of options

4.7.1 Designing for climate change

In line with Scottish Planning Policy a 0.5% AP (200 year) standard of protection for any scheme was the goal throughout the short listing process. Wherever possible, options have been short listed that at least aim to mitigate flooding to this standard and strive to meet the design standard for this event with an allowance for climate change, a 33% increase in the peak river flow.

Where a 0.5% AP (200 year) standard is not feasible interventions have been designed to allow for the greatest flood risk benefit possible after consideration of technical, environmental and social limitations and opportunities. River flood flows are expected to rise and where possible this has been accounted for in the design, for example by allowing for adaptable defences or by targeting a slightly higher standard of protection than may be ideal at the current time.

In the Tweed catchment the opportunities for Natural Flood Management are many. A growing body of evidence suggests that careful introduction of NFM measures may allow for reduced river flows in some cases. Mature NFM measures and improved land management in the Soonhope Burn catchment may reduce flows in the burn and in the River Tweed, potentially going some way to counteracting climate change increases in flow. For this reason we recommend that NFM measures be taken forward either alongside the more traditional options listed below or on their own if ultimately no other options are taken forward to outline design stage.

4.8 Flood Mitigation options

The following section details the constraints and benefits of the short listed options on the Soonhope Burn. A plan, included in the Figures section at the end of the report, shows the location and extents of the various interventions.

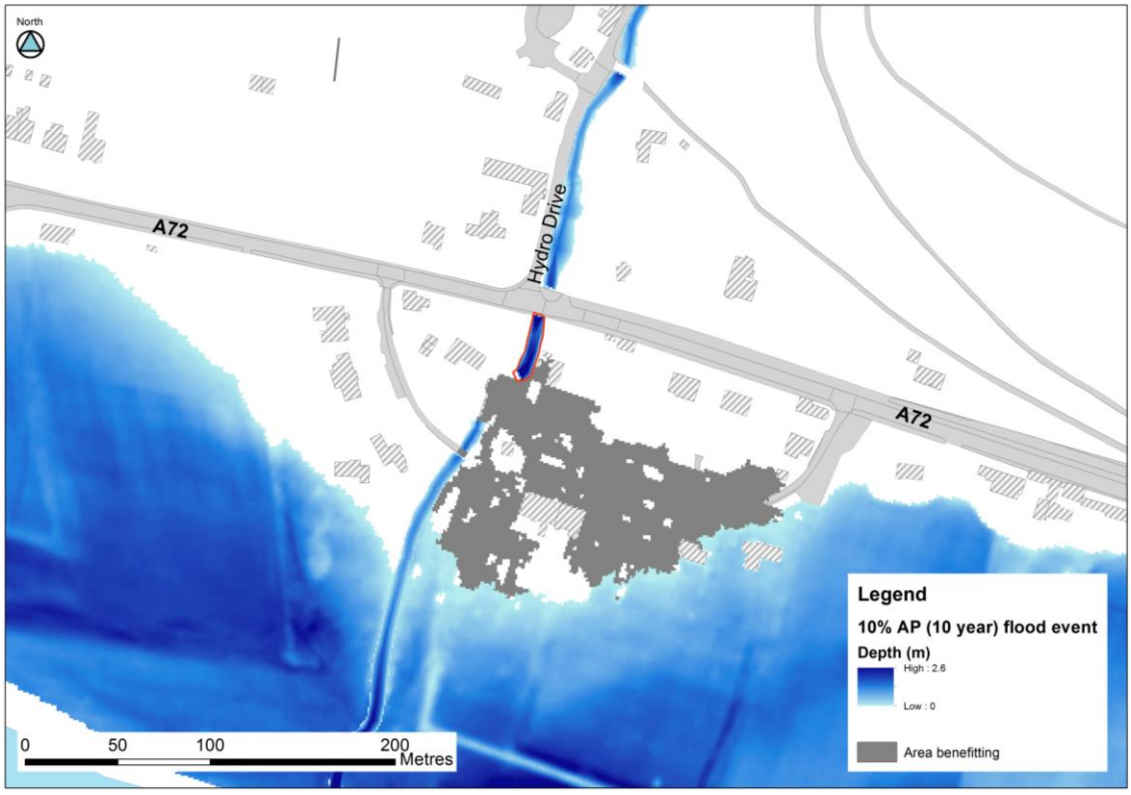
4.8.1 Option 1 - Direct defences upstream of Kerfield Cottage Culvert - 10 year standard of protection

Option 1 - Direct defences upstream of Kerfield Cottage Culvert

Description

This option aims to improve the standard of protection by installing/raising walls surrounding the reach just upstream of Kerfield Cottage culvert. The work includes the following:

- Total length of wall required is 79m up to a height of 1.6m.



A technical drawing relating to this option has been produced and is provided alongside this

report, named as follows:
AEM-JBAU-PB-SB-SK-C-1101-Op1_10yr-S3-P01.pdf

Standard of Protection (SOP)

Modelling of the above option suggests that a standard of protection of a 0.5% AP (200 year) flood is not feasible given the high defences required close to properties. A 10 year standard is achievable which equates to a flow of 6.82m^3/s. The small extent of defences acts to block a flowpath which is predicted by the model to occur from upstream of Kerfield Cottage towards the southeast. Since this option does not meet the critical success factors of this project a higher standard of protection version of this option is investigated in Option 2.

Alternative quick wins / Preliminary investigations

Smaller wall raising would offer a lesser standard of protection but for a marginally lower cost. A lower standard than 10 years is not expected to bring sufficient benefits.

Geotechnical issues

- A full GI will be required at a later stage in the project.
- A cut-off is likely to be needed. Piling may be difficult in this material and other forms of cut-off may need to be considered.
- A 1.25m deep x 0.5m wide mass concrete filled trench cut-off is included under walls for costing purposes.

Services

Overhead and underground services have been identified and their location is shown on drawing AEM-JBAU-PB-SB-SK-C-1001-Soonhope_Burn_Service.

- Electrical cables of unknown voltage and a gas pipe are located close to proposed wall, on the left bank of the watercourse.

Construction access

- Construction access to Flood Wall: Access off the A72.

Waste

- Expected quantity of waste material: 43m^3.
- Nature (inert, non-hazardous, hazardous): It is known that very limited industry was present in Peebles – soil expected to be inert. No potentially contaminative land use constraints identified by council.
- Proposed disposal: According to SEPA guidance. All waste produced during construction should be contained and prevented from entering the watercourse. Stock piles of soil and non-toxic spoilt and construction waste should be located away from the river (at least c.10m) and covered. SEPA pollution prevention guidelines should be adhered to throughout the works.

Environmental issues

- Statutory Environmental Designations: Soonhope Burn is a special area of conservation (SAC).
- Habitat: The area within the site boundaries is a National Forest Inventory.

Health and Safety hazards noted

- Geotechnical and excavation works - In channel works, falling into excavations, collapse of the sides of excavation, damage to underground services, undermining of nearby structures.
- Construction – flooding of works.

Social and community issues

Some aesthetic issues but these are relatively localised and the proposed walls will replace a hedge which already forms a visual barrier to the watercourse. Land take is minimal but a substantial length of flood wall is proposed. Any modifications to walls will need to take into account that Kerfield Cottage and associated buildings and boundary walls are Grade B listed structures.

Impact on other reaches

The works will increase the flow in the channel downstream of the works as a result of the reduction in out of bank flows. This will not increase risk to other properties as a result of the community being located upstream of the confluence with the Tweed.

Additional information required

- A detailed topographic survey.
- Detailed buried services survey, plotting their position with regards to site works.
- Ground investigation.

Additional works required to account for increase the standard of protection

Raising of the walls proposed for this option and construction of additional walls further upstream would be required to increase the standard of protection. A 200 year standard would likely not be achievable above Kerfield Cottage without further interventions such as upper catchment storage, see Option 3.

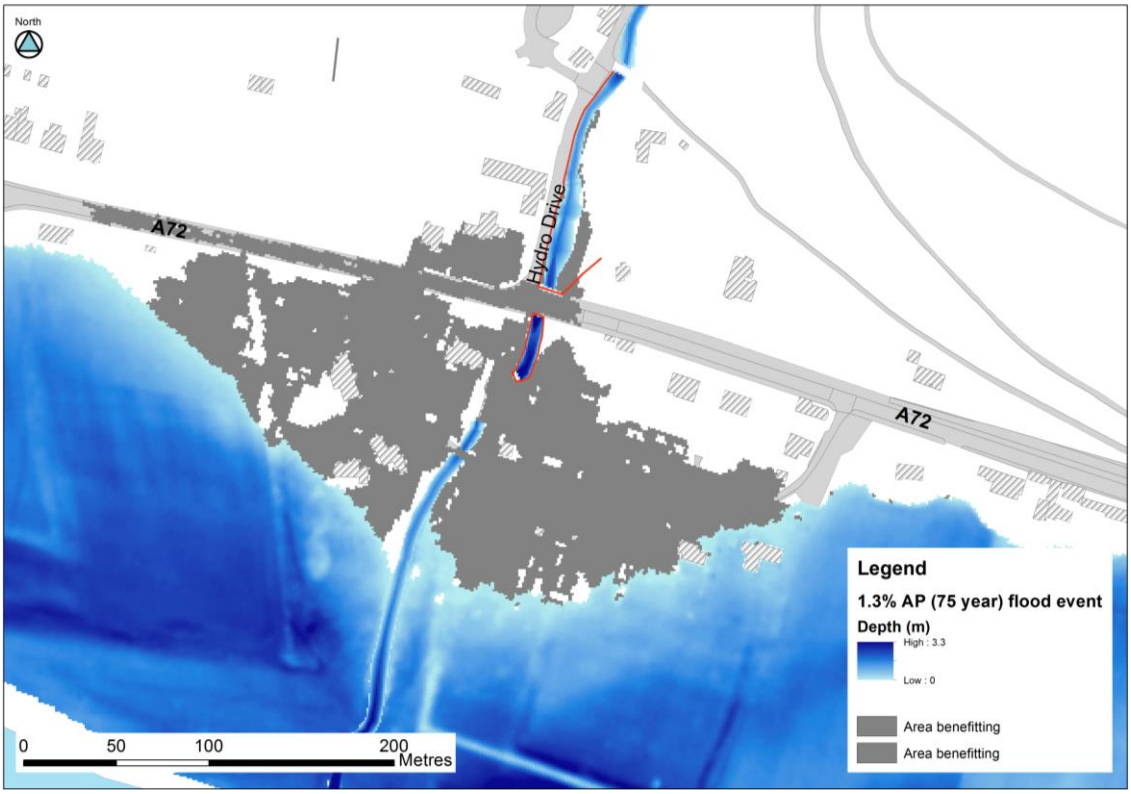
4.8.2 Option 2 - Direct defences upstream of Kerfield Cottage Culvert and upstream of A72 - 75 year standard of protection

Option 2 - Direct defences upstream of Kerfield Cottage Culvert and upstream of A72 - 75 year standard of protection

Description

This option aims to improve the standard of protection by upgrading existing walls and constructing new walls on the right bank of the watercourse as far as the arched access bridge leading to the cycle path whilst also installing walls in the reach immediately upstream of the Kerfield Cottage culvert as in Option 1. The work includes the following:

- Flood Wall upstream of A72 bridge: A concrete wall, approximately 168m long and between 0.6m and 1.7m high, highest near the A72.
- Flood Wall downstream of A72 bridge: A concrete wall, approximately 79m long and 1.6m high.



A technical drawing relating to this option has been produced and is provided alongside this report, named as follows:

AEM-JBAU-PB-SB-SK-C-1200-Op2_75yr_Direct_Defences-S3-P01.pdf

Standard of Protection (SOP)

Modelling of the above option suggests that a standard of protection of a 1.33% AP (75 year) flood is achievable without construction of very high flood walls in public spaces. This equates to a flow of 11m^3/s.

Alternative quick wins / Preliminary investigations

Smaller wall raising would offer a lesser standard of protection but for a lower cost - see Option 1.

Geotechnical issues

- A full GI will be required at a later stage in the project.
- A cut-off is likely to be needed. Piling may be difficult in this material and other forms of cut-off may need to be considered.
- A 1.25m deep x 0.5m wide mass concrete filled trench cut-off is included under walls for costing purposes.

Services

Overhead and underground services have been identified and their location is shown on drawing AEM-JBAU-PB-SB-SK-C-1001-Soonhope_Burn_Service.

- Electrical cables and a gas pipe are close to the proposed wall around the Kerfield Cottage reach with further cables, gas pipe and combined sewer located along Hydro Drive where the additional defences for this option are proposed.

Construction access

- Construction access to Flood Wall: Access off the A72 and Hydro Drive.

Waste

- Expected quantity of waste material: 134m^3.
- Nature (inert, non-hazardous, hazardous): It is known that very limited industry was present in Peebles – soil expected to be inert. No potentially contaminative land use constraints identified by council.
- Proposed disposal: According to SEPA guidance. All waste produced during construction should be contained and prevented from entering the watercourse. Stock piles of soil and non-toxic spoilt and construction waste should be located away from the river (at least c.10m) and covered. SEPA pollution prevention guidelines should be adhered to throughout the works.

Environmental issues

- Statutory Environmental Designations: Soonhope Burn is a special area of conservation (SAC).
- Habitat: The area within the site boundaries is a National Forest Inventory.

Health and safety hazards noted

- Geotechnical and excavation works - In channel works, falling into excavations, collapse of the sides of excavation, damage to underground services, undermining of nearby structures.
- Construction – flooding of works.

Social and community issues

Some aesthetic issues as this option has been designed to mitigate flood risk to extreme flood events which requires greater intervention than the quick win option. Land take is minimal but a substantial length of flood wall is proposed. Any modifications to walls will need to take into account that Kerfield Cottage and associated buildings and boundary walls are Grade B listed structures.

Impact on other reaches

The works will increase the flow in the channel downstream of the works as a result of the reduction in out of bank flows. This will not increase risk to other properties as a result of the community being located upstream of the confluence with the Tweed.

Additional information required

- A detailed topographic survey.
- Detailed buried services survey, plotting their position with regards to site works.
- Ground investigation.

Additional works required to account for increase in 200 year flow due to climate

change

- The proposed walls could be raised further but this is not likely to be acceptable to the public. A 200 year standard would likely not be achievable above Kerfield Cottage without further interventions such as upper catchment storage, see Option 3.

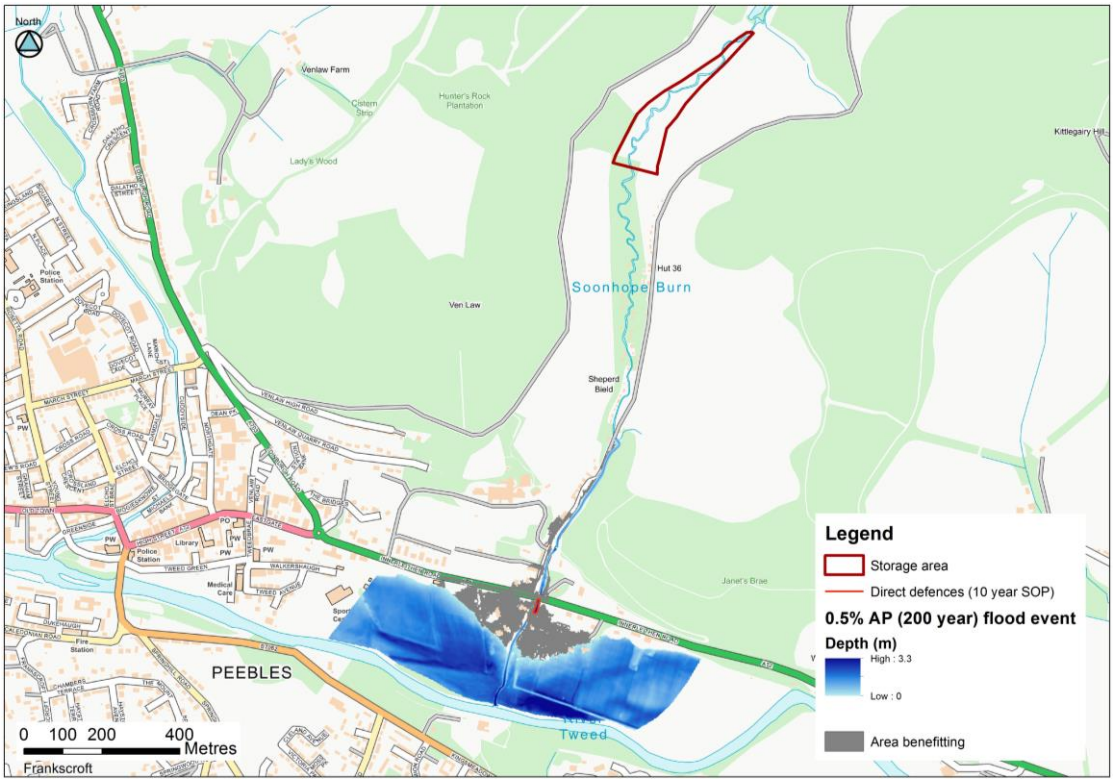
4.8.3 Option 3 - Flood storage in upper catchment and direct defences

Option 3 - Flood storage in upper catchment with direct defences

Description

This option aims to provide a high standard of protection by combining direct defences with flood attenuation in the upper catchment. The work includes the following:

- Construction of an embankment to retain floodwater in the upper catchment upstream of the Soonhope Chalets. Maximum height would be over 11m from the lowest channel level.
- A control structure within the embankment would be required that limits flow to 6.8m^3/s in the downstream reach (equivalent to the 10% AP flow). An orifice area of approximately 0.6m^2 would be needed, resulting in a maximum water level in the storage area of 202mAOD (~10m above bed level).
- Flood walls identical to those designed for Option 1 would be required upstream of the Kerfield Cottage culvert to protect against the 10 year flood, with a maximum height of 1.6m.



A technical drawing relating to this option has been produced and is provided alongside this report, named as follows:

AEM-JBAU-PB-SB-SK-C-1401-Op4_200Yr_Storage_&_Atten-S3-P01.pdf

Standard of Protection (SOP)

Modelling of the above option suggests that a standard of protection of a 0.5% AP (200 year) flood is achievable. This equates to flow of 13.7m^3/s.

Alternative quick wins / Preliminary investigations

This option represents a major intervention and whilst lower standards of protection could be achieved by reducing the embankment height for the storage area this is not advisable considering the scale of investment required.

Geotechnical issues

- A full GI will be required at a later stage in the project.
- A cut-off is likely to be needed. Piling may be difficult in this material and other forms of cut-

off may need to be considered.

- Walls: A 1.25m deep x 0.5m wide mass concrete filled trench cut-off is included under walls for costing purposes.
- Flood storage embankment: A 0.5m deep key is included for costing purposes.
- Southern end of the storage area historically housed rifle range targets - to be considered at future design stages.

Services

Overhead and underground services have been identified and their location is shown on drawing AEM-JBAU-PB-SB-SK-C-1001-Soonhope_Burn_Service.

- Electrical cables and gas pipe close to proposed flood walls near Kerfield Cottage.

Construction access

- Construction access to Flood Wall: Access off the A72.
- Construction access to flood storage embankment: Possible access from track beyond Hydro Drive. May need to be upgraded (not taken into consideration in the costs).

Waste

- Expected quantity of waste material: 2,128m^3.
- Nature (inert, non-hazardous, hazardous): It is known that very limited industry was present in Peebles – soil expected to be inert.
- Proposed disposal: According to SEPA guidance.

Environmental issues

No potentially contaminative land use constraints identified by council.

All waste produced during construction should be contained and prevented from entering the watercourse. Stock piles of soil and non-toxic spoilt and construction waste should be located away from the river (at least c.10m) and covered. SEPA pollution prevention guidelines should be adhered to throughout the works.

Health and Safety hazards noted

- Geotechnical and excavation works - In channel works, falling into excavations, collapse of the sides of excavation, damage to underground services, undermining of nearby structures.
- Construction – flooding of works.
- The occasional storage of large volumes of water directly upstream of an urbanised area would also represent a new risk and a critical maintenance burden for the Council.

Social and community issues

Significant aesthetic issues as this option has been designed to mitigate flood risk to extreme flood events which requires an extremely large embankment upstream of the properties. Land take is also a possible issue. The embankment in the upper catchment is likely to alter some access to the hills used by the wider Peebles community.

Impact on other reaches

The works will not increase flood risk elsewhere, however it will create a new risk of occasional storage of large volumes of water directly upstream of an urbanised area.

Additional information required

- A detailed topographic survey.
- Detailed buried services survey, plotting their position with regards to site works.
- Ground investigation.

Additional works required to account for increase in 200 year flow due to climate change

To give a 0.5% AP plus climate change standard of protection the reservoir would have a maximum water level of 205mAOD (12m above bed level) and therefore need to be constructed to a greater height.

4.8.4 Option 4 - Property Level Protection (PLP)

Option 4 - Property Level Protection (PLP)
Description This option aims to provide an increase in standard of protection for all properties where possible by protecting them up to a maximum flood depth of 0.6m. Beyond this water depth a building's integrity can be compromised. This option includes the survey, design and implementation of relevant PLP products to each property experiencing flooding. The number of properties expected to benefit from PLP: • 15 properties at the 0.5% AP (200 year) event. • 8 properties at the 1% AP (100 year) event. • 7 properties at the 1.33% AP (75 year) event.
Standard of Protection (SOP) PLP offers a variable standard of protection dependent on the property and expected flood depths but importantly on the Soonhope Burn the property with the lowest standard will be protected to a maximum of the 0.5% AP (200 year) event. Only 4 properties would exceed suitable flood depths for PLP at the 0.2% AP (500 year) flood event, with PLP still protecting 15 properties of the 19 at risk.
Technical issues All properties would require surveying by competent parties to determine which products are appropriate. Properties with non-standard or large entrances may require bespoke options which can significantly increase costs. The Scottish Government's Blueprint on PLP[3] should be considered when implementing this option. The use of passive measures is recommended as a result of the short flood lead time and rapid onset of flooding and the lack of suitable flood warning within the catchment. These measures are more expensive but would increase the effectiveness of the protection.
Construction issues Some properties such as the Freewheelin' Brewery may require bespoke PLP products and building remedial works may be required to allow the products to work effectively.
Environmental issues None expected.
Social and community issues The Soonhope community have not experienced flooding and therefore a smaller scale measure such as PLP may be more acceptable than a more invasive option.
Impact on other reaches There will be negligible impact on other reaches due to the small volume that would otherwise flow through properties.
Additional information required • A property threshold survey for any properties not already surveyed. • Public engagement meetings. • Flood risk reviews on each property.
Additional works required to account for increase in flow due to climate change • The PLP option is capable of mitigating against climate change as the flood depths are relatively low. This option can therefore be classed as sustainable assuming it is taken forward and kept up to date over the full appraisal period. • Some properties identified as suitable for PLP may become unsuitable with increasing river flows. Additionally, some properties that are not expected to flood frequently enough to make PLP worthwhile at present may be expected to flood more frequently in the future.

4.9 Residual risk

The options have differing levels of residual risk which could be managed in various ways. Options 1, 2 and 3 all seek to provide protection for all of the properties at risk from the Soonhope Burn.

3 Scottish Government (2014). Assessing the Flood Risk Management Benefits of Property Level; Blueprint for Local Authorities and Scottish Water. Final Report v2.0. 13 November 2014

Option 1 has the highest level of residual risk given the low standard of protection. Whilst not included in the option, PLP would be a sensible measure to increase the standard of protection for all properties at risk. Similarly, the 75 year option could be paired with PLP to increase the standard of protection. Adding PLP to these options is likely to reduce the benefit-cost ratio significantly.

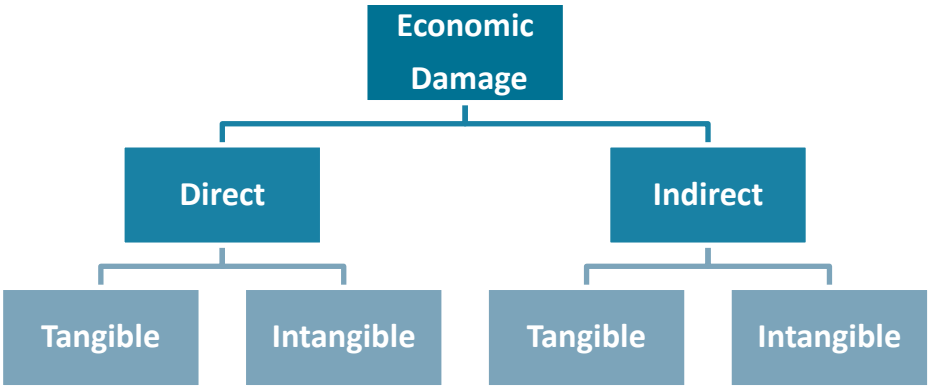
Kerfield Farm will remain at risk, mainly from the River Tweed, with any of the interventions proposed above. The farm is likely to have a high resilience to flooding and should therefore take measures to ensure this with advice from the Council as required.

5 Investment appraisal

5.1 Damage methodology

Flood damage assessment can include direct, indirect, tangible and intangible aspects of flooding, as shown in the Figure 5-1. Direct damages are the most significant in monetary terms, although the MCM and additional research provide additional methodologies, recommendations and estimates to account for the indirect and intangible aspects of flood damage.

Figure 5-1: Aspects of flood damage



Flood damage estimates have been derived for the following items:

1. Direct damages to residential properties;
2. Direct damages to commercial and industrial properties;
3. Indirect damages (emergency services);
4. Intangible damages associated with the impact of flooding;
5. Damage to vehicles;
6. Emergency evacuation and temporary accommodation costs.

The assumptions and additional data used to calculate the flood damages is provided in Appendix A.

5.2 Baseline Damages

Baseline damage results are presented for the Do Nothing and Do Minimum options overleaf.

Do Nothing

Assumptions:

Maintenance ceased, increasing hydraulic roughness due to vegetation growth and degradation of banks.

Bridges are small single span structures but there influence on property flooding is not significant and they are not considered likely to block so no changes are made to structures for the Do Nothing scenario. The wall along the right bank of the burn just upstream of the A72 is expected to degrade with no maintenance and is therefore not present in this scenario.

Properties at risk:

The total number of properties inundated above threshold level for the Do Nothing scenario on the Soonhope Burn has been assessed and is provided in the table below. In this scenario the lack of a wall upstream of the A72 road bridge means that floodwaters are able to reach the A72 with ease and then flow to the south and west, reducing flow to the southeast that is estimated to occur in the Do Minimum scenario.

Return period (years)	2	5	10	25	30	50	75	100	200	500	1000
Residential	0	1	3	5	6	8	12	13	13	15	18
Non-residential	0	0	0	0	0	0	1	1	1	1	1
Total	0	1	3	5	6	8	13	14	14	16	19

Key beneficiaries:

The flood damages derived have been ranked and assessed in terms of the proportion of flood damages per property. This highlights key beneficiaries of the scheme and is a useful auditing tool. The top ten properties are listed below and given the extremely shallow flood depths (generally under 0.1m) at all return periods the top 5 of these properties represent over 10% of the Present Value damages.

Rank	Property address	PVd (£k)	Percentage of total PVd (%)
1	Kerfield West, Innerleithen Road, EH45 8LY	61	13.1%
2	6 Hydro Cottages, Innerleithen Road, EH45 8BQ	57	12.3%
2	4 Hydro Cottages, Innerleithen Road, EH45 8BQ	57	12.3%
4	Kerfield West Lodge, Innerleithen Road, EH45 8BG	55	11.8%
5	Floors Cottage, Innerleithen Road, EH45 8BG	53	11.4%
6	3 Hydro Cottages, Innerleithen Road, EH45 8BQ	38	8.1%
6	2 Hydro Cottages, Innerleithen Road, EH45 8BQ	38	8.1%
6	1 Hydro Cottages, Innerleithen Road, EH45 8BQ	38	8.1%
9	Kerfield Coach House, Innerleithen Road, EH45 8BG	25	5.4%
10	Braeriach, Innerleithen Road, EH45 8BG	20	4.2%

Event property damages:

JBA's damage calculation method provides event damages based on MCM depth damage curves. Full results are provided in Appendix B. These represent the total potential flood damages based on the modelled flood level. Damages include all direct and indirect property flood damages.

Return period (years)	2	5	10	25	30	50	75	100	200	500	1000
Residential (£k)	0	3	12	47	63	208	348	496	680	843	948
Non-residential (£k)	0	0	0	0	0	0	5	7	9	11	12
Total (£k)	0	3	12	47	63	208	354	503	689	854	960

The above damages are used to calculate Annual Average Damages (AAD). Plotting the damages against the frequency of flooding (annual probabilities) allows us to determine the AAD as the area beneath the curve.

Intangible & intangible damages:

A summary of the proportion of total damages by each damage component is provided in the table below.

Do Nothing flood damages (£k):

Property PVd	Capped Property PVd	Total AAD	Indirect PVd	Intangible PVd	Total PVd
468	468	17	26	96	590

Do Minimum

Assumptions:

Maintenance ceased, increasing hydraulic roughness due to vegetation growth and degradation of banks. No bridge blockage assumed and the wall upstream of the A72 is expected to be maintained and act to contain flood flows up to its crest.

Properties at risk:

The total number of properties inundated above threshold level for the Do Minimum scenario on the Soonhope Burn has been assessed and is provided in the table below. In this scenario a flow route emerges from upstream of Kerfield Cottage and floods more properties than in the Do Nothing scenario.

Return period (years)	2	5	10	25	30	50	75	100	200	500	1000
Residential	0	0	5	7	7	7	7	8	14	18	18
Non-residential	0	0	0	0	0	0	0	0	1	1	1
Total	0	0	5	7	7	7	7	8	15	19	19

Key beneficiaries:

The flood damages derived have been ranked and assessed in terms of the proportion of flood damages per property. This highlights key beneficiaries of the scheme and is a useful auditing tool. The top ten properties are listed in the table below. The top two properties are both ranked number 1 in terms of their estimated damages as a result of property damages being capped at the market value (which is the same for all properties of this certain type). Since the damages are otherwise low thanks to shallow flood depths these properties, which are predicted to experience slightly deeper flood depths at over 0.2m represent well above 10% of the overall Present Value damages. Since any benefit-cost analysis is so keenly focussed on these properties they should be surveyed at outline design stage to ensure the estimated damages are appropriate.

Rank	Property address	PVd (£k)	Percentage of total PVd (%)
1	Kerfield Cottage, Innerleithen Road, EH45 8BG	220	34.4%
1	Kerfield Courtyard, Innerleithen Road, EH45 8BG	220	34.4%
3	Lower Kerfield Courtyard West, Innerleithen Road, EH45 8LY	32	5.0%
4	Upper Kerfield Courtyard West, Innerleithen Road, EH45 8LY	24	3.7%
5	6 Hydro Cottages, Innerleithen Road, EH45 8BQ	18	2.8%
5	4 Hydro Cottages, Innerleithen Road, EH45 8BQ	18	2.8%
7	3 Hydro Cottages, Innerleithen Road, EH45 8BQ	17	2.7%
7	2 Hydro Cottages, Innerleithen Road, EH45 8BQ	17	2.7%
7	1 Hydro Cottages, Innerleithen Road, EH45 8BQ	17	2.7%
10	Kerfield, Innerleithen Road, EH45 8LY	17	2.6%

Event property damages:

JBA's damage calculation method provides event damages based on MCM depth damage curves. Full results are provided in Appendix B. These represent the total potential flood damages based on the modelled flood level. Damages include all direct and indirect property flood damages.

Return period (years)	2	5	10	25	30	50	75	100	200	500	1000
Residential (£k)	0	0	93	181	187	202	210	218	514	848	966
Non-residential (£k)	0	0	0	0	0	0	0	0	0	0	0
Total (£k)	0	0	93	181	187	202	210	218	514	848	966

The above damages are used to calculate Annual Average Damages (AAD). Plotting the damages against the frequency of flooding (annual probabilities) allows us to determine the AAD as the area beneath the curve.

Intangible & intangible damages:

A summary of the proportion of total damages by each damage component is provided in the table below.

Do Minimum flood damages (£k):

Property PVd	Capped Property PVd	Total AAD	Indirect PVd	Intangible PVd	Total PVd
735	640	26	41	77	853

5.3 Options

The flood damages for each option were calculated for each return period up to the 1% AP (1000 year) event. Average annual flood damages were converted to present value damages using the discount factor and the residual damages for each option were compared against the flood damages estimated for the Do Nothing scenario. This comparison shows the damages avoided as a result of the options' interventions, also known as the benefit.

In line with current guidance[8] the PLP option was factored to account for the effectiveness and performance of measures and availability of homeowners to install and operate the measures. PLP was assumed to be 84% effective.

5.4 Damage benefit summary

The table below summarises the damages avoided for each option. The results show that each of the options assessed at least partly reduces flood damages relative to the Do Minimum scenario in the order of £124-750k but not when compared to the Do Nothing scenario which actually has lower flood damages than the Do Minimum scenario. Option 1 has negative benefits due to its low standard of protection and still experiencing more properties flooding at the higher return periods than in the Do Nothing scenario. The other options have positive benefits leaving low residual present value damages in the range £8-233k.

Table 5-1: Damage benefit summary (£k)

	DN	DM	Option 1	Option 2	Option 3	PLP
Option name	Do Nothing	Do Minimum	Direct Defences	Direct Defences	Storage & Direct Defences	PLP
Standard of Protection	2	5	10	75	200	200
BENEFITS:						
PV monetised flood damages	590	758	635	233	107	8
Total PV damages avoided/ benefits	-	-168	-44	357	484	490*
***Note:** PLP benefits are scaled down by 16% to account for the likelihood of PLP products only being 84% effective						

8 Post-Installation Effectiveness of Property Level Flood Protection, Final Report FD2668, 2014, DEFRA

6 Cost estimates

6.1 Price Base Date

The price base date is January 2018. The costs and benefits have been discounted over the 100 year life of the scheme to determine present values.

6.2 Whole life cost estimates

Whole life costs are typically compiled from the following four key cost categories:

1. Enabling costs. These costs relate to the next stage of appraisal, design, site investigation, consultation, planning and procurement of contractors.
2. Capital costs. These costs relate to the construction of the flood mitigation measures and include all relevant costs such as project management, construction and materials, licences, administration, supervision and land purchase costs (if relevant).
3. Operation and maintenance costs. Maintenance of assets is essential to ensure that the assets remain fit for purpose and to limit asset deterioration. Costs may include inspections, maintenance and intermittent asset repairs/replacement.
4. End of life replacement or decommissioning costs. These costs are only required when the design life of assets is less than the appraisal period. Most assets are likely to have a design life in excess of the 100 year financial period but PLP is expected to have a 25 year design life so this has been included in the cost estimate for PLP.

The Environment Agency's 'Long Term Costing' tool (2012) was the basis of all costs for this assessment to provide a uniform approach to costing across the flood studies.

Whole life (present value) costs have been estimated based on the above enabling, capital and maintenance costs. The following assumptions have been made:

1. The life span of the scheme and appraisal period is 100 years.
2. Discounting of costs are based on the standard Treasury discount rates as recommended by the 2003 revision to the HM Green Book (3.5% for years 0-30, 3.0% for years 31-75 and 2.5% for years 76-99).
3. Capital costs are assumed to occur in year 1 (equivalent to 2019).
4. Enabling costs occur in year 0.
5. An optimism bias of 60% has been applied and is representative of a scheme at the appraisal design stage of development. This provides a significant safety factor for cost implications and risks.

6.3 Maintenance costs

The EA Long Term Costing tool was used to calculate maintenance costs. These maintenance costs account for a default set of maintenance regimes for associated annual or frequent operation and maintenance activities.

The costs used assume efforts are made to maintain assets at condition grade 2 (Good) using the grading system described in the Environment Agency's asset condition assessment manual[9]. Average costs were used - between lower and upper bounds reproduced in the report - given the absence of detailed maintenance plans at this early design stage of development.

6.4 Optimism bias

An optimism bias of 60% has been applied and is representative of a scheme at the appraisal design stage of development. This provides a significant safety factor for cost implications and risks. This uplift is applied to present value capital and present value maintenance costs after their calculation.

6.5 Option 1 - Direct defences with a 10-year standard of protection

This option consists of the following measures:

- Flood Wall: A concrete wall, approximately 79m long and 1.6m high.

9 Condition Assessment Manual (CAM) (Environment Agency, 2012)

Costs are based on achieving a 10-year standard of protection and on near immediate initiation of works.

Table 6-1: Unit and total estimated costs (£)

Location	Typical defence height	Length / Volume	Unit cost	Total Cost (Rounded)
Flood Wall	1.5m	79.2m	£1,428	£113,105
Excavation and tipping	-	42.8m^3	£125.05	£5,352
			Total Capital cost	£118,457

Table 6-2: Total cash and Present Value (PV) option costs

Element	Cash cost (£k)	PV Cost (£k)
Enabling cost	29	29
Capital cost	118	114
Maintenance cost	3	1
Total	**150**	**145**
Total incl. Optimism Bias	-	231

6.6 Option 2 - Direct defences with a 75-year standard of protection

This option consists of the following measures:

- Flood Wall upstream of A72 bridge: A concrete wall, approximately 168m long and up to 1.7m high.
- Flood Wall downstream of A72 bridge: A concrete wall, approximately 79m long and up to 1.6m high.

Costs are based on achieving a 75-year standard of protection and on near immediate initiation of works.

Table 6-3: Unit and total estimated costs (£)

Location	Typical defence height	Length / Volume	Unit cost	Total Cost (Rounded)
Flood Wall d/s of A72 bridge	1.5m	79.2m	£3,432	£271,775
Flood Wall u/s of A72 bridge	1.6	168m	£3,432	£576,492
Excavation and tipping	-	133.5m^3	£125.05	£16,694
			Total Capital cost	£864,961

Table 6-4: Total cash and Present Value (PV) option costs

Element	Cash cost (£k)	PV Cost (£k)
Enabling cost	221	221
Capital cost	865	836
Maintenance cost	8	2
Total	**1,093**	**1,059**
Total incl. Optimism Bias	-	1,694

6.7 Option 3 - Storage and Direct defences with a 200-year standard of protection

This option consists of the following measures:

- Embankment: An embankment approximately 11m high, 150m long, with 4m wide crest and 1:3 side slopes upstream of the Soonhope chalets. Approximate volume 11,695.5m^3. Maximum height from channel bed level
- Storage: A storage reservoir, upstream of the embankment, to a maximum stored water level of approximately 202mAOD. Capacity approximately 410,189m^3.
- Flow Control Device consisting of an adjustable penstock set to pass forward the 10 year flow.
- Flood Wall d/s of A72 bridge to protect against the 10 year pass forward flow: A concrete wall, approximately 79m long and 1.6m high.

Costs are based on achieving a 200-year standard of protection and on near immediate initiation of works.

Table 6-5: Unit and total estimated costs (£)

Location	Typical defence height	Length / Volume	Unit cost	Total Cost (Rounded)
Flood Wall d/s of A72 bridge	1.5m	79.2m	£1,428	£113,105
Embankment	11m	11,695m^3	£81	£952,715
Storage	12.65m	410,189m^3	£5.2	£2,152,120
Excavation and tipping	-	2,128m^3	£125.05	£266,106
			Total Capital cost	£3,484,047

Table 6-6: Total cash and Present Value (PV) option costs

Element	Cash cost (£k)	PV Cost (£k)
Enabling cost	223	223
Capital cost	3,484	3,366
Maintenance cost	2,161	614
Total	**5,868**	**4,203**
Total incl. Optimism Bias	-	6,725

6.8 Option 4 - PLP

The costs for this option are derived from an estimate of the number of properties of different types that are likely to require PLP. These different property types are shown in Table 6-7. The base cost data is taken from the Scottish Government guidance document on PLP (2014)[11]. The total PV costs are based on PLP products having a design life of 25 years and therefore being replaced at this interval throughout the appraisal period. Automatic or 'passive' PLP products such as permanently active waterproof doors were costed rather than manually installed products like door guards.

Table 6-7: Unit and total estimated capital costs (£)

Property type	Count	Capital cost - mid range automatic
Detached	7	£58,681
Semi-detached	2	£15,716
Flat	5	£23,040
Office	1	£14,158
Total	15	£111,595

11 Assessing the Flood Risk Management Benefits of Property Level Protection, Scottish Government (2014)

Only one non-residential property was identified as being suitable for PLP on the Soonhope Burn, the Freewheelin' Brewery. In the absence of more detailed information this property was categorised as an office. Since more bespoke measures may be required the costs of providing PLP for this property should be reviewed in detail at outline design stage.

Table 6-8: Total cash and Present Value (PV) option costs

Element	Cash cost (£k)	PV Cost (£k)
Enabling cost	18	18
Capital cost	446	185
Maintenance cost	219	62
Total	**683**	**265**
Total incl. Optimism Bias	-	424

6.9 Summary of whole life costs

The table below summarises all Present Value costs for all of the short listed options:

Table 6-9: Summary of PV costs for all options

Option	PV Cost (£k)
1 - Option 1 10 year standard direct defences	549
2 - Option 2 75 year standard direct defences	1,714
3 - Option 3 storage and 10 year standard direct defences	6,842
4 - Property Level Protection	424

7 Benefit-cost analysis

7.1 Introduction

This section discusses the economic appraisal carried out during this study. The methods of calculating the benefits and costs are outlined together with an assessment of the benefit-cost ratios for the range of options assessed. Benefit-cost analysis looks at a flood risk management strategy or practice and compares all the benefits that will be gained by its implementation to all the costs that will be incurred during the lifetime of the project.

In accordance with the FCERM appraisal guidance, benefits are taken as annual average damages avoided, expressed as their present value using Treasury discount rates. These are compared with the whole life cost of the capital and maintenance costs of selected options, expressed as present value. If the benefits exceed the costs for the option, the scheme is deemed to be cost-effective and worthwhile for promotion.

Benefits are assessed as the flood damages that will be avoided by the implementation of a project. To calculate the benefits it is necessary to assess the damages that are likely to occur under both the Do Nothing and Do Something scenarios. The benefits of any particular Do Something option can then be calculated by deducting the Do Something damages from the Do Nothing damages.

7.2 Benefit-cost results

The benefit-cost results for the short listed options are provided in the table below.

Table 7-1: Benefit-cost ratio for options on the Soonhope Burn (£k)

	Do Nothing	Do Minimum	Option 1	Option 2	Option 3	PLP
PV Costs	-	-	145	1,059	4,203	265
Optimism Bias (60%)	-	-	87	635	2,522	159
Total PV Costs	-	-	231	1,694	6,725	424
PV damage	590	758	635	233	107	8
PV damage avoided	-	-168	-44	357	484	490
Net present value	-	-168	-275	-1,336	-6,242	66
Benefit-cost ratio	-	-	-0.2	0.2	0.1	1.2
Incremental benefit-cost ratio	-	-	0.5	0.3	0.0	1.5

Options 1-3 have not been found to be cost-effective, with them not providing sufficient benefit relative to the investment required to protect the few properties at risk from the Soonhope Burn. Fortunately, PLP appears to be a cost-effective solution to manage the shallow flood depths expected from this burn and is appropriate given the small overall number of properties at risk. PLP is expected to protect all properties at risk up to the 0.2% AP (500 year) flood event for significantly less investment than any of the lower standard of defence options. The prevalence of residential properties along the burn means that PLP is likely to be easily implemented with only the Freewheelin' brewery likely to require bespoke PLP products. Table 7-2 shows the major benefit that this option has in terms of the number of properties that are expected to benefit.

Table 7-2: Number of properties at risk in the Do Minimum and PLP options

Return period (years)	2	5	10	25	30	50	75	100	200	500	1000
Do Minimum	0	0	5	7	7	7	7	8	15	19	19
With PLP	0	0	0	0	0	0	0	0	0	4	5
Difference	0	0	5	7	7	7	7	8	15	15	14

7.3 Residual risks

The most cost-effective option, PLP, offers a 200 year standard of protection reducing property flood damages considerably and leaving comparatively little risk other than the risk of the PLP products themselves failing or local variations in flood depths exceeding the limits of the PLP products.

Alongside PLP Natural Flood Management (NFM) practices could aid in reducing flows in the Soonhope Burn and provide some resilience to climate change. A detailed NFM modelling study should be carried out to attempt to quantify the benefits of these practices in the wider Tweed valley.

8 Public Consultation

A public consultation event was held in Peebles in November 2018 to gauge opinion on the flood mitigation options proposed as part of this study. In general, the residents in attendance were in approval of the schemes proposed across Peebles.

There was some knowledge of historical flooding in properties surrounding Kerfield House which may have experienced basement flooding. Further details such as when this occurred, and the extent of damage are not known.

There were few specific comments regarding the proposed works on the Soonhope Burn but the owner of Aird Lodge (south west of the A72 bridge, adjacent to Kerfield House but on the right bank of the burn) expressed concern over the risk from the River Tweed, particularly in light of any works on the Soonhope Burn. The modelled flood outline for the 0.5% AP (200 year) flood event on the River Tweed reaches the property boundary of Aird Lodge but the buildings' threshold level means that it is not predicted to flood. In the unlikely event that a similar magnitude event occurs on the burn at the same time as on the River Tweed the water level on the River Tweed floodplain would not be expected to rise significantly due to the small overall contribution the burn makes to the Tweeds total flow at this point. For example, the total 0.5% AP (200 year) flow in the Soonhope Burn assuming no out of bank flooding, would be 13.67m^3/s whereas the same event on the River Tweed has a total flow of 502m^3/s as it passes the Soonhope Burn. Thus, the Soonhope Burn contributes under 3% of the total flow on the River Tweed and would therefore not affect levels sufficiently to flood properties at the foot of the Soonhope Burn.

No residents in the Soonhope area filled in questionnaires at the consultation event to provide opinion on the options proposed. Given the relatively low risk of flooding from this burn and the ability for PLP to reduce this risk yet further, this is seen to be a suitable option to carry forward, should the Council deem that necessary.

9 Conclusions and recommendations

9.1 Summary

This report presents the results of a detailed flood risk appraisal for the area of Peebles at risk from the Soonhope Burn. Properties south of the A72 in the grounds of Kerfield House are most at risk but with properties along Hydro Drive also likely to experience some flooding during higher magnitude events. 15 properties in total are estimated to be at risk from the 0.5% AP (200 year) flood event.

A detailed set of preliminary investigations was carried out ahead of this appraisal such that it was possible to inform discussion of flood protection options for this area of Peebles. These investigations involved a review of Peebles' flood history, an assessment of the hydrological inputs to the Soonhope Burn, collection and review of survey data, a River Basin Management Plan review, an assessment of Natural Flood Management opportunities in the catchment, a Preliminary Ecological Appraisal, asset condition assessment and hydraulic modelling of the burn.

The hydraulic model, consisting of a 1D-2D Flood Modeller Pro-TUFLOW model covering the reach from the upstream extent of Hydro Drive to the burns confluence with the River Tweed, allowed the generation of flood inundation maps for a range of Annual Probability (AP) flood events ranging from 50% AP (2 year) to 0.1% AP (1000 year). A number of scenarios were modelled to provide sufficient information on which to base the economic appraisal at a later stage in the study. These included the Do Nothing and Do Minimum scenarios with the former representing a 'walkaway' scenario where maintenance of the watercourse ceases, and the latter representing the present-day watercourse condition. Once these maps were produced it was possible to review flood flow pathways and progress from a wide-ranging long-list of potential flood protection options to a short list of feasible solutions tailored to Peebles' flood risk problem. Flood flows are expected to leave the burn at key constrictions such as the A72 culvert and the Kerfield Cottage culvert as well as generally flooding onto Hydro Drive during large magnitude events. Water passing onto Hydro Drive either re-enters the burn or passes onto the A72 and flows west towards Gytes leisure centre as well as south and east into the properties surrounding Kerfield House.

Several short-term measures were proposed which may assist in reducing flood risk to some properties. The Soonhope Burn does not have any Flood Warning and this could therefore be investigated to determine if this is achievable via an alert based system to provide local residents with warning of rising water levels. This would be particularly important if no scheme was put forward and instead at-risk properties made use of the Scottish Borders Council PLP discount scheme to protect themselves. Natural Flood Management (NFM) is a method whereby wider catchment benefits could be achieved alongside potentially reducing flows in the burn. Opportunities within the upper catchment could to some extent counteract the effects of increasing river flows with climate change.

A short list of flood protection options was produced and reviewed by comparing the expected benefit of the scheme (property damages avoided) with the estimated costs for scheme implementation and maintenance. Two of the short listed options are based on direct defences being constructed along the banks of the burn but due to the constrictions at the A72 road bridge and the Kerfield Cottage culvert high flood defence walls would be needed to protect to even low return periods. Options 1 and 2 therefore only protect to the 10% AP (10 year) and 1.33% AP (75 year) return periods but have significant costs associated with them. Option 3 involves storage of a majority of the flood waters for the 0.5% AP (200 year) magnitude event behind an embankment upstream of the Soonhope chalets, releasing water at a rate equivalent to the 10% AP (10 year) flood event and requiring the same flood defences upstream of Kerfield Cottage culvert as in Option 1.

Property Level Protection (PLP) was also included as an option, providing protection for properties experiencing flooding up to 0.6m in depth. Due to the shallow flood depths predicted for all properties this option is appropriate. However, 'Automatic' or 'passive' PLP products would be installed in all at-risk properties which would then reduce the need for prior Flood Warning as would be needed if using manually installed PLP. This option can protect properties to the 0.5% AP (200 year) flood event, with many properties also protected at the 0.2% AP (500 year) event.

A benefit-cost analysis has been undertaken for the present-day (Do Minimum) scenario and each of the above options. The Present Value flood damages calculated for the Do Minimum scenario are estimated to be £758,000. Costs for each option have been estimated using the Environment

Agency's Long Term Costing tool (2012). An optimism bias factor of 60% has been added to the total capital costs to allow for uncertainties in design at this level of appraisal and is typical for schemes at an early stage of appraisal.

None of the hard-engineered options are cost beneficial, leaving the PLP option as the sole option that is economically viable. The PLP option has a benefit-cost ratio of 1.2 and should have little impact on the surrounding environment. Once installed PLP products are unlikely to impose an impact on the lives of residents.

9.2 Recommendations

The above assessments have led to the following key recommendations for Peebles:

The PLP option, which provides protection to all properties, could be progressed by the Council.

In the short term PLP should be marketed to those at flood risk through the Council's discount scheme. Flood action groups, in partnership with the Community Council should seek to establish a network of support between members of the community, Scottish Borders Council, Tweed Forum and emergency services. Community engagement should be continued to raise awareness of flood risk and potential short and longer-term solutions.

The Council's emergency plan should be updated, informed by the findings of this study including the new flood mapping. The outputs from this study should be shared with the Peebles resilience group to ensure that they are aware of the new flood maps and to assist with emergency procedures.

Channel maintenance, particularly surrounding structures, should be carried out, including repair of the wall on the right bank of the burn upstream of the A72. The council should also consider construction of a coarse debris screen to reduce the possibility of large woody debris blocking the small capacity structures near the A72.

Natural Flood Management opportunities should be progressed where feasible through engagement with land owners and other stakeholders. Should NFM be progressed as part of a scheme funding should be sought through the scheme itself but in the shorter term it may be possible to secure funding through other sources if the focus can be widened from flood risk management to catchment and land management benefit.

A suitable flood alert system should be investigated and introduced on the Soonhope Burn and will aid in ensuring readiness to future flood events should PLP products be installed in properties. The installation of a gauge may also be useful for updating future estimates of flood flows on this ungauged catchment.

Wherever possible, Scottish Planning Policy should be leveraged to provide the potential for future implementation of other options that are currently not possible due to the sporadic presence of properties on the floodplain.

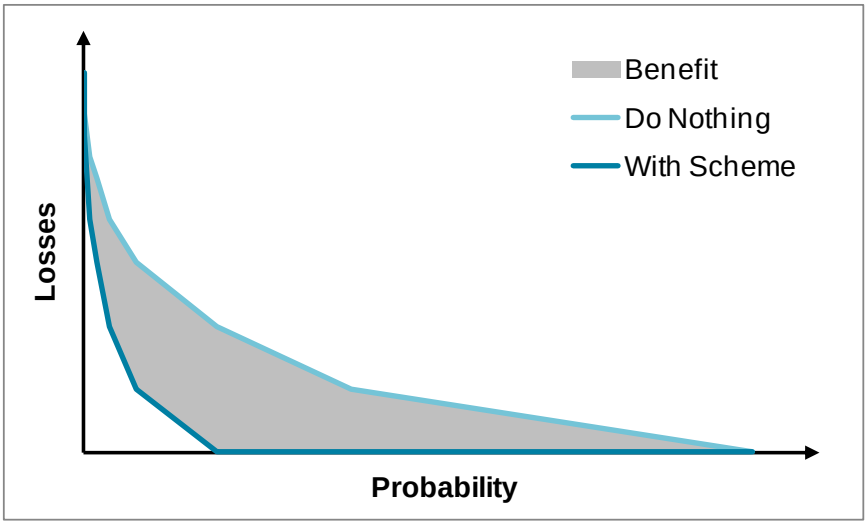
Appendices

A Appendix A - Damage Methodology

A.1 Direct damages - methodology

The process to estimate the benefits of an intervention option is to plot the two loss-probability curves: that for the situation now, and that with the proposed option as shown in Figure A-1. The scale on the y axis is the event loss (£); the scale on the x axis is the probability of the flood events being considered. When the two curves are plotted the difference in the areas beneath the curve is the annual reduction in flood losses to be expected from the scheme or mitigation approach.

Figure A-1: Loss Probability Curve



To derive these two curves, straight lines are drawn between the floods for which there are data from the threshold event (the most extreme flood which does not cause any damage) to an extreme flood above the intended standard of protection. The greater the number of flood event probabilities, the more accurately the curves can be plotted.

A.1.1 Flood damage calculation and data

The FHRC Multi Coloured Manual (MCM) provides standard flood depth/direct damage datasets for a range of property types, both residential and commercial. This standard depth/damage data for direct and indirect damages has been utilised in this study to assess the potential damages that could occur under each of the options. Flood depths within each property have been calculated from the hydraulic modelling by comparing predicted water levels at each property to the surveyed threshold levels.

A flood damage estimate was generated using JBA's in-house flood damage tools. These estimate flood damages using FHRC data and the modelled flood level data. Each property data point was mapped on to its building's footprint. A mean, minimum and maximum flood level within each property is derived using GIS tools based on the range of flood levels around the building footprint. The inundation depth is calculated by comparing water levels with the surveyed threshold level. The mean (based on mean flood water level across the buildings floor area) flood damage estimates have been calculated and are presented in section 5.2.

The following assumptions, presented in the Table A-1, were used to generate direct flood damage estimates.

Table A-1: Damage considerations and method

Aspect	Values used	Justification
Flood duration	<12hrs	Flood water is not anticipated to inundate properties for prolonged periods.
Residential	MCM codes broken down by type	Appropriate for this level of

Aspect	Values used	Justification
property type	and age.	analysis.
Non-residential property type	Standard 2016 MCM codes applied.	Best available data used.
Upper floor flats	Upper floor flats have been removed from the flood damage estimates.	Whilst homeowners may be affected it is assumed that no direct flood damages are applicable.
MCM damage type	MCM 2016 data with no basements.	Most up to date economic analysis data used. Basements are not appropriate for the type of properties within the study area.
MCM flood type	MCM 2016 fluvial depth damages for combined fluvial-tidal scenario.	Best available data used.
Threshold level	Thresholds surveyed by surveyor for the majority of properties in area of interest.	Best available data used.
Property areas	OS Mastermap used to define property areas	Best available data used.
Capping value	Residential properties based on house prices from Zoopla. Commercial properties valued from rateable values for individual properties (supplied by SAA).	Best available data used.

A.1.2 Property data set

The property dataset was compiled for all residential and commercial properties. The majority of these properties were visited by a JBA Surveyor during the threshold survey.

A.1.3 Capping

The FHRC and appraisal guidance suggests that care should be exercised for properties with high total (Present Value) damages which might exceed the market value of the property. In most cases it is prudent to assume that the long-term economic losses cannot exceed the capital value of the property. The present value flood damages for each property were capped at the market value using average property values obtained from internet sources (e.g. Zoopla).

Market values for non-residential properties were initially estimated from a properties rateable value based on the following equation:

Capital Valuation = (100/Equivalent Yield) x Rateable Value

Rateable values for all available properties in Peebles were obtained from the Scottish Assessors Association website[12]. Equivalent yield varies regionally and temporarily but is recommended to be a value of 10-12.5 for flood defence purposes[13]. A value of 12.5 was used.

However, the resulting property valuations were judged as being undervalued. An alternative approach was used whereby the estimated value is 3 times the max depth damage MCM curve damage value for the commercial property type multiplied by the properties ground floor area.

A.1.4 Updating of Damage Values

The MCM data used is based on January 2017 values and therefore does not need to be brought up to date to compare the costs and benefits.

12 www.saa.gov.uk
13 Environment Agency (2009). Flood and Coastal Erosion Risk Management - Appraisal Guidance.

A.2 Intangible damages

Current guidance indicates that the value of avoiding health impacts of fluvial flooding is of the order of £286 per year per household. This value is equivalent to the reduction in damages associated with moving from a do-nothing option to an option with an annual flood probability of 1:100 year standard. A risk reduction matrix has been used to calculate the value of benefits for different pre-scheme standards and designed scheme protection standards.

A.3 Indirect damages

The multi coloured manual provides guidance on the assessment of indirect damages. It recommends that a value equal to 10.7% of the direct property damages is used to represent emergency costs. These include the response and recovery costs incurred by organisations such as the emergency services, the local authority and SEPA.

A.3.5 Indirect commercial damages

Obtaining accurate data on indirect flood losses is difficult. Indirect losses are of two kinds:

- losses of business to overseas competitors, and
- the additional costs of seeking to respond to the threat of disruption or to disruption itself which fall upon firms when flooded.

The first of these losses is unusual and is limited to highly specialised companies which are unable to transfer their productive activities to a branch site in this country, and which therefore lose to overseas competitors. The second type of loss is likely to be incurred by most Non-Residential Properties (NRPs) which are flooded. They exclude post-flood clean-up costs but include the cost of additional work and other costs associated with inevitable efforts to minimise or avoid disruption. These costs include costs of moving inventories, hiring vehicles and costs of overtime working. These costs also include the costs of moving operations to an alternative site or branch and may include additional transport costs.

Chapter 5, Section 5.7 of the MCM (2013)[14] recommends estimating and including potential indirect costs where these are the additional costs associated with trying to minimise indirect losses. This is by calculating total indirect losses as an uplift factor of 3% of estimated total direct NRP losses at each return period included within the damage estimation process.

14 Penning-Rowsell et al., 2013. Flood and Coastal Erosion Risk Management - A Manual for Economic Appraisal

B Appendix B - Economic Appraisal

Project Summary Sheet

Client/Authority				Prepared (date)	23/08/2018
Scottish Borders Council				Printed	06/12/2018
Project name				Prepared by	B.Bedford
Soonhope Burn FPS				Checked by	A.Pettit
Project reference	2017s5526			Checked date	01/09/2018
Base date for estimates (year 0)	Jan-2018				
Scaling factor (e.g. £m, £k, £)	£k	(used for all costs, losses and benefits)			
Year	0	30	75		
Discount Rate	3.5%	3.00%	2.50%		
Optimism bias adjustment factor	60%				

Costs and benefits of options

	Costs and benefits £k					
Option number	**Do Nothing**	**Do Minimum**	**OP01**	**OP02**	**OP04**	**PLP**
Option name	Do Nothing	Do Minimum	DD - 10yr SoP	DD - 75yr SoP	Storage	PLP
AEP or SoP (where relevant)	<2	<2	10	75	200	200
COSTS:						
PV Enabling costs	0	0	29	221	223	18
PV Capital costs	0	0	114	836	3,366	185
PV operation and maintenance costs	0	0	1	2	614	62
Optimism bias adjustment	0	0	87	635	2,522	159
PV contributions						
Total PV Costs £k excluding contributions	0	0	231	1,694	6,725	424
Total PV Costs £k taking contributions into account	0	0	231	1,694	6,725	424
BENEFITS:			124	525	651	750
PV monetised flood damages	590	758	635	233	107	8
PV monetised flood damages avoided		-168	-44	357	484	490
PV monetised erosion damages	0	0	0	0	0	0
PV monetised erosion damages avoided (protected)		0	0	0	0	0
Total monetised PV damages £k	590	758	635	233	107	8
Total monetised PV benefits £k		-168	-44	357	484	583
PV damages (from scoring and weighting)						
PV damages avoided/benefits (from scoring and weighting)						
PV benefits from ecosystem services						
Total PV damages £k	590	758	635	233	107	8
Total PV benefits £k		-168	-44	357	484	490
DECISION-MAKING CRITERIA:						
Based on monetised PV benefits (*ex* ***cludes benefits from scoring and weighting and ecosystem services)***						
Net Present Value **NPV**		-168	-275	-1,336	-6,242	66
Average benefit/cost ratio **BCR**			-0.2	0.2	0.1	1.2
Incremental benefit/cost ratio **IBCR**			0.5	0.3	0.0	1.5
						Highest bcr IBCR>1
Best practicable environmental option (WFD)						

Brief description of options:

Do Nothing	Do Nothing
Do Minimum	Do Minimum
OP01	DD - 10yr SoP
OP02	DD - 75yr SoP
OP04	Storage
PLP	PLP

Comments and assumptions:

Summary Annual Average Damage

Sheet Nr.

Client/Authority
Scottish Borders Council

Project name
Soonhope Burn FPS

Option:
Do Nothing

Project reference 2017s5526

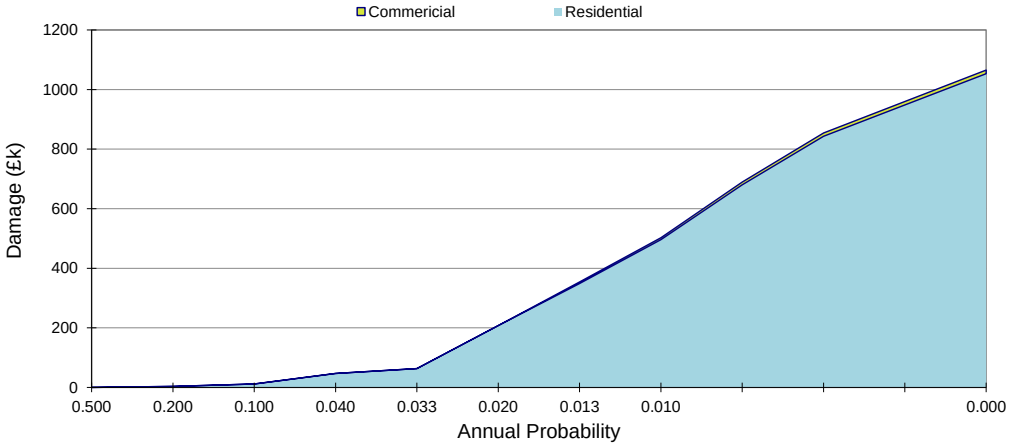
Base date for estimates (year 0)	43101	First year of damage:	0	Prepared (date)	23/08/2018
Scaling factor (e.g. £m, £k, £)	£k	Last year of period:	99	Printed	06/12/2018
Discount rate	3.5%	PV factor for mid-year 0:	29.813	Prepared by	B.Bedford
				Checked by	A.Pettit
Applicable year (if time varying)				Checked date	01/09/2018

	Average waiting time (yrs) between events/frequency per year												Total PV
	2	5	10	25	30	50	75	100	200	500	1000	Infinity	£k
	0.500	0.200	0.100	0.040	0.033	0.020	0.013	0.010	0.005	0.002	0.001	0	
Damage category	Damage £k												
Residential property	0	3	12	47	63	208	348	496	680	843	948	1053	464
Ind/commercial (direct)	0	0	0	0	0	0	5	7	9	11	12	12	4
Ind/comm (indirect)	0	0	0	0	0	0	0	0	0	0	0	0	0
Traffic related												0	-
Emergency services	0	0	1	3	4	12	20	28	38	47	53	59	26
Other	0	0	0	0	0	0	0	0	0	0	0	0	-
Intangible damages												0	96
												0	-
Total damage £k	0	4	12	49	67	220	374	531	728	901	1013	1125	
Area (damagexfrequency)		1	1	2	0	2	2	2	3	2	1	1	

Total area, as above	17	
PV Factor, as above	29.813	
Present value (assuming no change in damage or event frequency)	494	590

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet

Project: Soonhope Burn FPS **Option: Do Nothing**



Summary Annual Average Damage

Sheet Nr.

Client/Authority
Scottish Borders Council

Project name
Soonhope Burn FPS

Option:
Do Minimum

Project reference 2017s5526

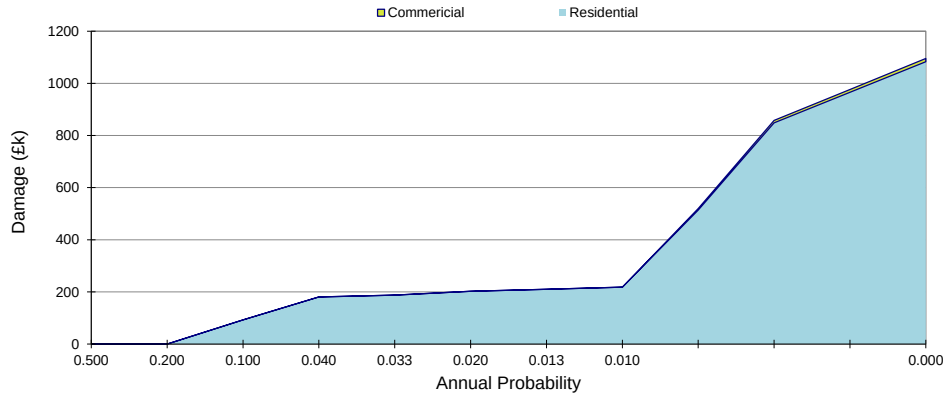
Base date for estimates (year 0)	43101	First year of damage:	0	Prepared (date)	23/08/2018
Scaling factor (e.g. £m, £k, £)	£k	Last year of period:	99	Printed	06/12/2018
Discount rate	3.5%	PV factor for mid-year 0:	29.813	Prepared by	B.Bedford
				Checked by	A.Pettit
Applicable year (if time varying)				Checked date	01/09/2018

	Average waiting time (yrs) between events/frequency per year												Total PV	Capped PV
	2	5	10	25	30	50	75	100	200	500	1000	Infinity	£k	£k
	0.500	0.200	0.100	0.040	0.033	0.020	0.013	0.010	0.005	0.002	0.001	0		
Damage category	Damage £k													
Residential property	0	0	93	181	187	202	210	218	514	848	966	1083	733	638
Ind/commercial (direct)	0	0	0	0	0	0	0	0	6	9	11	12	2	2
Ind/comm (indirect)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Traffic related												0	-	-
Emergency services	0	0	5	10	10	11	12	12	29	48	54	61	41	41
Other	0	0	0	0	0	0	0	0	0	0	0	0	-	-
Intangible damages												0	77	77
												0	-	-
Total damage £k	0	0	98	191	198	214	222	231	549	906	1031	1157		
Area (damagexfrequency)		0	5	9	1	3	1	1	2	2	1	1		

Total area, as above	26		
PV Factor, as above	29.813		
Present value (assuming no change in damage or event frequency)	776	853	758

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet

Project: Soonhope Burn FPS **Option: Do Minimum**



Summary Annual Average Damage

Sheet Nr.

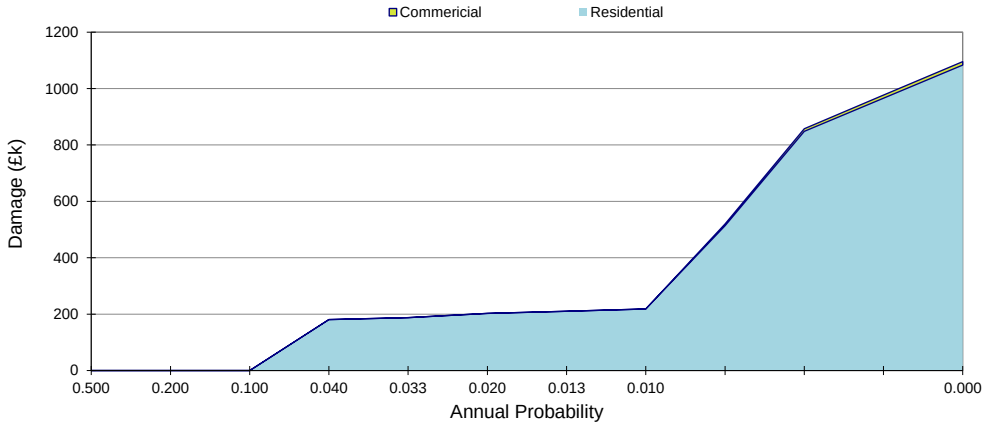
Client/Authority					
Scottish Borders Council					
Project name		**Option:**			
Soonhope Burn FPS		DD - 10yr SoP			
Project reference	2017s5526				
Base date for estimates (year 0)	43101	First year of damage:	0	Prepared (date)	23/08/2018
Scaling factor (e.g. £m, £k, £)	£k	Last year of period:	99	Printed	06/12/2018
Discount rate	3.5%	PV factor for mid-year 0:	29.813	Prepared by	B.Bedford
				Checked by	A.Pettit
Applicable year (if time varying)				Checked date	01/09/2018

	Average waiting time (yrs) between events/frequency per year												Total PV
	2	5	10	25	30	50	75	100	200	500	1000	Infinity	£k
	0.500	0.200	0.100	0.040	0.033	0.020	0.013	0.010	0.005	0.002	0.001	0	
Damage category	Damage £k												
Residential property	0	0	0	181	187	202	210	218	514	848	966	1083	511.07
Ind/commercial (direct)	0	0	0	0	0	0	0	0	6	9	11	12	1.78
Ind/comm (indirect)	0	0	0	0	0	0	0	0	0	0	0	0	0.05
Traffic related												0	-
Emergency services	0	0	0	10	10	11	12	12	29	48	54	61	28.62
Other	0	0	0	0	0	0	0	0	0	0	0	0	-
Intangible damages												0	93.00
												0	-
Total damage £k	0	0	0	191	198	214	222	231	549	906	1031	1157	
Area (damagexfrequency)		0	0	6	1	3	1	1	2	2	1	1	

Total area, as above	18.16	
PV Factor, as above	29.81	
Present value (assuming no change in damage or event frequency)	541.52	634.52

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet

Project: Soonhope Burn FPS **Option: DD - 10yr SoP**



Summary Annual Average Damage

Sheet Nr.

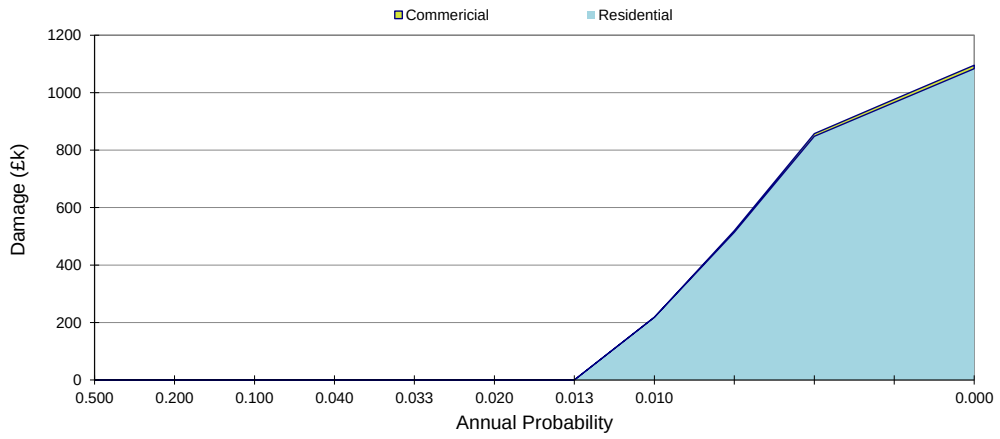
Client/Authority					
Scottish Borders Council					
Project name		**Option:**			
Soonhope Burn FPS		DD - 75yr SoP			
Project reference	2017s5526				
Base date for estimates (year 0)	43101	First year of damage:	0	Prepared (date)	23/08/2018
Scaling factor (e.g. £m, £k, £)	£k	Last year of period:	99	Printed	06/12/2018
Discount rate	3.5%	PV factor for mid-year 0:	29.813	Prepared by	B.Bedford
				Checked by	A.Pettit
Applicable year (if time varying)				Checked date	01/09/2018

	Average waiting time (yrs) between events/frequency per year												Total PV
	2	5	10	25	30	50	75	100	200	500	1000	Infinity	£k
	0.500	0.200	0.100	0.040	0.033	0.020	0.013	0.010	0.005	0.002	0.001	0	
Damage category	Damage £k												
Residential property	0	0	0	-	-	-	-	218	514	848	966	1,083	184
Ind/commercial (direct)	0	0	0	-	-	-	-	-	6	9	11	12	2
Ind/comm (indirect)	0	0	0	-	-	-	-	-	0	0	0	0	0
Traffic related												-	-
Emergency services	0	0	0	-	-	-	-	12	29	48	54	61	10
Other	0	0	0	-	-	-	-	-	-	-	-	-	-
Intangible damages												-	37
												-	-
Total damage £k	0	0	0	-	-	-	-	231	549	906	1,031	1,157	
Area (damagexfrequency)		0	0	-	-	-	-	0	2	2	1	1	

Total area, as above	7	
PV Factor, as above	30	
Present value (assuming no change in damage or event frequency)	196	233

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet

Project: Soonhope Burn FPS **Option: DD - 75yr SoP**



Summary Annual Average Damage

Sheet Nr.

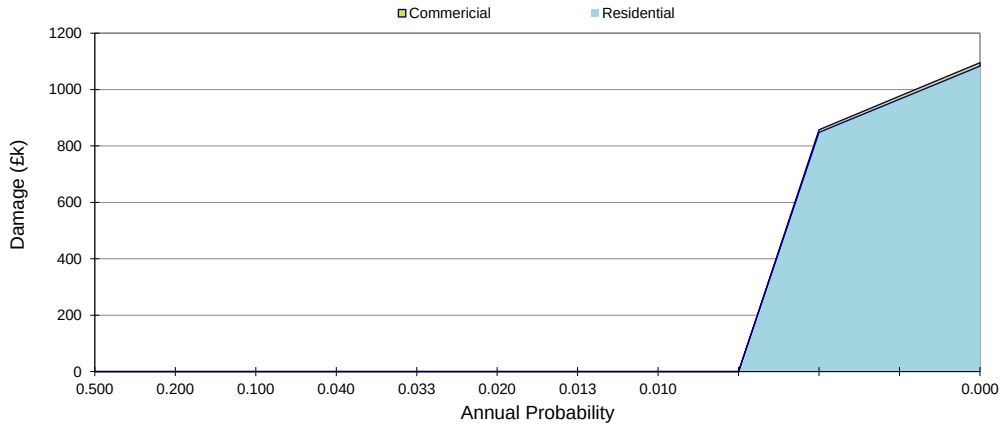
Client/Authority					
Scottish Borders Council					
Project name		**Option:**			
Soonhope Burn FPS		Storage			
Project reference	2017s5526				
Base date for estimates (year 0)	43101	First year of damage:	0	Prepared (date)	23/08/2018
Scaling factor (e.g. £m, £k, £)	£k	Last year of period:	99	Printed	06/12/2018
Discount rate	3.5%	PV factor for mid-year 0:	29.813	Prepared by	B.Bedford
				Checked by	A.Pettit
Applicable year (if time varying)				Checked date	01/09/2018

	Average waiting time (yrs) between events/frequency per year												Total PV
	2	5	10	25	30	50	75	100	200	500	1000	Infinity	£k
	0.500	0.200	0.100	0.040	0.033	0.020	0.013	0.010	0.005	0.002	0.001	0	
Damage category	Damage £k												
Residential property	0	0	0	0	0	0	0	0	0	848	966	1083	96
Ind/commercial (direct)	0	0	0	0	0	0	0	0	0	9	11	12	1
Ind/comm (indirect)	0	0	0	0	0	0	0	0	0	0	0	0	0
Traffic related												0	-
Emergency services	0	0	0	0	0	0	0	0	0	48	54	61	5
Other	0	0	0	0	0	0	0	0	0	0	0	0	-
Intangible damages												0	5
												0	-
Total damage £k	0	0	0	0	0	0	0	0	0	906	1031	1157	
Area (damagexfrequency)		0	0	0	0	0	0	0	0	1	1	1	

Total area, as above	3	
PV Factor, as above	29.813	
Present value (assuming no change in damage or event frequency)	102	107

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet

Project: Soonhope Burn FPS **Option: Storage**



Summary Annual Average Damage

Sheet Nr.

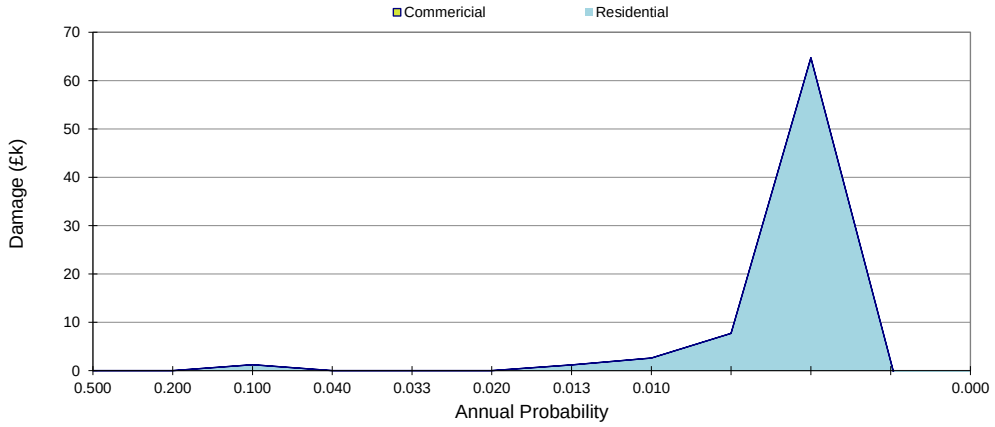
Client/Authority						
Scottish Borders Council						
Project name		**Option:**				
Soonhope Burn FPS		PLP				
Project reference	2017s5526					
Base date for estimates (year 0)	43101	First year of damage:	0	Prepared (date)		23/08/2018
Scaling factor (e.g. £m, £k, £)	£k	Last year of period:	99	Printed		06/12/2018
Discount rate	3.5%	PV factor for mid-year 0:	29.813	Prepared by		B.Bedford
				Checked by		A.Pettit
Applicable year (if time varying)				Checked date		01/09/2018

	Average waiting time (yrs) between events/frequency per year												Total PV
	2	5	10	25	30	50	75	100	200	500	1000	Infinity	£k
	0.500	0.200	0.100	0.040	0.033	0.020	0.013	0.010	0.005	0.002	0.001	0	
Damage category	Damage £k												
Residential property	0	0	1.21	0	0	0	1.18	2.61	7.69	64.73	1.94	-60.86	7
Ind/commercial (direct)	0	0	0	0	0	0	0	0	0	0	0	0	-
Ind/comm (indirect)	0	-	-	-	-	-	-	-	-	-	-	-	-
Traffic related												-	-
Emergency services	0	-	0.07	-	-	-	0.07	0.15	0.43	3.62	0.11	- 3.41	0
Other	0	-	-	-	-	-	-	-	-	-	-	-	-
Intangible damages												-	-
												-	-
Total damage £k	0	-	1.28	-	-	-	1.25	2.75	8.12	68.35	2.04	- 64.26	
Area (damagexfrequency)		0.00	0.06	0.04	0.00	0.00	0.00	0.01	0.03	0.11	0.04	-0.03	

Total area, as above	0.26	
PV Factor, as above	29.813	
Present value (assuming no change in damage or event frequency)	8	8

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet

Project: Soonhope Burn FPS **Option: PLP**



Summary of costs

Client/Authority		Prepared (date)	
Scottish Borders Council		Printed	07/12/2018
Project/Option name		Prepared by	C.Kampanou
Soonhope Burn FPS		Checked by	S.Cooney
Project reference	2017s5526	Checked date	
Base date for estimates (year 0)	Jan-2018		
Scaling factor (e.g. £m, £k, £)	£k		
Optimism bias adjustment factor	60%		

PV Cost Summary	Costs in £k
Enabling Costs	£29.41
Capital Costs	£118.46
O & M Costs	£2.55
Other Costs	£0.00
Total Real Cost	£150.41
Total Cost PV	£144.58
Total Cost PV + OB	**£231.33**

Note: Macros are required to open individual cost modules and the user should ensure they are enabled in the Excel Security Settings.

Note: Cost modules are opened from blank templates by clicking on the pentagons below. If a template exists, the user is sent the module. Only one module per worksheet is permitted.

Note: Costs are automatically summed from all individual cost module sheets every time the user returns to this summary sheet. This process takes into account the above scaling factor.

Note: If multiple measures are used, the optimism bias value used in each module is overridden by that selected above (Cell D10).

Additional user notes:

Add additional user notes here.

FRM Measure	Asset	Open / Go to Costing Sheet	Delete Sheet	Enabling Costs	Capital Costs	O & M Costs	Other Costs	Cash	Total Cost PV
Fluvial raised defence	Embankment								
	Wall			£29.41	£113.11	£2.55	£0.00	£145.06	£139.41
	Sheet Piling								
Channel management	N/A								
Culvert & screen	N/A								
Control assets	Weir								
	Pumping station								
	Flood gate								
	Outfall								
	Flow barrier								
Coastal protection	Wall								
	Revetment								
	Groyne								
	Recharge								
Flood storage	N/A								
Flood warning and forecasting	Various								
Temporary & demountable barriers	Various								
Household resistance	Various								
Household resilience	Various								
SUDS and urban drainage	Various								
Managed realignment	Various								
Habitat creation	Various								
Landuse & runoff management	Various								
River Restoration	Various								
User Defined 1	Various			£0.00	£5.35	£0.00	£0.00	£5.35	£5.17
User Defined 2	Various								
User Defined 3	Various								

Direct Defences - 10 year

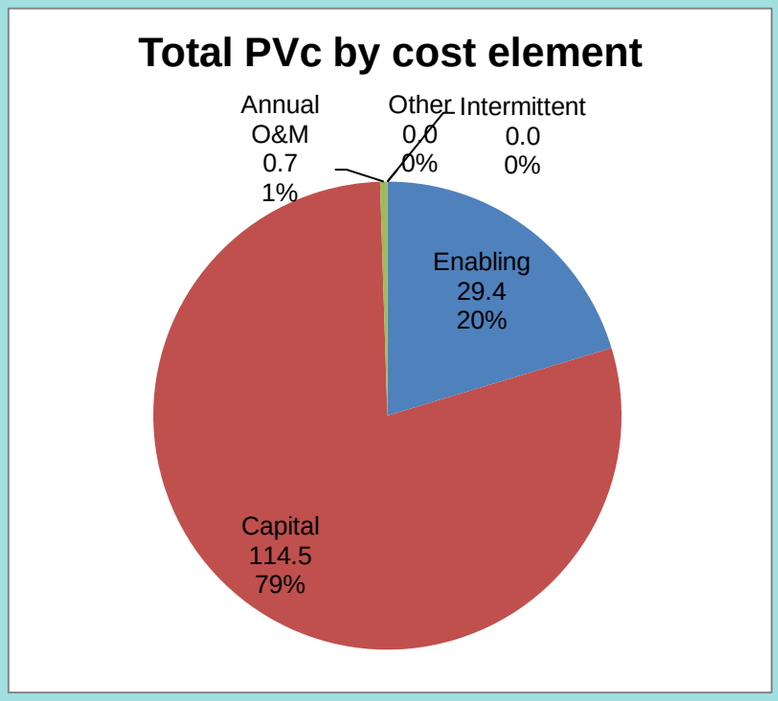
Whole Life and Present Value Cost Analysis		PV factor	29.813				Total PVc (£k):	144.6	
		Enabling £k	Capital £k	Annual O&M £k	Intermittent O&M £k	Other £k	TOTALS: Current price	PV (£k)	
	Total real cost	29.4	118.5	2.5	0.0	0.0	150.41	144.6	
	Total PV cost	29.4	114.5	0.7	0.0	0.0		144.6	
year	Discount Factor								Cumulative PV Costs (£k)
0	1.000	29.4	0.0	0.0	0.0	0.0	29.4	29.4	29.4
1	0.966	0.0	118.5	0.0	0.0	0.0	118.5	114.5	143.9
2	0.934	0.0	0.0	0.0	0.0	0.0	0.0	0.0	143.9
3	0.902	0.0	0.0	0.0	0.0	0.0	0.0	0.0	143.9
4	0.871	0.0	0.0	0.0	0.0	0.0	0.0	0.0	143.9
5	0.842	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.0
6	0.814	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.0
7	0.786	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.0
8	0.759	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.0
9	0.734	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.0
10	0.709	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.1
11	0.685	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.1
12	0.662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.1
13	0.639	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.1
14	0.618	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.1
15	0.597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.1
16	0.577	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.1
17	0.557	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.2
18	0.538	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.2
19	0.520	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.2
20	0.503	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.2
21	0.486	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.2
22	0.469	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.2
23	0.453	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.2
24	0.438	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.3
25	0.423	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.3
26	0.409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.3
27	0.395	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.3
28	0.382	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.3
29	0.369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.3
30	0.356	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.3
31	0.346	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.3
32	0.336	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.3
33	0.326	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.3
34	0.317	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.3
35	0.307	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
36	0.298	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
37	0.290	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
38	0.281	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
39	0.273	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
40	0.265	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
41	0.257	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
42	0.250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
43	0.243	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
44	0.236	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
45	0.229	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
46	0.222	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
47	0.216	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
48	0.209	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
49	0.203	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.4
50	0.197	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
51	0.192	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
52	0.186	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
53	0.181	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
54	0.175	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
55	0.170	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
56	0.165	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
57	0.160	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
58	0.156	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
59	0.151	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
60	0.147	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
61	0.143	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
62	0.138	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
63	0.134	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
64	0.130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
65	0.127	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
66	0.123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
67	0.119	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
68	0.116	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
69	0.112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
70	0.109	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
71	0.106	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
72	0.103	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
73	0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
74	0.097	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
75	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
76	0.092	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
77	0.090	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
78	0.087	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
79	0.085	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.5
80	0.083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
81	0.081	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
82	0.079	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
83	0.077	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
84	0.075	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
85	0.074	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
86	0.072	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
87	0.070	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
88	0.068	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
89	0.067	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
90	0.065	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6

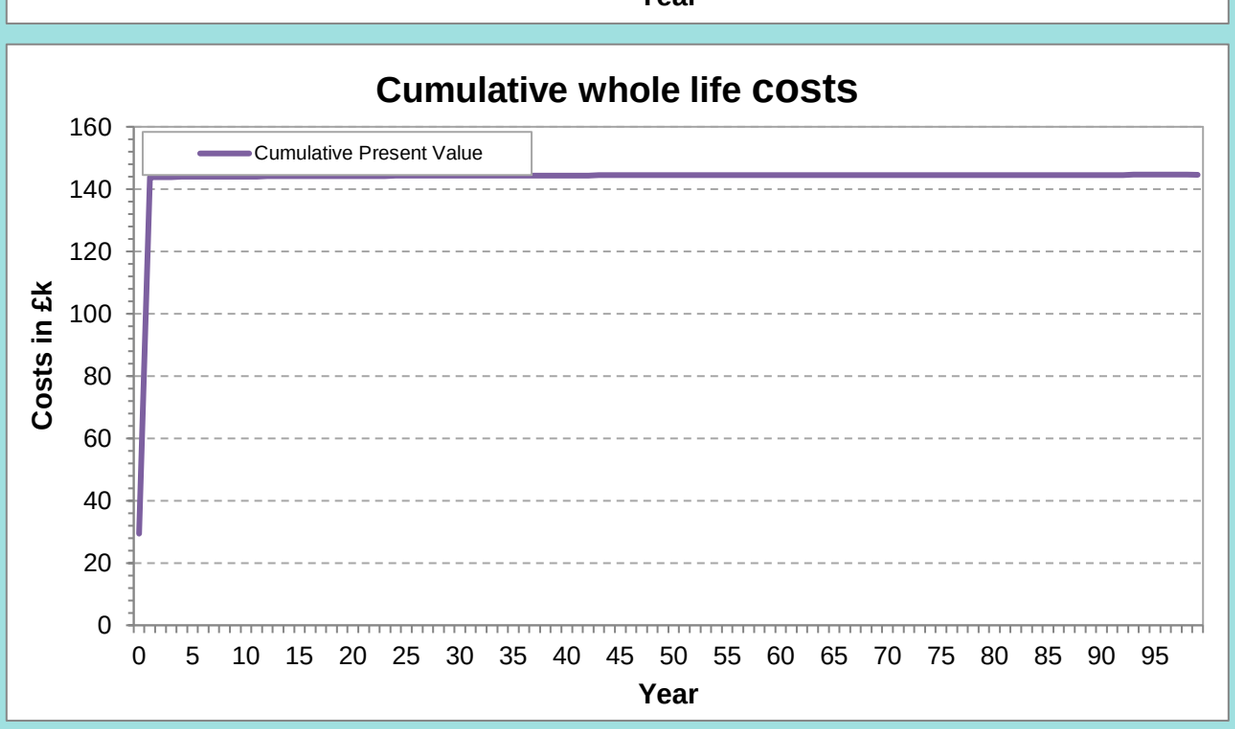
Direct Defences - 10 year

91	0.063	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
92	0.062	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
93	0.060	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
94	0.059	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
95	0.057	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
96	0.056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
97	0.055	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
98	0.053	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6
99	0.052	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6

Direct Defences - 10 year

Whole life cost charts





Summary of costs

Client/Authority		Prepared (date)	
Scottish Borders Council		Printed	07/12/2018
Project/Option name		Prepared by	C.Kampanou
Soonhope Burn FPS		Checked by	S.Cooney
Project reference	2017s5526	Checked date	
Base date for estimates (year 0)	Jan-2018		
Scaling factor (e.g. £m, £k, £)	£k		
Optimism bias adjustment factor	60%		

PV Cost Summary	Costs in £k
Enabling Costs	£220.55
Capital Costs	£864.96
O & M Costs	£7.96
Other Costs	£0.00
Total Real Cost	£1,093.47
Total Cost PV	£1,058.52
Total Cost PV + OB	**£1,693.64**

Note: Macros are required to open individual cost modules and the user should ensure they are enabled in the Excel Security Settings.

Note: Cost modules are opened from blank templates by clicking on the pentagons below. If a template exists, the user is sent the module. Only one module per worksheet is permitted.

Note: Costs are automatically summed from all individual cost module sheets every time the user returns to this summary sheet. This process takes into account the above scaling factor.

Note: If multiple measures are used, the optimism bias value used in each module is overridden by that selected above (Cell D10).

Additional user notes:

Add additional user notes here.

FRM Measure	Asset	Open / Go to Costing Sheet	Delete Sheet	Enabling Costs	Capital Costs	O & M Costs	Other Costs	Total Cost Cash	Total Cost PV
Fluvial raised defence	Embankment								
	Wall			£220.55	£848.27	£7.96	£0.00	£1,076.77	£1,042.39
	Sheet Piling								
Channel management	N/A								
Culvert & screen	N/A								
Control assets	Weir								
	Pumping station								
	Flood gate								
	Outfall								
	Flow barrier								
Coastal protection	Wall								
	Revetment								
	Groyne								
	Recharge								
Flood storage	N/A								
Flood warning and forecasting	Various								
Temporary & demountable barriers	Various								
Household resistance	Various								
Household resilience	Various								
SUDS and urban drainage	Various								
Managed realignment	Various								
Habitat creation	Various								
Landuse & runoff management	Various								
River Restoration	Various								
User Defined 1	Various			£0.00	£16.69	£0.00	£0.00	£16.69	£16.13
User Defined 2	Various								
User Defined 3	Various								

Direct Defences - 75 year

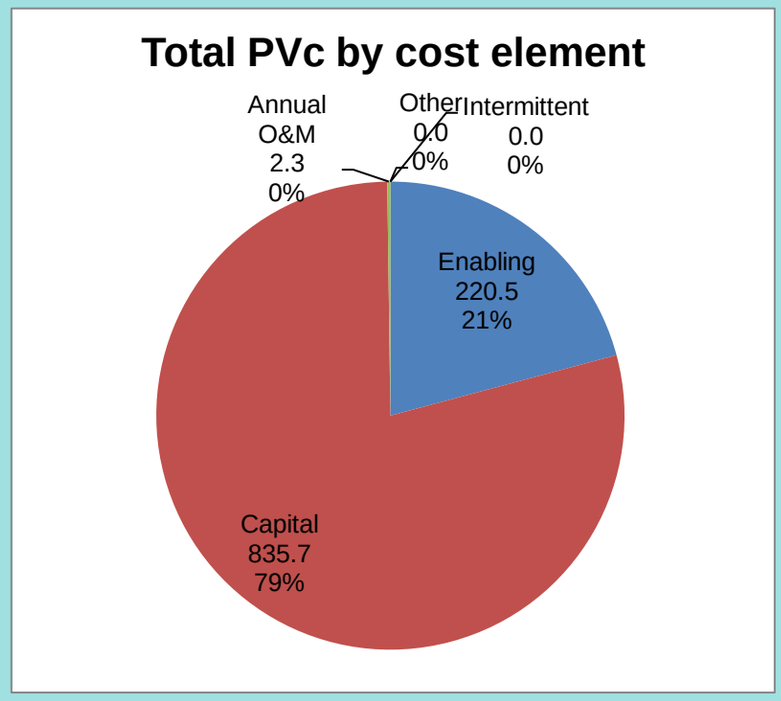
Whole Life and Present Value Cost Analysis		PV factor	29.813				Total PVc (£k):	1058.5	
		Enabling £k	Capital £k	Annual O&M £k	Intermittent O&M £k	Other £k	TOTALS: Current price	PV (£k)	
	Total real cost	220.5	865.0	8.0	0.0	0.0	1093.47	1058.5	
	Total PV cost	220.5	835.7	2.3	0.0	0.0		1058.5	
year	Discount Factor								Cumulative PV Costs (£k)
0	1.000	220.5	0.0	0.0	0.0	0.0	220.5	220.5	220.5
1	0.966	0.0	865.0	0.0	0.0	0.0	865.0	835.7	1056.3
2	0.934	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1056.3
3	0.902	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1056.4
4	0.871	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1056.5
5	0.842	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1056.5
6	0.814	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1056.6
7	0.786	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1056.7
8	0.759	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1056.7
9	0.734	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1056.8
10	0.709	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1056.9
11	0.685	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1056.9
12	0.662	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1057.0
13	0.639	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1057.0
14	0.618	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1057.1
15	0.597	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.1
16	0.577	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.2
17	0.557	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.2
18	0.538	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.3
19	0.520	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.3
20	0.503	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.3
21	0.486	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.4
22	0.469	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.4
23	0.453	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.5
24	0.438	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.5
25	0.423	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.5
26	0.409	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.6
27	0.395	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.6
28	0.382	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.6
29	0.369	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.6
30	0.356	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.7
31	0.346	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.7
32	0.336	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.7
33	0.326	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.8
34	0.317	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.8
35	0.307	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.8
36	0.298	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.8
37	0.290	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.9
38	0.281	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.9
39	0.273	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.9
40	0.265	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.9
41	0.257	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1057.9
42	0.250	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.0
43	0.243	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.0
44	0.236	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.0
45	0.229	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.0
46	0.222	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.0
47	0.216	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.1
48	0.209	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.1
49	0.203	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.1
50	0.197	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.1
51	0.192	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.1
52	0.186	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.1
53	0.181	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.2
54	0.175	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.2
55	0.170	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.2
56	0.165	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.2
57	0.160	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.2
58	0.156	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.2
59	0.151	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.2
60	0.147	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.2
61	0.143	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.3
62	0.138	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.3
63	0.134	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.3
64	0.130	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.3
65	0.127	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.3
66	0.123	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.3
67	0.119	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.3
68	0.116	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.3
69	0.112	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.3
70	0.109	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.3
71	0.106	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
72	0.103	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
73	0.100	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
74	0.097	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
75	0.094	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
76	0.092	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
77	0.090	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
78	0.087	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
79	0.085	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
80	0.083	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
81	0.081	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
82	0.079	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
83	0.077	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
84	0.075	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.4
85	0.074	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
86	0.072	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
87	0.070	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
88	0.068	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
89	0.067	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
90	0.065	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5

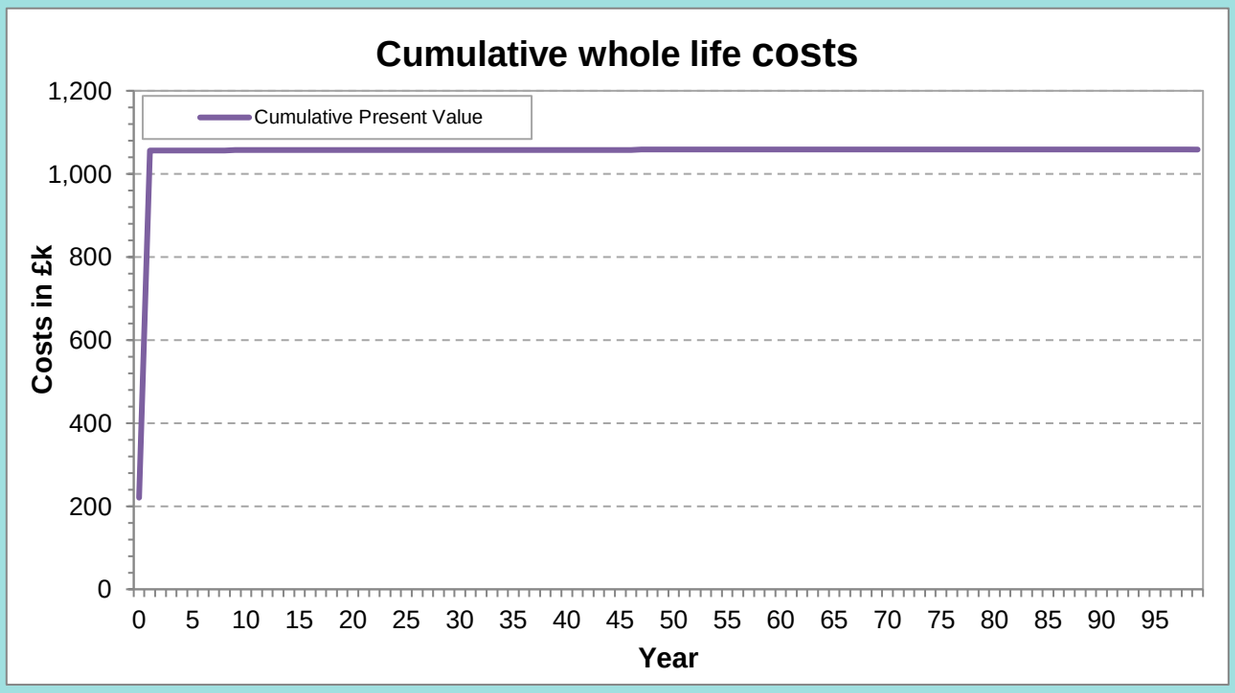
Direct Defences - 75 year

91	0.063	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
92	0.062	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
93	0.060	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
94	0.059	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
95	0.057	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
96	0.056	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
97	0.055	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
98	0.053	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5
99	0.052	0.0	0.0	0.1	0.0	0.0	0.1	0.0	1058.5

Direct Defences - 75 year

Whole life cost charts





Summary of costs

Client/Authority		Prepared (date)	
Scottish Borders Council		Printed	07/12/2018
Project/Option name		Prepared by	C.Kampanou
Soonhope Burn FPS		Checked by	S.Cooney
Project reference	2017s5526	Checked date	
Base date for estimates (year 0)	Jan-2018		
Scaling factor (e.g. £m, £k, £)	£k		
Optimism bias adjustment factor	60%		

PV Cost Summary	Costs in £k
Enabling Costs	£223.10
Capital Costs	£3,484.05
O & M Costs	£2,161.16
Other Costs	£0.00
Total Real Cost	£5,868.31
Total Cost PV	£4,203.41
Total Cost PV + OB	**£6,725.46**

Note: Macros are required to open individual cost modules and the user should ensure they are enabled in the Excel Security Settings.

Note: Cost modules are opened from blank templates by clicking on the pentagons below. If a template exists, the user is sent the module. Only one module per worksheet is permitted.

Note: Costs are automatically summed from all individual cost module sheets every time the user returns to this summary sheet. This process takes into account the above scaling factor.

Note: If multiple measures are used, the optimism bias value used in each module is overridden by that selected above (Cell D10).

Additional user notes:

Add additional user notes here.

FRM Measure	Asset	Open / Go to Costing Sheet	Delete Sheet	Enabling Costs	Capital Costs	O & M Costs	Other Costs	Total Cost Cash	Total Cost PV
Fluvial raised defence	Embankment			£0.00	£952.72	£49.53	£0.00	£1,002.25	£934.57
	Wall			£29.41	£113.11	£2.55	£0.00	£145.06	£139.41
	Sheet Piling								
Channel management	N/A								
Culvert & screen	N/A								
Control assets	Weir								
	Pumping station								
	Flood gate								
	Outfall								
	Flow barrier								
Coastal protection	Wall								
	Revetment								
	Groyne								
	Recharge								
Flood storage	N/A			£193.69	£2,152.12	£2,109.08	£0.00	£4,454.89	£2,872.32
Flood warning and forecasting	Various								
Temporary & demountable barriers	Various								
Household resistance	Various								
Household resilience	Various								
SUDS and urban drainage	Various								
Managed realignment	Various								
Habitat creation	Various								
Landuse & runoff management	Various								
River Restoration	Various								
User Defined 1	Various			£0.00	£266.11	£0.00	£0.00	£266.11	£257.11
User Defined 2	Various								
User Defined 3	Various								

Storage and Direct Defences - 200 year

Whole Life and Present Value Cost Analysis

PV factor	29.813

Total PVc (£k):	4203.4

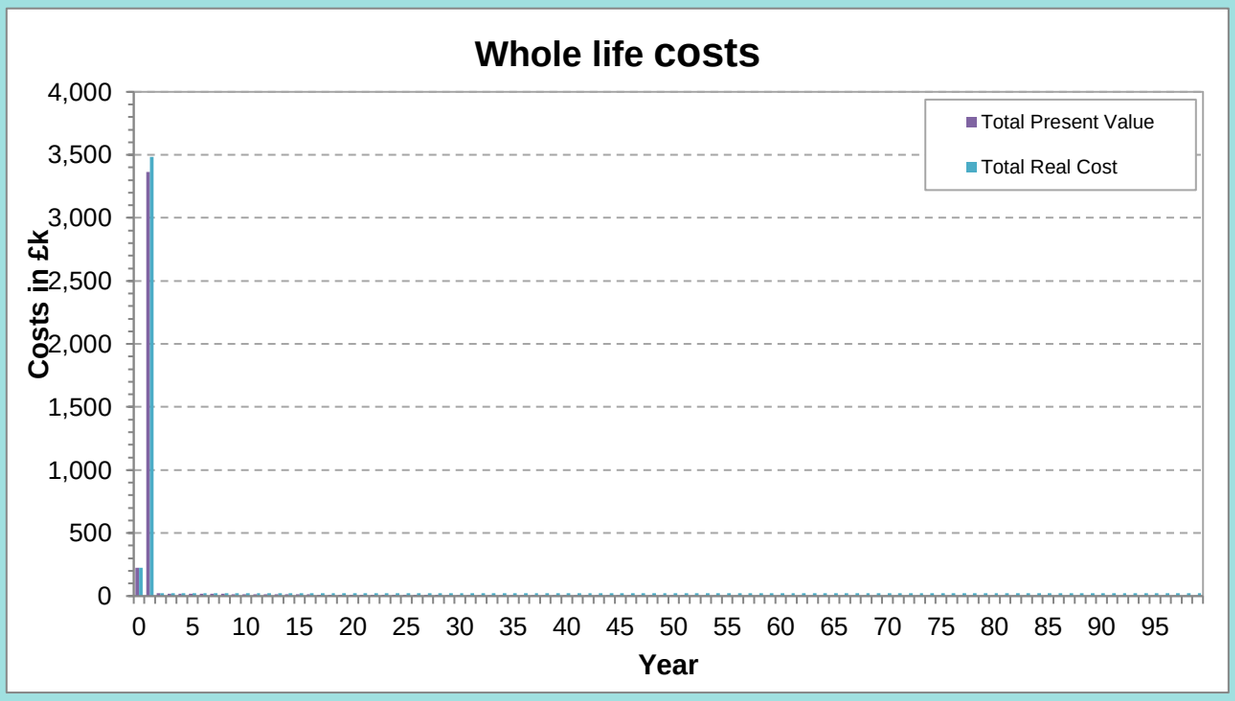
		Enabling £k	Capital £k	Annual O&M £k	Intermittent O&M £k	Other £k	TOTALS: Current price	PV (£k)	
	Total real cost	223.1	3484.0	2161.2	0.0	0.0	5868.31	**4203.4**	
	Total PV cost	223.1	3366.2	614.1	0.0	0.0		**4203.4**	
year	**Discount Factor**								**Cumulative PV Costs (£k)**
0	1.000	223.1	0.0	0.0	0.0	0.0	223.1	223.1	223.1
1	0.966	0.0	3484.0	0.0	0.0	0.0	3484.0	3366.2	3589.3
2	0.934	0.0	0.0	22.1	0.0	0.0	22.1	20.6	3609.9
3	0.902	0.0	0.0	22.1	0.0	0.0	22.1	19.9	3629.8
4	0.871	0.0	0.0	22.1	0.0	0.0	22.1	19.2	3649.0
5	0.842	0.0	0.0	22.1	0.0	0.0	22.1	18.6	3667.6
6	0.814	0.0	0.0	22.1	0.0	0.0	22.1	17.9	3685.5
7	0.786	0.0	0.0	22.1	0.0	0.0	22.1	17.3	3702.9
8	0.759	0.0	0.0	22.1	0.0	0.0	22.1	16.7	3719.6
9	0.734	0.0	0.0	22.1	0.0	0.0	22.1	16.2	3735.8
10	0.709	0.0	0.0	22.1	0.0	0.0	22.1	15.6	3751.4
11	0.685	0.0	0.0	22.1	0.0	0.0	22.1	15.1	3766.5
12	0.662	0.0	0.0	22.1	0.0	0.0	22.1	14.6	3781.1
13	0.639	0.0	0.0	22.1	0.0	0.0	22.1	14.1	3795.2
14	0.618	0.0	0.0	22.1	0.0	0.0	22.1	13.6	3808.8
15	0.597	0.0	0.0	22.1	0.0	0.0	22.1	13.2	3822.0
16	0.577	0.0	0.0	22.1	0.0	0.0	22.1	12.7	3834.7
17	0.557	0.0	0.0	22.1	0.0	0.0	22.1	12.3	3847.0
18	0.538	0.0	0.0	22.1	0.0	0.0	22.1	11.9	3858.9
19	0.520	0.0	0.0	22.1	0.0	0.0	22.1	11.5	3870.4
20	0.503	0.0	0.0	22.1	0.0	0.0	22.1	11.1	3881.4
21	0.486	0.0	0.0	22.1	0.0	0.0	22.1	10.7	3892.1
22	0.469	0.0	0.0	22.1	0.0	0.0	22.1	10.3	3902.5
23	0.453	0.0	0.0	22.1	0.0	0.0	22.1	10.0	3912.5
24	0.438	0.0	0.0	22.1	0.0	0.0	22.1	9.7	3922.2
25	0.423	0.0	0.0	22.1	0.0	0.0	22.1	9.3	3931.5
26	0.409	0.0	0.0	22.1	0.0	0.0	22.1	9.0	3940.5
27	0.395	0.0	0.0	22.1	0.0	0.0	22.1	8.7	3949.2
28	0.382	0.0	0.0	22.1	0.0	0.0	22.1	8.4	3957.6
29	0.369	0.0	0.0	22.1	0.0	0.0	22.1	8.1	3965.8
30	0.356	0.0	0.0	22.1	0.0	0.0	22.1	7.9	3973.6
31	0.346	0.0	0.0	22.1	0.0	0.0	22.1	7.6	3981.2
32	0.336	0.0	0.0	22.1	0.0	0.0	22.1	7.4	3988.6
33	0.326	0.0	0.0	22.1	0.0	0.0	22.1	7.2	3995.8
34	0.317	0.0	0.0	22.1	0.0	0.0	22.1	7.0	4002.8
35	0.307	0.0	0.0	22.1	0.0	0.0	22.1	6.8	4009.6
36	0.298	0.0	0.0	22.1	0.0	0.0	22.1	6.6	4016.2
37	0.290	0.0	0.0	22.1	0.0	0.0	22.1	6.4	4022.6
38	0.281	0.0	0.0	22.1	0.0	0.0	22.1	6.2	4028.8
39	0.273	0.0	0.0	22.1	0.0	0.0	22.1	6.0	4034.8
40	0.265	0.0	0.0	22.1	0.0	0.0	22.1	5.8	4040.6
41	0.257	0.0	0.0	22.1	0.0	0.0	22.1	5.7	4046.3
42	0.250	0.0	0.0	22.1	0.0	0.0	22.1	5.5	4051.8
43	0.243	0.0	0.0	22.1	0.0	0.0	22.1	5.4	4057.2
44	0.236	0.0	0.0	22.1	0.0	0.0	22.1	5.2	4062.4
45	0.229	0.0	0.0	22.1	0.0	0.0	22.1	5.0	4067.4
46	0.222	0.0	0.0	22.1	0.0	0.0	22.1	4.9	4072.3
47	0.216	0.0	0.0	22.1	0.0	0.0	22.1	4.8	4077.1
48	0.209	0.0	0.0	22.1	0.0	0.0	22.1	4.6	4081.7
49	0.203	0.0	0.0	22.1	0.0	0.0	22.1	4.5	4086.2
50	0.197	0.0	0.0	22.1	0.0	0.0	22.1	4.4	4090.5
51	0.192	0.0	0.0	22.1	0.0	0.0	22.1	4.2	4094.7
52	0.186	0.0	0.0	22.1	0.0	0.0	22.1	4.1	4098.8
53	0.181	0.0	0.0	22.1	0.0	0.0	22.1	4.0	4102.8
54	0.175	0.0	0.0	22.1	0.0	0.0	22.1	3.9	4106.7
55	0.170	0.0	0.0	22.1	0.0	0.0	22.1	3.8	4110.4
56	0.165	0.0	0.0	22.1	0.0	0.0	22.1	3.6	4114.1
57	0.160	0.0	0.0	22.1	0.0	0.0	22.1	3.5	4117.6
58	0.156	0.0	0.0	22.1	0.0	0.0	22.1	3.4	4121.0
59	0.151	0.0	0.0	22.1	0.0	0.0	22.1	3.3	4124.4
60	0.147	0.0	0.0	22.1	0.0	0.0	22.1	3.2	4127.6
61	0.143	0.0	0.0	22.1	0.0	0.0	22.1	3.1	4130.8
62	0.138	0.0	0.0	22.1	0.0	0.0	22.1	3.1	4133.8
63	0.134	0.0	0.0	22.1	0.0	0.0	22.1	3.0	4136.8
64	0.130	0.0	0.0	22.1	0.0	0.0	22.1	2.9	4139.6
65	0.127	0.0	0.0	22.1	0.0	0.0	22.1	2.8	4142.4
66	0.123	0.0	0.0	22.1	0.0	0.0	22.1	2.7	4145.1
67	0.119	0.0	0.0	22.1	0.0	0.0	22.1	2.6	4147.8
68	0.116	0.0	0.0	22.1	0.0	0.0	22.1	2.6	4150.3
69	0.112	0.0	0.0	22.1	0.0	0.0	22.1	2.5	4152.8
70	0.109	0.0	0.0	22.1	0.0	0.0	22.1	2.4	4155.2
71	0.106	0.0	0.0	22.1	0.0	0.0	22.1	2.3	4157.6
72	0.103	0.0	0.0	22.1	0.0	0.0	22.1	2.3	4159.8
73	0.100	0.0	0.0	22.1	0.0	0.0	22.1	2.2	4162.0
74	0.097	0.0	0.0	22.1	0.0	0.0	22.1	2.1	4164.2
75	0.094	0.0	0.0	22.1	0.0	0.0	22.1	2.1	4166.3
76	0.092	0.0	0.0	22.1	0.0	0.0	22.1	2.0	4168.3
77	0.090	0.0	0.0	22.1	0.0	0.0	22.1	2.0	4170.3
78	0.087	0.0	0.0	22.1	0.0	0.0	22.1	1.9	4172.2
79	0.085	0.0	0.0	22.1	0.0	0.0	22.1	1.9	4174.1
80	0.083	0.0	0.0	22.1	0.0	0.0	22.1	1.8	4175.9
81	0.081	0.0	0.0	22.1	0.0	0.0	22.1	1.8	4177.7
82	0.079	0.0	0.0	22.1	0.0	0.0	22.1	1.7	4179.4
83	0.077	0.0	0.0	22.1	0.0	0.0	22.1	1.7	4181.2
84	0.075	0.0	0.0	22.1	0.0	0.0	22.1	1.7	4182.8
85	0.074	0.0	0.0	22.1	0.0	0.0	22.1	1.6	4184.4
86	0.072	0.0	0.0	22.1	0.0	0.0	22.1	1.6	4186.0
87	0.070	0.0	0.0	22.1	0.0	0.0	22.1	1.5	4187.6
88	0.068	0.0	0.0	22.1	0.0	0.0	22.1	1.5	4189.1
89	0.067	0.0	0.0	22.1	0.0	0.0	22.1	1.5	4190.5
90	0.065	0.0	0.0	22.1	0.0	0.0	22.1	1.4	4192.0

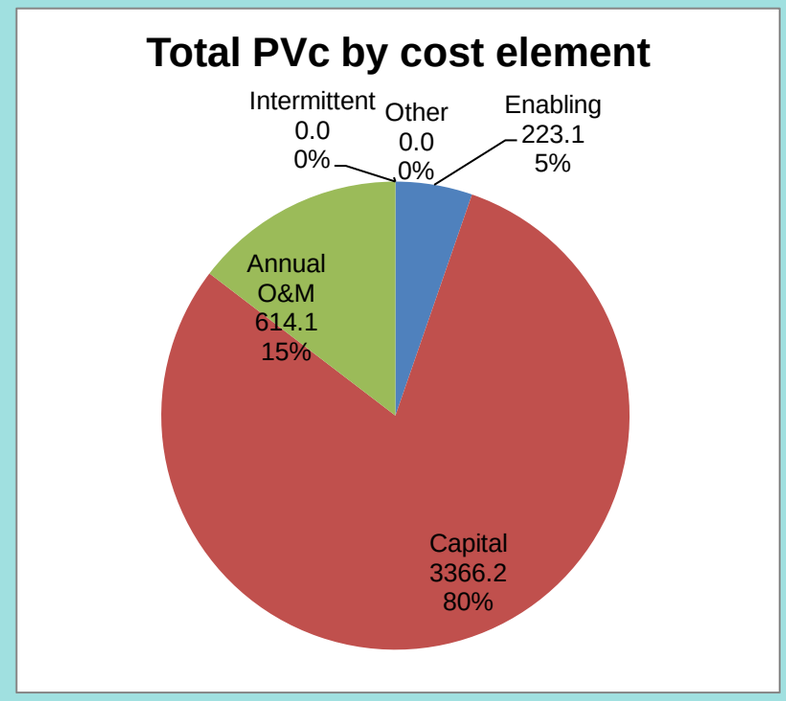
Storage and Direct Defences - 200 year

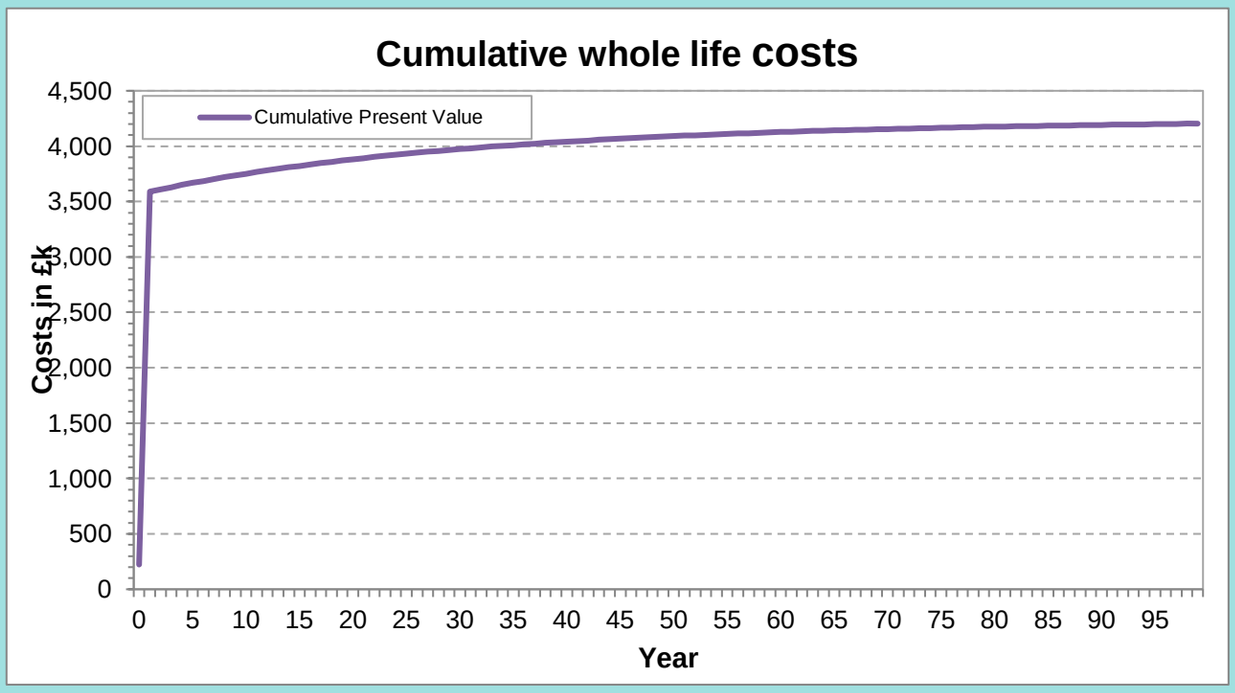
91	0.063	0.0	0.0	22.1	0.0	0.0	22.1	1.4	4193.4
92	0.062	0.0	0.0	22.1	0.0	0.0	22.1	1.4	4194.7
93	0.060	0.0	0.0	22.1	0.0	0.0	22.1	1.3	4196.1
94	0.059	0.0	0.0	22.1	0.0	0.0	22.1	1.3	4197.4
95	0.057	0.0	0.0	22.1	0.0	0.0	22.1	1.3	4198.6
96	0.056	0.0	0.0	22.1	0.0	0.0	22.1	1.2	4199.9
97	0.055	0.0	0.0	22.1	0.0	0.0	22.1	1.2	4201.1
98	0.053	0.0	0.0	22.1	0.0	0.0	22.1	1.2	4202.3
99	0.052	0.0	0.0	22.1	0.0	0.0	22.1	1.1	4203.4

Storage and Direct Defences - 200 year

Whole life cost charts







Whole life cost and PVc analysis example - with replacement costs

Enter enabling, capital, annual O&M and other costs in table below
Enter frequency of other (or replacement) works in table below

Enabling cost (£k)	£17.8
Year of capital works (year)	1
Capital cost (£k)	£111.6
Annual maintenance cost (£k)	£2.2
Other cost (£k)	£0.0
Other works frequency (years)	1
Other cost (£k)	£0.0
Other works frequency (years)	1
Replacement (£)	111.595
Replacement frequency (years)	25
Optimism Bias	60%

Key	
	Information
	Calculation
	Cost input
	Default

Total PVc (£k) with Optimism Bias: 424

Initial discount rate 3.5% 29.813 **Total PVc (£k): 265**

		Cost Elements				PV			TOTALS:	
		Enabling	Capital	Maint.	Interm.	Enabling	Capital	Maint.	Cash	PV
	Cash sum	18	446	219	0	18	185	62	683	265
year	Discount Factor									
0	1.000	17.8			0	17.76			17.8	17.8
1	0.966		112		0		107.8213		111.6	107.8
2	0.934			2	0			2.083503	2.2	2.1
3	0.902			2	0			2.013046	2.2	2.0
4	0.871			2	0			1.944972	2.2	1.9
5	0.842			2	0			1.8792	2.2	1.9
6	0.814			2	0			1.815652	2.2	1.8
7	0.786			2	0			1.754253	2.2	1.8
8	0.759			2	0			1.694931	2.2	1.7
9	0.734			2	0			1.637614	2.2	1.6
10	0.709			2	0			1.582236	2.2	1.6
11	0.685			2	0			1.52873	2.2	1.5
12	0.662			2	0			1.477034	2.2	1.5
13	0.639			2	0			1.427086	2.2	1.4
14	0.618			2	0			1.378827	2.2	1.4
15	0.597			2	0			1.3322	2.2	1.3
16	0.577			2	0			1.28715	2.2	1.3
17	0.557			2	0			1.243623	2.2	1.2
18	0.538			2	0			1.201568	2.2	1.2
19	0.520			2	0			1.160935	2.2	1.2
20	0.503			2	0			1.121677	2.2	1.1
21	0.486			2	0			1.083746	2.2	1.1
22	0.469			2	0			1.047097	2.2	1.0
23	0.453			2	0			1.011688	2.2	1.0
24	0.438			2	0			0.977477	2.2	1.0
25	0.423			2	0			0.944422	2.2	0.9
26	0.409		112	2	0		45.62424	0.912485	113.8	46.5
27	0.395			2	0			0.881628	2.2	0.9
28	0.382			2	0			0.851814	2.2	0.9
29	0.369			2	0			0.823009	2.2	0.8
30	0.356			2	0			0.795178	2.2	0.8
31	0.346			2	0			0.772017	2.2	0.8
32	0.336			2	0			0.749531	2.2	0.7
33	0.326			2	0			0.7277	2.2	0.7
34	0.317			2	0			0.706505	2.2	0.7
35	0.307			2	0			0.685927	2.2	0.7
36	0.298			2	0			0.665949	2.2	0.7
37	0.290			2	0			0.646552	2.2	0.6
38	0.281			2	0			0.627721	2.2	0.6
39	0.273			2	0			0.609438	2.2	0.6
40	0.265			2	0			0.591687	2.2	0.6
41	0.257			2	0			0.574453	2.2	0.6
42	0.250			2	0			0.557722	2.2	0.6
43	0.243			2	0			0.541477	2.2	0.5

44	0.236			2	0		0.525706	2.2	0.5
45	0.229			2	0		0.510394	2.2	0.5
46	0.222			2	0		0.495529	2.2	0.5
47	0.216			2	0		0.481096	2.2	0.5
48	0.209			2	0		0.467083	2.2	0.5
49	0.203			2	0		0.453479	2.2	0.5
50	0.197			2	0		0.440271	2.2	0.4
51	0.192		112	2	0	21.37236	0.427447	113.8	21.8
52	0.186			2	0		0.414997	2.2	0.4
53	0.181			2	0		0.40291	2.2	0.4
54	0.175			2	0		0.391175	2.2	0.4
55	0.170			2	0		0.379781	2.2	0.4
56	0.165			2	0		0.36872	2.2	0.4
57	0.160			2	0		0.35798	2.2	0.4
58	0.156			2	0		0.347554	2.2	0.3
59	0.151			2	0		0.337431	2.2	0.3
60	0.147			2	0		0.327603	2.2	0.3
61	0.143			2	0		0.318061	2.2	0.3
62	0.138			2	0		0.308797	2.2	0.3
63	0.134			2	0		0.299803	2.2	0.3
64	0.130			2	0		0.291071	2.2	0.3
65	0.127			2	0		0.282593	2.2	0.3
66	0.123			2	0		0.274362	2.2	0.3
67	0.119			2	0		0.266371	2.2	0.3
68	0.116			2	0		0.258613	2.2	0.3
69	0.112			2	0		0.25108	2.2	0.3
70	0.109			2	0		0.243767	2.2	0.2
71	0.106			2	0		0.236667	2.2	0.2
72	0.103			2	0		0.229774	2.2	0.2
73	0.100			2	0		0.223082	2.2	0.2
74	0.097			2	0		0.216584	2.2	0.2
75	0.094			2	0		0.210276	2.2	0.2
76	0.092		112	2	0	10.25735	0.205147	113.8	10.5
77	0.090			2	0		0.200143	2.2	0.2
78	0.087			2	0		0.195262	2.2	0.2
79	0.085			2	0		0.190499	2.2	0.2
80	0.083			2	0		0.185853	2.2	0.2
81	0.081			2	0		0.18132	2.2	0.2
82	0.079			2	0		0.176898	2.2	0.2
83	0.077			2	0		0.172583	2.2	0.2
84	0.075			2	0		0.168374	2.2	0.2
85	0.074			2	0		0.164267	2.2	0.2
86	0.072			2	0		0.160261	2.2	0.2
87	0.070			2	0		0.156352	2.2	0.2
88	0.068			2	0		0.152538	2.2	0.2
89	0.067			2	0		0.148818	2.2	0.1
90	0.065			2	0		0.145188	2.2	0.1
91	0.063			2	0		0.141647	2.2	0.1
92	0.062			2	0		0.138192	2.2	0.1
93	0.060			2	0		0.134822	2.2	0.1
94	0.059			2	0		0.131533	2.2	0.1
95	0.057			2	0		0.128325	2.2	0.1
96	0.056			2	0		0.125195	2.2	0.1
97	0.055			2	0		0.122142	2.2	0.1
98	0.053			2	0		0.119163	2.2	0.1
99	0.052			2	0		0	2.2	0.1

C Appendix C - Public Consultation Questionnaire

Peebles Flood Questionnaire Report

Purpose

In order to gain an insight into the reaction of the public to proposed flood protection schemes, a questionnaire was available to be filled in at the Peebles Flood Study Exhibition on 6th November 2018. Local knowledge and feedback is key to influencing decisions on flood protection schemes and out of 56 people who attended the exhibition, 17 questionnaire responses were received (30%).

Questionnaire Format

The anonymous questionnaires that were available to the local public of Peebles consisted of 10 questions which could be circled 'yes' or 'no' and also included a comments box to elaborate on each answer. This simple layout allowed the questionnaires to be filled in quickly while still giving the option to voice opinions and feedback in greater detail. Below are all the questions which were on the questionnaire sheet:

1. Please name the watercourse(s) which impacts upon you?
2. Have you previously experiences flooding?
3. Do you want to see a flood protection scheme in the site of interest?
4. Do you approve of the approach that we are taking in developing a Flood Protection Scheme in your community?
5. Are there any flood related issues that you feel that we have missed?
6. Do you use the river for recreational purposes?
7. Do you have any concerns about how the flood mitigation options proposed may affect recreation activities at the river?
8. Currently are there any access issues to the existing river infrastructure, including issues which effect individuals with a disability?
9. Are you particularly concerned with any of the proposed options?
10. Do you have any other issues that you would like to raise?

Questionnaire Analysis

****Council responses within red*

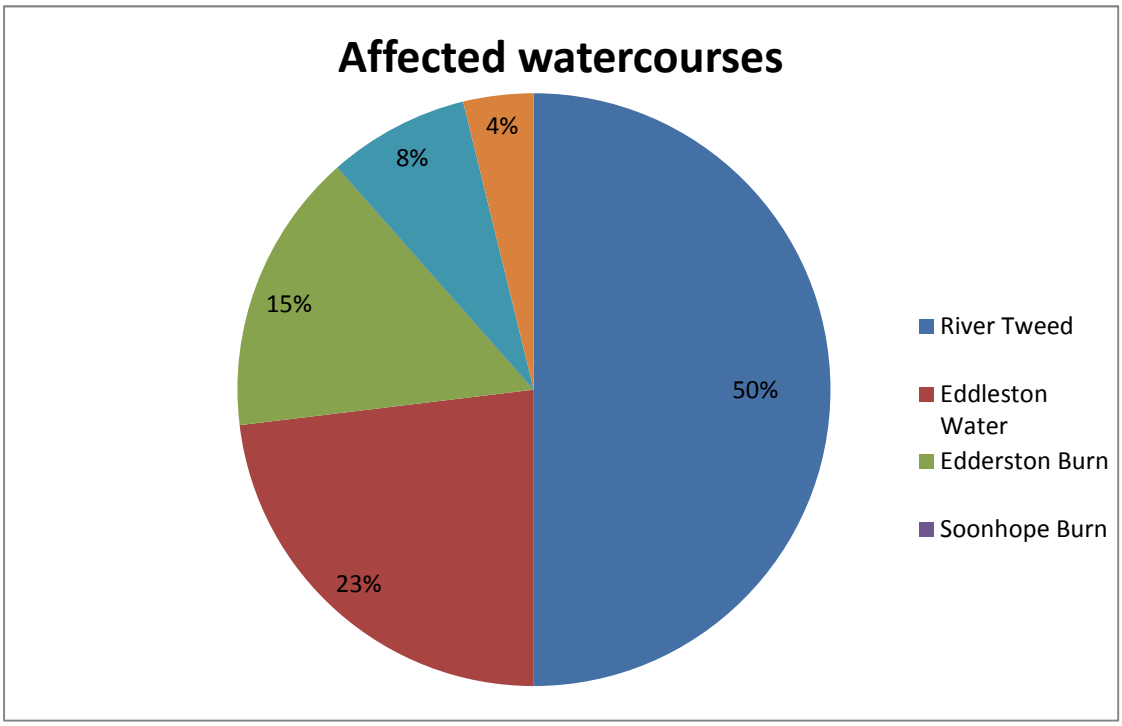
Question 1

Please circle the watercourse/s which impact upon you?

In Peebles there are five main water courses which are of concern and may impact upon different people depending on where they live in the town. The watercourses that were available to circle on the questionnaire were **the River Tweed, Eddleston Water, Edderston Burn, Soonhope Burn and Haystoun Burn**. There was also an 'N/A' option to circle if you were not affected by any of these or would rather not say. Some residents who may have been affected by a few different watercourses circled multiple answers which are reflected in the table below.

Affected watercourse	Number of people affected
River Tweed	13
Eddleston Water	6
Edderston Burn	4
Soonhope Burn	0
Haystoun Burn	2
N/A or unspecified	1

As shown from the data collected, the members of the public who took part in the questionnaire were mostly affected by the River Tweed & Eddleston Water watercourses.



Question 2

Have you previously experienced flooding?

Out of the 17 participants, 11 answered yes to this question and the remaining 6 answered 'No'. Of those who answered 'Yes' there were a variety of comments, mostly explaining what date they experienced the flooding. The majority of comments related to the devastating floods of December 2015, one resident noted "major impact" describing the effect of the flooding in their home in Peebles. A few participants noted that they were evacuated and some had witnessed flooding but not in their homes.

Question 3

Do you want to see a flood protection scheme in the site of interest?

15 people answered yes to this question, indicating that there is a strong desire to have a flood protection scheme in Peebles. 1 person answered no but stated "I realise it is required". The 1 participant who did not circle an answer stated that they were "undecided". Most made comments regarding wanting a protection scheme in order to protect their homes after previously being flooded, examples of which are below;

- *"The exhibition suggested that a proposed scheme was very cost effective. Flooding is devastating for those involved. We all pay a price (e.g. through insurance)".*
- *"To prevent further flooding of our residence."*
- *"Most definitely. Need to reduce risk of this happening again."*
- *"To prevent flooding of properties."*
- *I don't want our house/street to be flooded again - we were affected for 2 years afterward.*

One participant expressed their opinion on what type of scheme they would like making it clear that they would not like a wall to be built and that they would like Natural flood Management (NFM) to be used instead.

- *"It depends, Natural flood management yes, walls etc. no."*

Question 4

Do you approve of the approach that we are taking in developing a Flood Protection Scheme in your community?

14 out of the 17 Participants answered yes to this question and 3 left it unanswered but provided additional details which support why they chose not to answer. Those who answered yes supported their answers with positive comments welcoming the approach that is being taken towards the development of a flood scheme:

- *"Great consultation information and friendly staff to explain info at the event."*
- *"Tweed Green, Tweed Avenue and Walkershaugh were badly affected by the flood in 2015 and the scheme is very much addressing this."*
- *"To protect my home. Any flood reduction would be appreciated. Older folk find it hard to use normal property protection measures. Not everyone can afford them."*
- *"Seems to be very comprehensive."*

The participants who left the question unanswered were concerned about the visual effect of the proposed flood schemes and some believed the flooding is caused by poor land management:

- *"Too much emphasis on structural 'solutions' in town, the main problem is the catchments are terribly managed by landowners / farmers. Tax payers are basically subsiding poor land management. We are paying to create more floods."*
  - *A long list of solutions was drawn up and non-feasible options were withdrawn from the process, allowing us to create a short list of options, with a preferred option. In this instance, there is no feasible alternative to structural solutions within Peebles but we will look at areas where NFM measures can be incorporated. With regards to land management upstream, policy changes etc. would be required out with the remit of flood risk management.*
- *"Partially. I think the council is listening more than before. I still think [there is] too much emphasis on hard solutions and not enough on soft (NFM)."*
  - *Answer as above.*

Question 5

Are there any flood related issues that you feel we have missed?

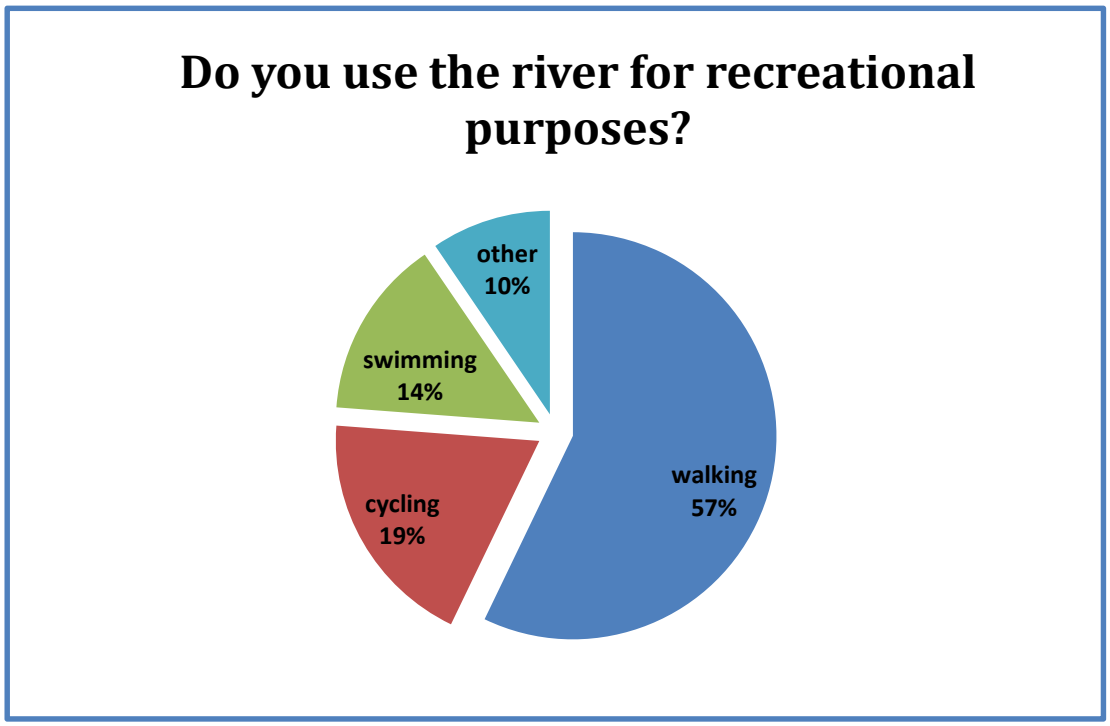
There was a divided response to this question. 8 People answered 'no' showing they are happy that the majority of flood issues in Peebles have been discussed. 3 people answered 'yes' and 6 left it unanswered however included comments regarding some issues that may have been missed. The comments from those that answered yes and where a comment has been left but the question was left unanswered are shown in the table below:

Response no.	Watercourse area	Comments
1	Eddleston Water	*"Timeline of Eddleston water incorrect. Not stating water levels in 2000 (my home was flooded twice)" – Can be incorporated.*
2	Eddleston Water Edderston Burn River Tweed	*"Yes flooding from Eddleston Water at Manor Swore Bridge not included. Advised member of team." – Can be incorporated.*
3	River Tweed Eddleston Water	*"More on NFM. It is more proven than you give credit for. The challenges are also social and political - engaging with and/or regulating land use in the catchment." – NFM potential will be looked at as a long-term strategy?*
4	River Tweed	*"The plan shows how lateral water would be kept out. One of the biggest unknowns is what the water table would do in event of significant flooding." – Protection against groundwater would be incorporated into the design, for example sheet piling for the wall or a waterproof core of an embankment taken down x metres.*
5	River Tweed	*"Natural flood defences upstream of Peebles were mentioned, but largely ignored. Scottish Water and the Forestry Commission could help but do not seem minded too. (They are public bodies in Scotland, and should therefore be accountable to us all, but they don't seem to be in reality)" – Stakeholder engagement with Scottish Water and Forestry will take place / has taken place. NFM potential will be considered.*
6	River Tweed Edderston Burn	*"Despite the poster explaining why sediment removal is not suitable I can see the huge island forming in the Tweed is affecting the river banks (erosion) and will soon impact the Tweed bridge." – Study undertaken on effect on removing the island – very limited effect and will likely re-fill very quickly – we will not be removing (or undertaking any other dredging)*
7	Eddleston Water	*"Yes flooding from Eddleston water at Manor Swore Bridge not included. Advised member of the team." – Can be incorporated.*
8	Eddleston Water	*"The whole grant system which incentivises poor land management, over grazing by sheep etc. is ridiculous. After exiting the CAP, build grants from bottom up to incentivise good land management." – Policy that is out with flood risk management.*

Question 6

Do you use the river for recreational purposes?

Collated data from the questionnaire makes it apparent that walking is the most common recreational activity that people use the riverside for. Other recreational uses include cycling and swimming, as shown in the chart below.



Question 7

Do you have any concerns about how the flood mitigation options proposed may affect recreation activities at the river?

Out of the 17 participants 12 were not concerned about the flood defences affecting any of their recreational activities that they take part in at the river. 1 left the question unanswered and the remaining 4 circled 'yes' indicating that they were concerned. Issues raised by participants who circled 'yes' included concerns about access to the river and the existing walkway and the aesthetics of the proposed flood defence options.

"Too many structures affecting how the river looks and works."

"Yes. It is essential we are not cut off from walking along the river. The "Three Bridges walk" is a very popular and regular walk for many."

"Mitigation for other areas needs to blend in as much as possible, both on the ground & for events."

A mitigation option that blends in suitably with the current area is essential and we will look to reduce the aesthetic losses and mitigate these with alternatives such as raised footpaths. The riverside walkway will exist post-scheme.

Question 8

Currently are there any access issues to the existing river infrastructure including issues which effect individuals with a disability?

9 people responded 'yes' – there were issues accessing the river infrastructure, 3 responded 'no' and 5 left the question unanswered. Below are a couple of comments from participants who responded with 'yes'.

"The hump and the path below riverside house which is not fit for purpose - muddy and eroded."

"Behind Haylodge hospital, pathway not possible in a wheelchair. Both Priorsford & Haylodge footbridge have been successfully dealt with."

The answers to this question are useful as if there are any issues of accessibility, we can work to address these and consider them in the design of flood defences.

Question 9

Are you particularly concerned with any of the proposed options?

11 people respondents were not concerned with the proposed options, representing around 65 percent of the total consultees. Concerns and issues that were raised on the questionnaires by those answering yes are shown in the table below.

Response no.	Watercourse area	Comments
1	River Tweed	*"Somewhat [concerned] about building a wall in Tweed Green"*
2	Eddleston Water	*"Structural protection measures focus on good land management upstream and flood individual houses. Stop grants for land management that increases flood risk."*
3	River Tweed	*"If a wall or embankment is sited at Tweed Green then access to existing footpaths could be an issue."*

Question 10

Do you have any other issues that you would like to raise?

The final question on the questionnaire gave participants the opportunity to voice any issues they had, which may not have applied to the other questions. 3 people raised their concerns, 8 had no issues to raise and 6 left the question unanswered. The concerns highlighted by residents are detailed below;

Response no.	Watercourse area	Comments
1	River Tweed	*"Water level data from the early stages of the Tweed, at Glenbreck and Kingledores, is critical to understanding the potential of flooding in Peebles. The monitoring needs to be well protected."*
2	Eddleston Water	*"Look at link between CAP, land ownership / reform, length / security of tenancy for farmers and floods! Identify and treat the causes not only the symptoms"*
3	Eddleston Water River Tweed	*"Take NFM seriously"*

A participant who raised an issue included a comment displaying their positive thoughts about a flood defence to protect property:

"Fully in support of proposal to protect property affected by the River Tweed with the construction of a flood retaining wall. Seems to be excellent cost/benefit"

Outcome / Conclusion

As shown from the data collected in the questionnaires, there has been a generally positive response to flood defence options presented in Peebles. However, the questionnaire has highlighted issues that will be considered at the next stages of the process, including negative comments about flood walls and the lack of natural flood management.

The mainly positive view is likely to be because many people have unfortunately been affected by flooding in the recent past, understand how devastating flooding can be and appreciate the benefit of having their properties protected by a formal flood protection scheme.

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