NEWTON STEWART FLOOD PROTECTION SCHEME – SUPPORTING DOCUMENT
FLOOD MANAGEMENT PREFERRED OPTION & ECONOMIC APPRAISAL REPORT

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FPO ISSUE

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SWECO UK LIMITED

Change list

VER.	DATE	CHANGE CONCERNS	ORIGINATOR	REVIEWED	APPROVED
0	13/09/18	DRAFT FOR COMMENT	JK	JP	DRL
2	27/11/18	CLIENT COMMENTS	ARW	ITS	ITS
3	15/01/18	CLIENT COMMENTS	ARW	MT	MT
4	26/08/19	UPDATE FOLLOWING NEW MODEL RESULTS	JK	DG	ARW
5	26/09/19	UPDATE FOLLOWING J CHATTERTON MEETING	JK	DG	ARW
6	15/10/19	UPDATE FOLLOWING DGC REVIEW MEETING	JK	DG	ARW
7	14/04/20	UPDATE FOLLOWING CLIENT REVIEW	JK	ARW	ARW
8	11/05/23	ADDENDUM FOR SCHEME CHANGES	JF	DE	GA

Summary

A Flood Protection Scheme is currently being appraised for the town of Newton Stewart, Dumfries & Galloway. Scottish Environment Protection Agency (SEPA) has identified Newton Stewart as a Potentially Vulnerable Area (PVA), in the Solway Local Plan District (PVA 14/12). Under the Solway Local Plan District Local Flood Risk Management Plan, an action has been placed on Dumfries & Galloway Council to progress work on a proposed Flood Protection Scheme.

This document outlines the Preferred Option and its components. Additional information is provided on each component (direct defences, land reprofiling and increased flow area beneath both the A75T and the site of the new Sparling Bridge, as well as secondary flooding mitigation measures) with estimated costs provided. These estimated costs have been compared with predicted pre- and post- development flood damages to show that a benefit-cost ratio exceeding 1 and therefore that the proposed scheme is economically viable.

For details on the rationale behind the Flood Protection Scheme and process leading to the Preferred Option, please refer to the supporting document "*Flood Management Optioneering Report*".

Addendum Summary

Four scheme changes were introduced in November 2022:

- Realignment of defences at the Monument next to the Cree Bridge.
- Realignment of defences at SEPA station.
- Floodgate on Goods Lanes leading to Sparling Bridge. (removing additional defences from the Bridge to the Car Park
- Replacement of Ramped Feature at Creebridge with a floodgate on access road.

These changes are anticipated to reduce overall scheme costs and hence the BCR will not be negatively affected, remaining at 1.07 or higher, continuing to show a net economic benefit from the Scheme. Scheme changes have been presented in the Addendum.

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1 Preferred Option

There were twenty-four options originally considered as flood protection measures which were reduced to a short-list of ten. These were evaluated and modelled leading to the preferred option.

The Preferred Option is a combination of direct defences and reprofiling of land, with each of these scheme elements described in this chapter. A summary of the Preferred Option and a comparison between the 1:200 defended/baseline predicted flood extents is shown in Figure 1-1.

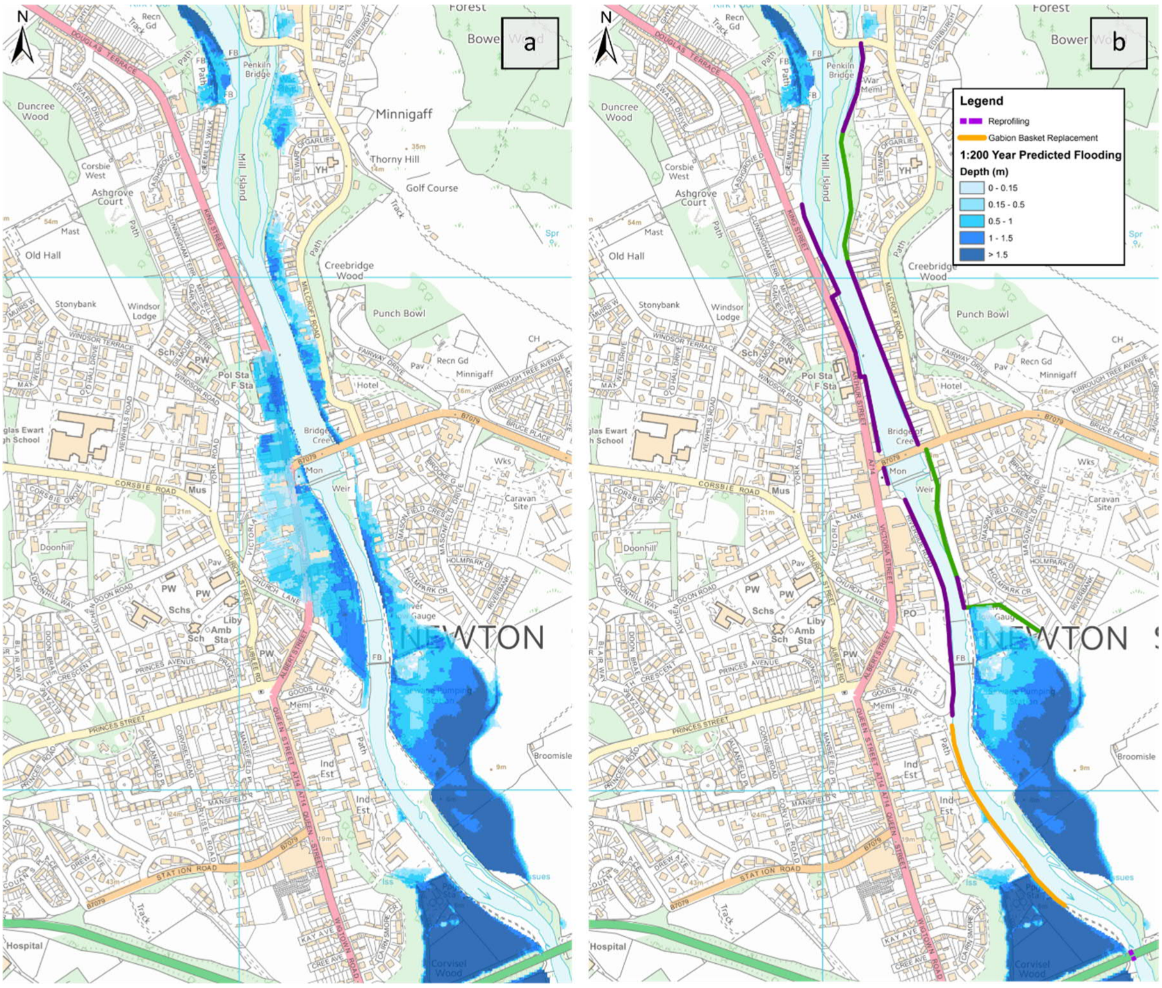


Figure 1-1 - Predicted baseline (a) flood extents; and predicted defended (b) flood extents with preferred option

The outline design, which was based on the above illustrated (Figure 1.1) Preferred Option, was presented to stakeholders at the VM3 meeting on Tuesday, 5 June 2018.

1.1 Direct Defences

Direct defences comprise embankments, walls and glass-panelled walls. Detailed plans showing the locations of each type of defence are provided in Appendix A. The following summarises the location of direct defences:

- Embankments, walls and glass-panelled walls will be constructed on the east bank of the Penkiln Burn.

- Embankments and glass panelled-walls will be constructed on the west bank of the River Cree north of the bridge. Glass panelled walls will be installed on the east bank also.
- South of the bridge, glass panelled walls will be constructed on the west bank between the B7079 road and the proposed Sparling Bridge. Glass panelled walls and embankments will also be added to the east bank along this reach.

1.1.1 Embankments

Embankment design comprises an impermeable core (e.g. steel sheet piles or other impermeable material) surrounded by clay side slopes covered in topsoil. A schematic of a typical flood embankment is provided in Figure 1-2, with a photograph of a typical structure shown alongside this.

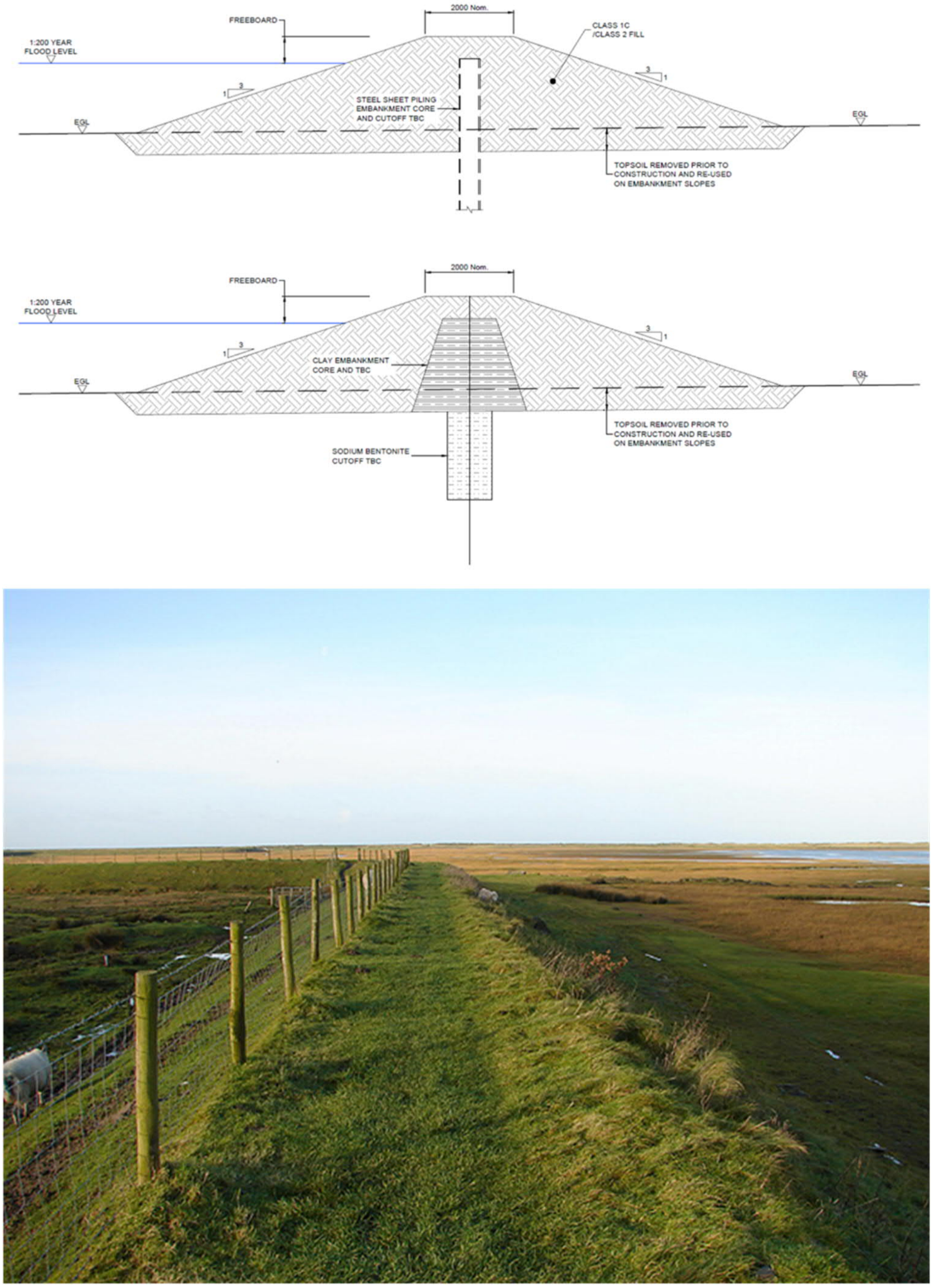


Figure 1-2 - Typical flood embankment sketch (top) and example (bottom)

1.1.2 **Flood Walls**

Flood walls would be constructed using either reinforced concrete or sheet piling to resist the sliding and overturning forces imposed upon them during flood events. Such walls are typically clad with masonry to ensure that they are in keeping with their setting as part of the urban landscape. Furthermore, where a flood wall is too high in terms of the urban landscape (generally around a typical person's head level) its visual impact may be mitigated by means of an upper section constructed of structural glass, capable of resisting forces from the floodwater.

A schematic of typical flood walls is shown in Figure 1-3 with examples of cladding provided in Figure 1-4.

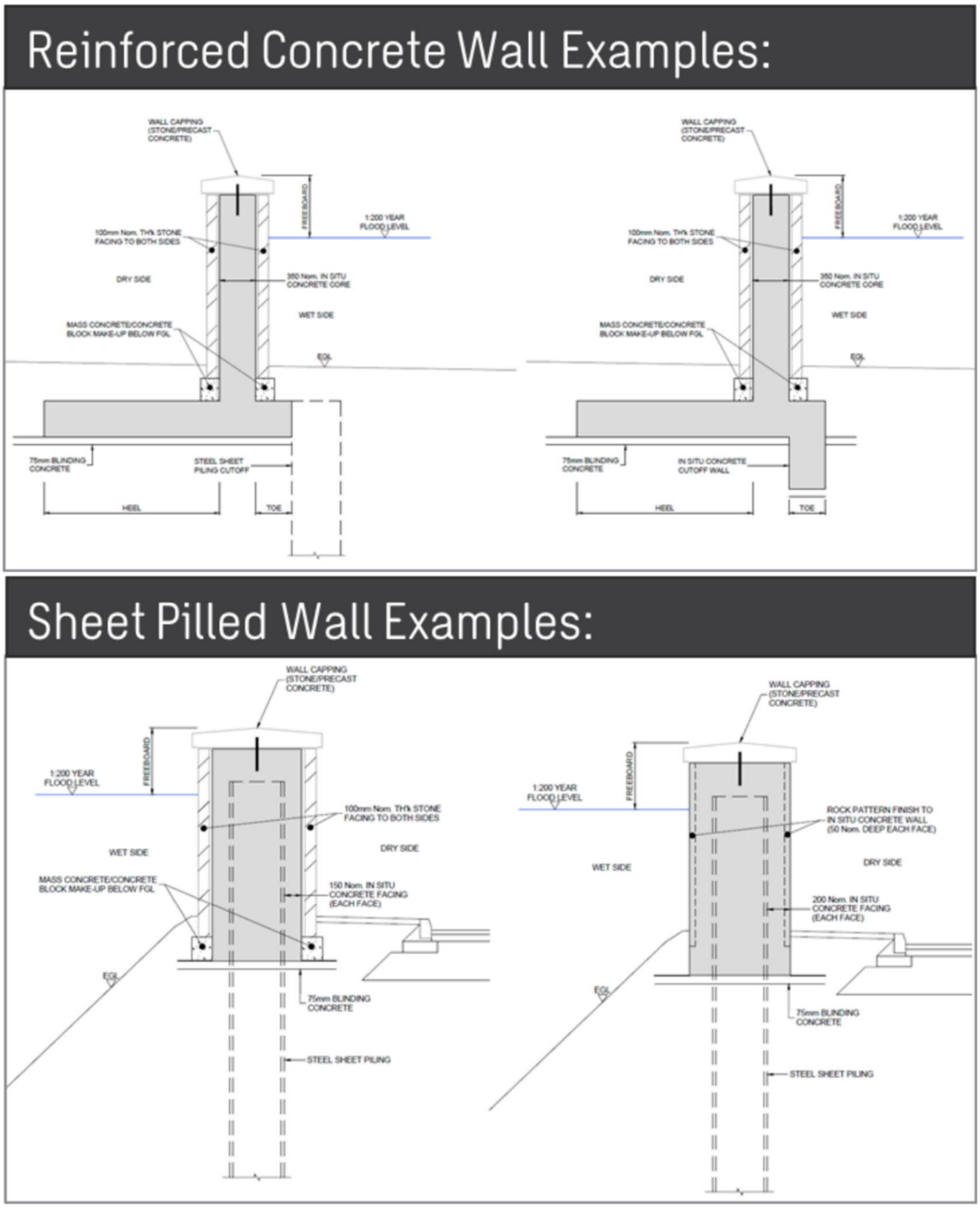


Figure 1-3 - Typical flood wall schematic

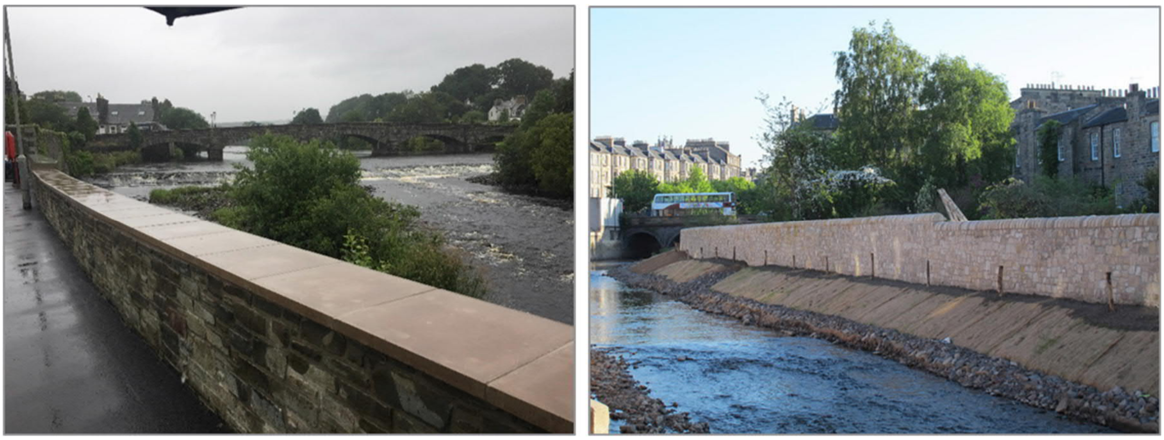


Figure 1-4 - Example of flood wall cladding

1.1.3 Continuing Riverbank Access

These defences can prevent access to the river channel from the town. Hence, in mitigation of this effect, access to the channel and riparian zone will be provided at regular intervals along the flood walls. Figure 1-5 and Figure 1-6 below show examples of steps that can be installed in the walls to allow access from gardens, and for fishing and other recreational activities.

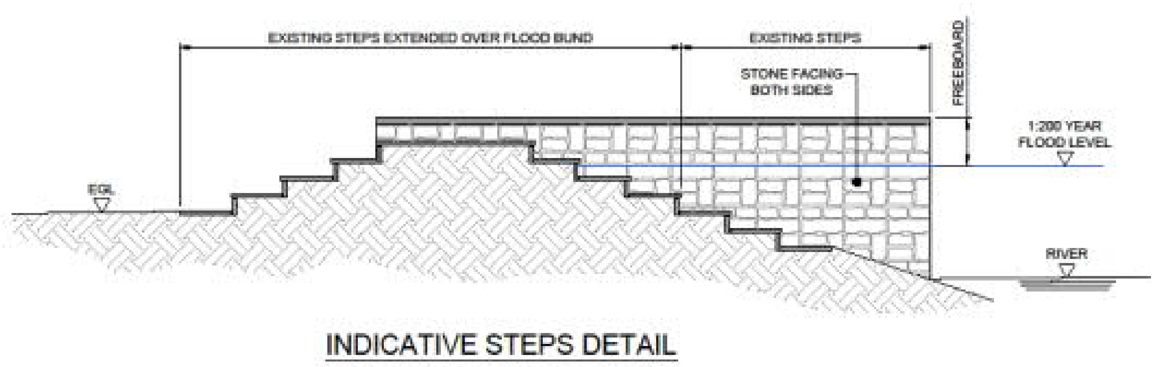


Figure 1-5 - Example cross section of access steps for recreational activities. Note the steps will be designed as such as to ensure that the 1:200 flood will not overtop the defences.

Most direct defences will be set back from the river edge to simplify the construction process and reduce the designed height. Defences on the western side of the channel will make use of existing walls, which will require structural maintenance works. This will necessitate a construction interface with the river, potentially requiring either access from above via a scaffold facilitated by a temporary road narrowing or one-way system, or a temporary bund constructed in front of the existing flood walls to allow the scaffold to be constructed riverside (an example shown in Figure 1-7).

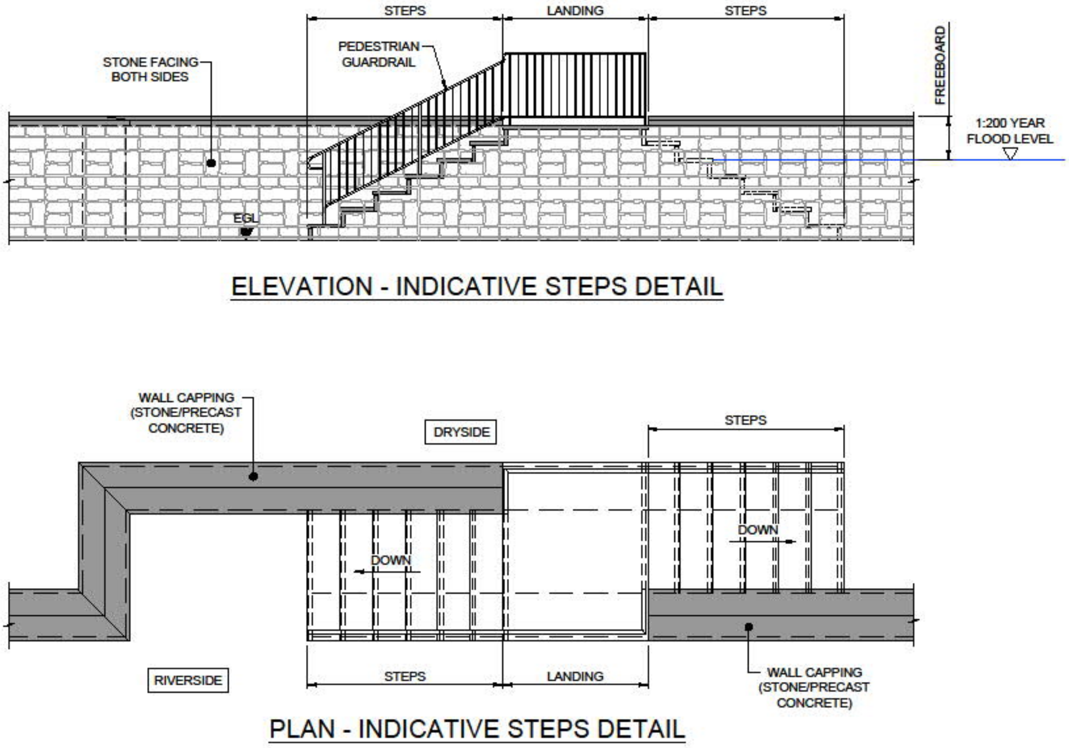


Figure 1-6 - Example cross section of access steps to and from gardens. Note the steps will be designed as such as to ensure that the 1:200 flood will not overtop the defences.

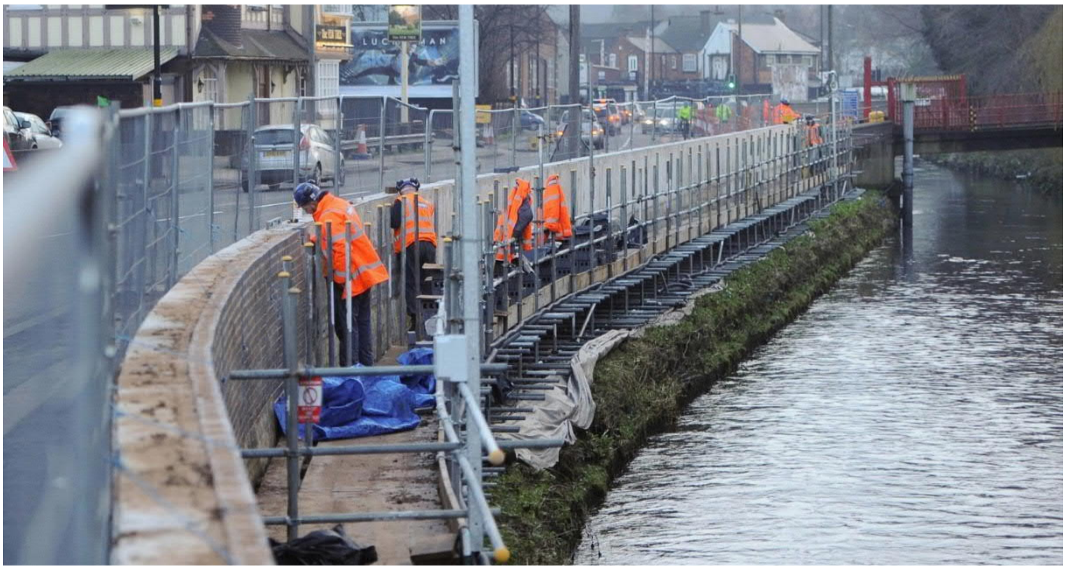


Figure 1-7 - Example of temporary bunding, allowing riverside scaffold construction for wall maintenance.

1.2 Sparling Bridge

Kaya Consulting's initial hydraulic modelling study (2015) concluded that the former Sparling Bridge caused backing-up of flows during extreme events, due to the level of its deck. Furthermore, the design of the bridge exacerbated the backing-up effect through blockage of floating debris; an example is shown in Figure 1-8. As this bridge provides a vital link between the communities on both sides of the river, it was envisaged that the flood scheme would seek to provide a replacement crossing which would be designed with the flood protection scheme in mind.

Concerns regarding the ongoing flood risk from the previous Sparling Bridge led to removal of crossing before the flood protection scheme outline design was completed. Following consultation with the Community, a new location was chosen for a replacement cycle/pedestrian bridge and a new Sparling Bridge has been designed alongside the flood protection scheme, which ties into the direct defences/land reprofiling. This is shown in Figure 1-9 with a plan in Appendix B. The new bridge has been designed to have a soffit above the 1 in 200-year flood level. It has enhanced facilities for cyclists and, hence, has attracted funding for 50% of its cost from Sustrans.

The new cycle bridge has now been constructed over the River Cree approximately 150m downstream of the former Sparling footbridge. It opened in December 2019.

Figure 1-8 – Former Sparling Bridge design (left) and debris following flood event (right).

Figure 1-9 – New Sparling Bridge

1.3 Secondary Flooding

A secondary flooding analysis has identified five areas that would be subjected to residual flood risk after the construction of the direct defences (Figure 1-10)

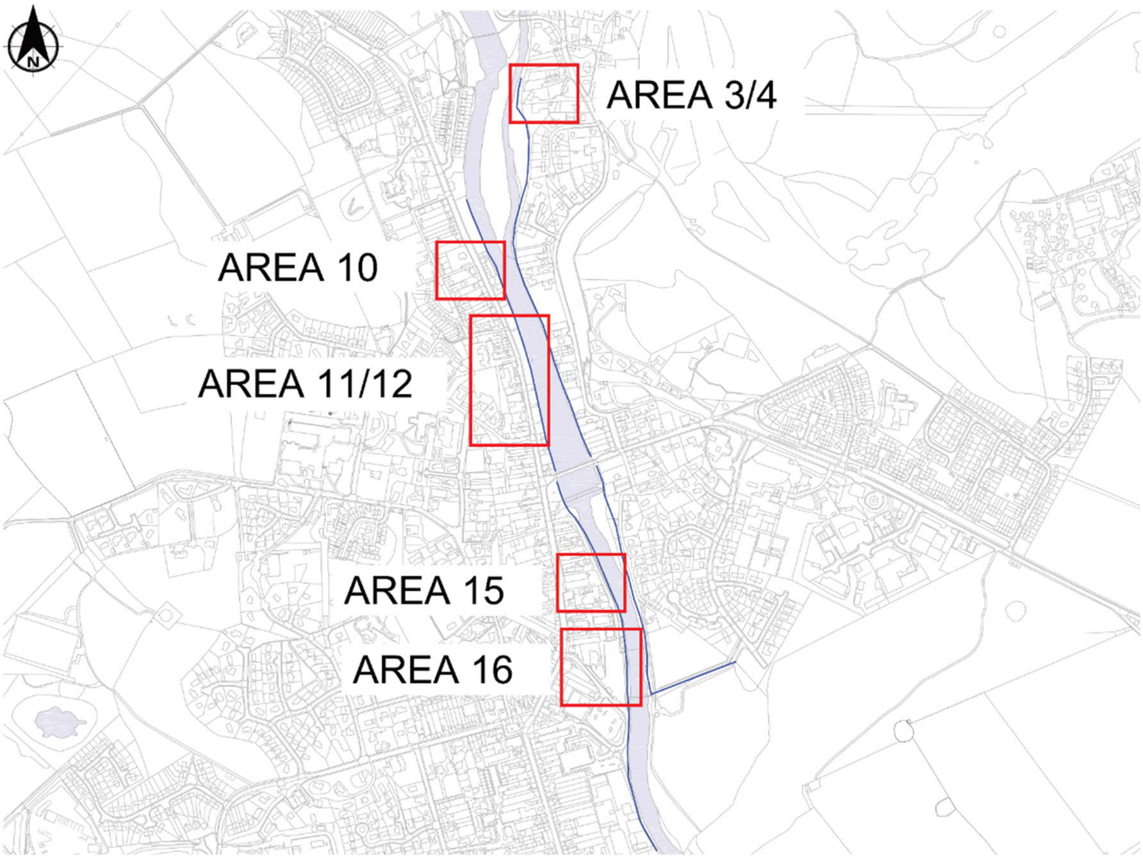


Figure 1-10 - Areas of secondary flooding.

In Area 3/4, flooding in the private gardens occurs as a combination of road runoff and surcharging of the combined sewer outlet (CSO) flows. The sewer runs through the gardens and spills into them at and above the 1 in 30-year event. Construction of flood defences is predicted to increase the volume of floodwater in this area by 437 m^3 at the 1in 200 year + climate change allowance (CC) event. The proposed mitigation is to install pipes with tide flap valves in the defence walls within each of the five private gardens, thereby reducing secondary flooding effects to 2 m^3.

In Area 10, flooding is caused by road runoff from King Street Ponded water in the area impacting nearby properties. Construction of the flood defences will increase secondary flooding in this area by an additional 300 m^3 of floodwater during the 1 in 200 year + CC event. Proposed mitigation comprises the installation of a 30 m long drainage channel along King Street connecting into a new 300 mm diameter outfall pipe with a tide flap built into the flood defence wall. Hydraulic modelling predicts that this will eliminate the secondary flooding effects.

In Area 11/12, flooding is caused by road runoff from Mitchell Terrace, which flows down Arthur Street and ponds near the existing CSO. Construction of the flood defences will increase the volume of secondary floodwater in this area by 167 m^3 during the 1 in 200 year + CC event. Proposed mitigation comprises two new outfall pipes with the outflow regulated by tide flap valves. Modelling analysis predicts that this will not only eliminate secondary flooding but also provide a small improvement on the existing situation through a reduction in pluvial flooding of approximately 9 m³.

In Area 15, flooding is caused by road runoff flowing from Victoria Street towards Mortons Entry. Construction of the flood defences will increase the volume of secondary floodwater in this area by 107 m³ during the 1 in 200-year + CC event. The proposed mitigation comprises a new outfall pipe, with tide flap valve through the defence walls. A new pumping station is also required utilising three 150 l/s standby pumps. This proposal is predicted to reduce the volume of secondary floodwater to 14 m³.

Current flooding in Area 16 occurs due to a combination of the road runoff (emanating from Albert Street, Goods Lane and Riverside Road) and surcharge from the CSOs at the car park. Construction of the flood defences will increase the volume of secondary floodwater in this area by 1,305 m³ during the 1 in 200-year + CC event, combined with the 2-year return period fluvial flood event. This can be reduced to zero utilising the following mitigation measures:

- Provision of two new drainage systems;
- Provision of new storm storage facilities (700 m² capacity concrete underground storage tank);
- Provision of a new outfall pipe with tide flap valve, outlet through the flood defence wall;
- A pumping station (two 10 l/s standby pumps).

These proposed measures are predicted to eliminate the effects of secondary flooding in this area.

1.4 Geomorphology and Tree Loss

Both the River Cree and Penkiln Burn are gravel bed rivers which experience high levels of geomorphic activity, as evidenced by high rates or erosion and deposition.

Engineering of the rivers, such as bridging, the addition of extensive bank protection, and relocation of the River Cree and Penkiln Burn confluence, has resulted in significant morphological pressure on the channels.

Several extensive sections of high scour potential are predicted to occur on both the Penkiln Burn and the River Cree following the construction of the flood defences. Most of the River Cree and parts of the Penkiln Burn will require hard bank protection to avoid erosion during flood events. The proposed erosion protection comprises the removal of the existing gabion baskets between the new Sparling Bridge and the A75T Bridge and its replacement with a rock roll revetment (refer example shown in Figure 1-11). In addition to the new protection measures, an investigation into the current condition of the existing gabion walls is recommended as much of this currently appears to be failing. The cost of replacing the gabions has been included within the Scheme cost estimate.

Figure 1-81 - Example of a rock roll revetment from Salix

An estimate of tree removal was also made through a visual survey. Approximately 425 small to medium sized trees on the left bank of the Penkiln Burn may need to be removed. On the River Cree, approximately 25 trees on the west bank immediately upstream of the B7079 bridge may need to be removed, together with a further 100 trees downstream of the bridge (including 30 trees on the right bank of the River Cree around the new Sparling Bridge). It should be noted that these figures are approximate and there is an opportunity to minimise the number to be removed through careful consideration in the detailed design phase.

1.5 Penkiln Burn

Between February 2018 and May 2018 a number of local residents provided feedback about the preferred option stating that they felt the risk of flooding in the north-east of the town (Minnigaff) along the eastern bank of the Penkiln Burn would not be adequately addressed by the proposed scheme. The design team, therefore, carried out further investigation on measures to extend the defences proposed in the preferred option further upstream along the Penkiln Burn.

Further investigation following the residents' feedback (April 2018) highlighted that the river model did not contain the required level of detail in the Minnigaff area appropriate for the scheme design process. As a result of this, additional topographic survey was commissioned, which became available in June 2018.

The design team and DGC considered it important to report an interim assessment at the VM3 stakeholder meeting in June 2018 so that the residents' concerns could be responded to in a timely manner. This interim assessment comprised of the river model which contained LiDAR in the 2D zone upstream of Stewart of Garlies (on the eastern bank) and contained a pure 1D river sections (i.e. no 2D zone) upstream of the Penkiln Bridge. The assessment which was presented from this model was very high-level because a 'glass-wall' effect was observed in the 1D sections along the Penkiln Burn. This means that the depth of water is greater than the highest point on the river section and the model assumes an artificial ‘glass-wall’ at the boundaries which results in the overestimation of flood levels. These flood levels were then extrapolated across the 2D zone to provide an estimate of the potential for flooding in the area in the absence of any further information. This concept was accepted by the design team because it allowed for the worst-case (i.e. known overestimate) defence alignment to be presented to all stakeholders and any concerns or issues with this to be discussed. This allowed the feedback to be gathered safe in the knowledge that the final alignment would undoubtedly be less onerous than what was presented; and that any and all feedback relating to the area had been responsibly collected.

Following the VM3 stakeholder meeting in June 2018, the river modeller (a sub-consultant of DGC) completed their assessment of the area using the updated topographic survey data. Various other aspects of the scheme (e.g. Sparling Bridge, final defence design etc.) then had to be modelled in detail and a final review of the outline design was prepared in November 2018.

An economic analysis of the outline design revisited the different measures comprising the preferred option to check that each individual measure was still technically and economically viable. A review of the updated river model, which was now a 1D-2D linked model containing the new topographic survey data and all other relevant elements of the scheme design showed (as expected) less prevalence of flooding in Minnigaff than had previously been reported from the interim model (which was a known overestimate). This is because the presence of a full 2D zone permitted the out-of-bank flood water to spread out over a larger area (i.e. same volume over a larger area yields less depth) rather than be constrained to the channel by an artificial ‘glass-wall’. Only 6 properties remained at risk of flooding in this re-assessment and the cost of protecting those properties and complexity of working in the river adjacent to them meant that the BCR for the section of defence upstream of the Penkiln Bridge was 0.16. Full details of the overall final scheme BCR may be found in Section 2.

It should be noted that the section of defence was extended further upstream from the original preferred option following the residents’ feedback, and the scheme now extends as far north as the downstream face of the Penkiln Bridge on the north-eastern bank.

2 Economic Analysis of Preferred Option

The financial viability of the proposed flood protection scheme has been assessed through the estimation of reduction in flood damages (baseline and post-development), against the costs of the option, with both costs and benefits evaluated over a 100-year appraisal period.

In the economic appraisal, the baseline is normally the “do-nothing scenario”, a zero-cost option assuming no maintenance or intervention, resulting in an increase in flood damages and other “negative benefits”. However, it is more sensible for the baseline scenario instead to be based on the minimum investment needed to maintain the system in its current state, acknowledging that statutory duties oblige that a basic level of maintenance is required, such that a true do-nothing scenario is unrealistic.

Hence, the baseline scenario considered here is the do minimum scenario and the preferred option is the “do something” scenario. Flood damages have been estimated for both scenarios, with costs estimated for the do something scenario.

2.1 Damage Calculations

Damages have been calculated in line with the Flood and Coastal Erosion Risk Management (FCERM) “Multi-Coloured Handbook” (MCH). This presents a detailed approach for estimating the direct and indirect benefits of flood and coastal erosion risk management. This is accepted as a standard approach for use in economic appraisal of FCERM policy and investment options. The MCH method is centred around assessment of direct and indirect flood damages to residential and non-residential properties, based on damage cost statistics compiled for different building categories, flooding depths and flooding persistence.

Identification of residential and non-residential receptors has been facilitated through use of the Environment Agency’s (EA’s) National Receptor Database (NRD) and OS Mastermap datasets - both supplied by the Council. The NRD provides details of the property type and the floor areas of the associated properties. These were used to provide estimates of damage to each property for a given flooding depth, obtained from the hydraulic modelling outputs. OS Mastermap data was used to associate a building polygon with each receptor point, and damages calculated based on the maximum predicted depth of flooding within the building polygon for a given model simulation.

Damage values were taken from the most up-to-date set of MCH tables, which at time of analysis was the 2017 price base.

2.1.1 Residential Damages

Residential damages, using the methodology outlines within the MCH, are based on the following key factors:

- Property type (e.g. detached, flat, etc.);
- Property age; and
- Property social grade.

The property type is provided within the NRD and property age has been obtained through examination of historical mapping. The property social grade was estimated from data obtained in the Scottish Index of Multiple Deprivation (SIMD).

In compliance with FCERM guidance, all property damages were capped (i.e. the total Present Value (PV) damage for a given property over the appraisal period cannot exceed its estimated market value). Any properties identified with >5% PvD were investigated in further details to ascertain if the applied cap value was appropriate.

2.1.2 Non-Residential Damages

The MCH calculates damages of non-residential receptors based on a typical cost to businesses per m^2. The floor area of non-residential properties has been provided as part of the NRD. The NRD also contains the *MCM Code*, which indicates which category (e.g. retail, offices, etc.) each receptor falls into. The MCH provides varying damage data (£/m^2) relevant to each non-residential property category for a given flood depth.

Non-residential receptors have been capped in line with MCH guidance (i.e. the total PV damage for a given NRP over the appraisal period cannot exceed the estimated rateable value, as set out by the Scottish Assessors Association, multiplied by 10).

2.1.3 Vehicle Damages

Privately-owned vehicle damage is calculated for each return period analysed at an assumed value of £3,600 per residential property flooded to at least 350 mm depth, as per MCH guidance.

2.1.4 Evacuation Costs

The MCH calculates typical evacuation costs based on the maximum flooded depth within a property, and on the property type (e.g. detached, flat, etc.).

Residential evacuation costs, in the MCH at time of analysis, attract damages of up to £16,383.

2.1.5 Road Closure

The impact of road closure is taken into account by the MCH, by means of the cost of diverting vehicles for the duration that any given road would require to be closed. This cost is estimated for each vehicle through traffic modelling results demonstrating the duration of closure for any given road, the calculated diversion distance and the road speed. Annual average daily flows (AADF) for an identified road at risk of closure during flood are provided by the Department for Transport (DfT) traffic counts.

In Newton Stewart, only Victoria Street was identified as being at risk of closure during a flood event.

The diversion route considered, which is 120 km long, is shown in Figure 2-1.

Figure 2-1 - Diversion Route

2.1.6 Intangible Health Benefits

This refers to intangible health benefits to the economy associated from a reduction in flood risk to residential properties, based on tabulated annualised values functional on the "before" and "after" Standard of Protection (SoP) produced by Defra (2004).

2.1.7 Overall Damage Calculation

Calculated damages associated with each property for each modelled return period are multiplied by the probability increment and summed to arrive at an annualised average damage estimate. This is summed over the appraisal period, with appropriate discounting applied based on HM Treasury Green Book values, to arrive at a total estimated uncapped present value (PV) damage for each property, with values then capped as necessary by the market value of the property. Emergency service response costs are then calculated as 5.6% of the summed capped PV damage cost. Residential evacuation and emergency service costs, as well as vehicle damage costs, are similarly calculated by annualising and summing. The summation of these values comprises the estimated PV flood damages for the scenario.

The potential for flood damages to worsen due to future climate change has also been taken into account. Three different epochs have been considered: the present day, mid-epoch (year 2050) and end-epoch (year 2080) based upon the Environment Agency publication '*Flood Risk Assessments: Climate Change Allowances*'. The consideration of these three epochs takes account of the predicted future climate change which may occur over the 100-year design life of the scheme. At the mid-life epoch, 28% uplift on flow inputs to the model have been applied and at the end-life epoch, 44% uplift on flow inputs have been applied. Damages at each climate-epoch have been converted to an annualised average damage (AAD) which allows for them to be discounted to the present-value for each year across their respective time epochs and subsequently summed to produce the total PV damages for the 100-year appraisal period. This total PV damages is inclusive of the potential for flood damages to worsen due to future climate change and produces a more realistic estimate of the economic impact of the proposed scheme than considering present-day flows alone.

Sheets summarizing the output of the flood damage calculations are shown in Appendix C. These show the loss probability curves for the uncapped case, as well as a curve showing the results inclusive of residential and non-residential capping proportional to each return period event considered.

2.2 Gross Value Added (GVA) Analysis

The standard Flooding and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG) provides information on the estimation of direct damages to non-residential receptors due to flooding. The contribution of local businesses to the overall local economy is captured through the GVA analysis. This assigns a value to the economic output of businesses when they are productive. Hence, the economic damage due to lack of productivity resulting from a flood may be estimated using this method.

Data on the number of employees and the Standard Industrial Classification (SIC) of each business in the town were obtained from Experian. This has permitted the estimation of whether a business would “stay-and-adapt”, “stay-and-do-nothing” or “shut down/move away” based on its location dependence and adaptive capability. Following this, an assessment was made (in conjunction with the hydraulic modelling results) on the expected annual value of lost productive time, representative of the loss to the local economy.

The GVA analysis adds an additional £1,921,000 (PV) to the flood damages appraised over the 100-year design life of the proposed scheme, based on a business being closed for an average of 10 weeks per flood. Evidence was obtained from local news reports that businesses in Newton Stewart have, in the past, taken between 1-5 months to recover and; hence, 10 weeks is considered a reasonable middle-ground assumption.

Most of the businesses in Newton Stewart fell under the “high location dependence” and “low adaptive capacity” categories due to their business types, explaining the relatively high value resulting from the GVA analysis. The figure is commensurate with the case made by the local community that the recent floods have caused significant economic damage to businesses throughout Newton Stewart.

2.3 Cost Calculations

Calculations of costs are based on 2017 prices, in line with the price based used in the damage calculations.

2.3.1 Secondary Flooding Costs

Cost estimates for the proposed secondary flooding mitigation measures (outlined in Section 1.3) are summarised in Table 2-1. These are calculated assuming construction of the proposed measures will occur during construction of the flood walls, thereby avoiding several costs noted below;

- Costs do not include for demolition of the existing riverside wall in locations where the wall is being replaced (deemed included instead in flood wall costs);
- Costs do not include for temporary access roads (included instead in flood wall costs, where relevant);

- Traffic management costs are included;
- Outfall pipes are to be located within the new flood defence wall, with no requirement for a separate headwall;
- Excavated soils are reused on site, with no allowance in costing for disposal (e.g. by raising ground levels or landscaping where feasible); and
- Costs for Area 16 are based on construction of a “stormcell” tank

There will be several utility crossings in King Street, Riverside Road and Morton Entry; an allowance has been included for their protection at each crossing point. Replacement costs for gully pots are included in the new drainage system cost estimate. Accommodating a new combined kerb and drainage system will require diversion of the water pipe in Goods Lane, which has been allowed for in the cost estimate. Costing also includes for reinstatement or roads, footpaths and car park surfaces and at all other locations where an existing paved surface is excavated as part of construction of the secondary flooding solution.

Table 2-1 - Estimated capital cost of mitigation measures required to control secondary flooding.

Area	Estimated Cost	Proposed Solution
3/4	£22,000	Pipes with tide flap valves
10	£24,000	Drainage channel, outfall pipe with tide flap valve
11/12	Outfall pipe 1: £20,000 Outfall pipe 2: £12,000 **Subtotal**: **£32,000**	Drainage channel, pipes with tide flap valves
15	Pipe & channel: £26,000 Pumping station: £322,000 **Subtotal: £348,800**	Pumping station, drainage channel, pipes with tide flap valves, including coffer dam and dewatering for pumping station excavation works
16	Drain 1: £38,000 Drain 2: £9,000 Storm tank: £344,000 Pipe: £7,000 Water pipe diversion: £5,000 Pumping station: £138,000 **Subtotal: £541,000**	Drainage systems, storm storage tank, pipes with tide flap valves and pumping station
TOTAL	**£967,000**	

2.3.2 Flood Walls

Costs associated with the flood walls, including scour protection are detailed in Table 2-2.

Table 2-2 - Estimated Capital Costs, Flood Walls

Section	Estimated Cost	Notes
River Cree West Bank, South of the B7079	£1,031,000	Includes temporary works for riverside walls
River Cree West Bank, North of the B7079	£788,000	Includes for upgrading and heightening existing walls
River Cree East Bank immediately South of the B7079	£704,000	Includes alterations to footway to cross the embankment
Wall (River Cree East Bank immediately North of the B7079)	£1,270,000	
TOTAL	**£3,793,000**	Site preliminaries, optimism bias, etc. estimated later – see Table 2-6

Table 2-3 - Estimated Costs, A75T Bridge

Item	Estimated Cost	Notes
Site clearance, strip topsoil, general excavation	£1,000	
Bridge scour protection	£20,000	
Reinstate Footpath	£8,000	
TOTAL	**£29,000**	

Costs associated with removal of the gabion baskets and replacement with a rock roll revetment are shown in Table 2-4.

Table 2-4 - Costing of Removal of Gabion Baskets and Installation of Rock Roll Revetment

Activity	Estimated Cost	Notes
Site clearance, strip topsoil, general excavation, storage, topsoil deposition and grass seeding	£3,000	
Fill	£2,000	
Rock roll installation (250 m)	£52,000	Based on reno mattress
Gabion activities including tipping	£27,000	Includes manual handling & non-hazardous disposal
Reinstatement of Footpath	£21,000	
TOTAL	**£105,000**	

2.3.3 Other Activities

The estimated detailed design stage cost of the replacement Sparling Bridge is £1,000,000.

Costs associated with landscaping includes replacement of approximately 550 trees. These would need to be replanted where possible around the design area, with most to the north and south of the A75T on the western bank of the River Cree. This also includes landscaping and replanting in various locations including the memorial area to the south-west of the River Cree Bridge.

Several utility diversions and reinforcements has been included in the cost estimate. This principally involves the diversion of the 230 m foul sewer on the eastern bank of the River Cree which runs parallel to the proposed wall.

Average annual maintenance costs of £5,000 over the 100-year appraisal period have been assumed.

2.3.4 Preferred Option

Optimism bias is used to account for scheme uncertainties and to account for variations in cost estimation as a function of the detail available through each stage of the design process. A 60% uplift is applied to cost estimates in the early stages of optioneering to account for optimism bias.

An estimate of costs associated with construction of the Sparling Bridge has been provided by DGC.

Costs associated with the proposed Preferred Option are summarised in Table 2-5.

Table 2-5 – Costing of Preferred Option

Activity	Cost	Notes
Secondary flooding	£966,000	All locations
Direct defences	£3,793,000	Full protection of affected areas
A75T reprofiling	£29,000	Under and upstream of bridge
Gabion basket replacement	£105,000	Along south-west bankside
Utilities diversions	£189,000	Sewer line
Landscaping & Trees	£60,000	80% north and 20% south of Cree Bridge
Sparling Bridge Replace	£1,000,000	DGC estimate
Maintenance (100 years)	£148,000	Assumes £5,000 avg. per year for 100 years
Land & DGC Costs	£110,000	Estimate
10% Preliminaries	£514,000	on CAPEX
15% Construction Overheads	£771,000	on CAPEX
8% Detailed Design / Site Supervision	£411,000	on CAPEX
60% Optimism Bias	£3,085,000	on CAPEX
TOTAL COST	**£11,181,000**	

A combination of the scheme and Sparling Bridge costs below yield a grand total of **£11,181,000**.

2.4 Benefit:Cost Ratio

The benefit:cost ratio (BCR) considers the *reduction* in present value damages from the Scheme (i.e. the **benefit**) divided by the estimated present whole life **cost** of the scheme. Where the ratio is greater than unity investment in the scheme will provide value for money.

The estimated flood damages over the 100-year appraisal, taking into account CC, is £17,141,000. The estimated total flood damages for the same period with the proposed scheme in place is £7,142,000. Therefore, the estimated direct flood damages avoided by the proposed scheme are £9,999,000 (PV).

The additional economic benefit to the town assessed through Gross Value Added (GVA) analysis is estimated to be £1,921,000 (PV).

Therefore, the total economic benefit is estimated to be: £11,920,000 (PV).

Taking account of the preferred option total cost (Section 2.3.4) at £11,181,000, the BCR is **1.07**.

Table 2-6 – Economic appraisal summary, in present value (PV) 2017 terms.

Item	Value
Flood damage reduction PV benefit	*£9,999,000*
Gross Value Added (GVA) benefit	*£1,921,000*
Total PV benefit	£11,920,000
Total PV cost	£11,181,000
Net PV	£739,000
Benefit-cost ratio	1.07

2.5 Summary

Costs for the Preferred Option have been estimated to 2017 prices. This is consistent with the price base used in the damage calculations, which have been carried out in line with the methodology in the MCH. The benefit: cost analysis of the Scheme shows that there is an overall BCR of 1.07, showing a net economic benefit from the Scheme.

When uplifted to 2020 prices, the costs for the Preferred Option have been estimated to be £12,217,780. Note the BCR remains the same, as inflationary rates are relative and the same rate of 3% per annum (based on historical Bank of England data) is applicable to both the cost and benefit estimates.

Appendix A – Cost-Benefit Analysis, Baseline Damage Calculation Summary

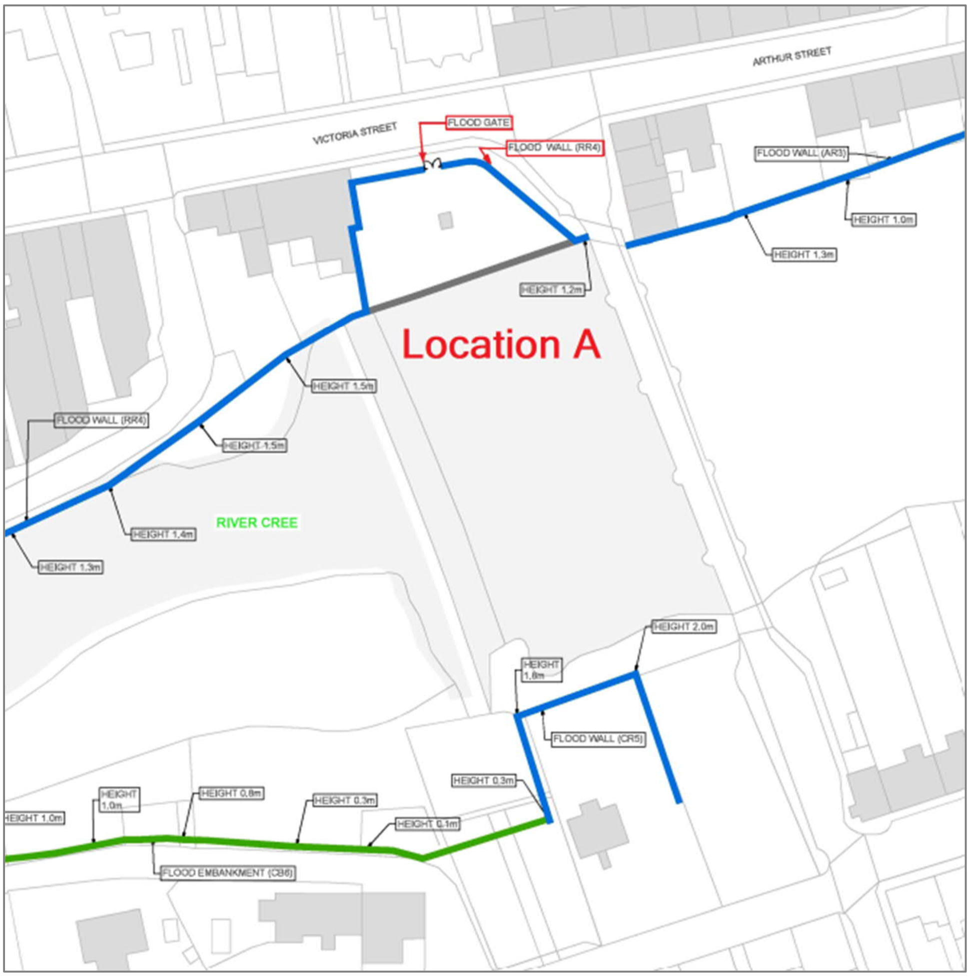
ADDENDUM – MAY 2023

This addendum should be read in conjunction with the *Newton Stewart Flood Protection Scheme – Supporting Document Flood Management Preferred Option & Economic Appraisal Report*, it has summarised several updates to the defence alignment.

The alignment changes were the result of consultation with stakeholders following public consultation. In all locations the changes can be considered minor and move defences further from the river.

Realignment of defences at the Monument next to the Cree Bridge

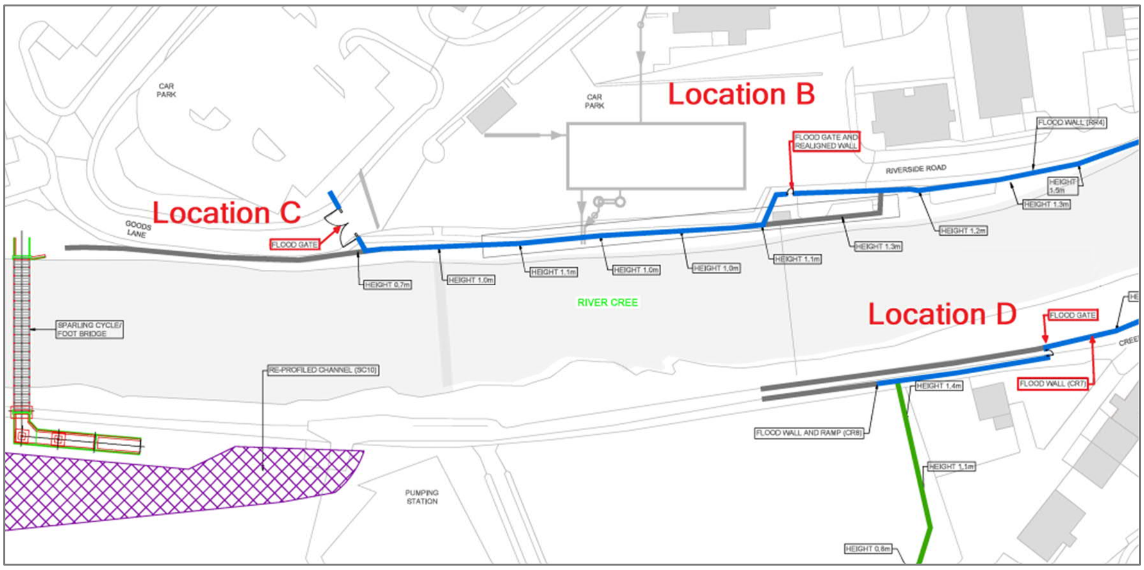
This change can be seen at Location A in Plan 1. The alignment at this location was changed to provide a very low defence to the rear of this site (the ground level rises away from the river) and to provide the adjacent building with property level protection. The previous proposal was for a defence line along the river edge to the front of the Monument site (shown in grey). The change means there will now be virtually no visual impact, or adverse effects on views or setting. This change has been welcomed by Planning/Conservation Officers. It also eliminates major construction on the site and there will be no requirement for works along the river edge.



Plan 1 - Realignment of defences at the Monument next to the Cree Bridge

Realignment of defences at SEPA station.

This change can be seen in Plan 2 at Location B. This is a minor change moving the defence line from the front to the rear of the SEPA station to allow unaffected river access. It has the advantage that construction will be away from the immediate river edge.



Plan 2 - Floodgate on Goods Lanes and Creebridge

Floodgate on Goods Lanes leading to Sparling Bridge.

This change can be seen in Plan 2 at Location C. In this area the scheme has changed from a 'passive' system where all defences would be permanent features to floodgate installation on the roadway. The original proposal resulted in the defence line at this location extending along from the riverside carpark to the Sparling Bridge (shown in grey). Installation of a floodgate will replace the requirement for these defences and reduce disruption to the shops during construction. It is anticipated that this gate would be closed infrequently and only in high level events, compared to the significant amount of time required for road closures or disruption during Scheme construction.

Dumfries and Galloway Council are aware that the introduction of a flood gate was not desirable as the scheme can be compromised if the flood gate is not maintained and operated properly. However, there is an active council depot in Newton Stewart to deploy personnel for flood gate closures. There is a residual risk of the defence line being compromised through road user collision with the flood gates.

Dumfries and Galloway Council are also aware that the sharp change in defence alignment may create higher loading to the defence structures facing the flow and higher potential for erosion at the pinch point. As a result the defence could require a significantly deeper foundation and scour protection, public realm damages can be expected when the flood gate is in operation.

However, there were a number of competing interests and design constraints at this location which led to selection of this solution.

Replacement of Ramped Feature at Creebridge

This change can be seen in Plan 2 at Location D. In this area the scheme has changed from a 'passive' system where all defences would be permanent features to floodgate installation on path. The original passive scheme required a return embankment for the Scottish Water site which meant the access road would have to be 'ramped' over the embankment. The current proposal is to provide a floodgate on this access road. This will be beneficial in visual terms (particularly from the west side looking over the river) and for the adjacent bungalows and a more cost-effective solution.

Dumfries and Galloway Council are aware that the introduction of a flood gate was not desirable as the scheme can be compromised if the flood gate is not maintained and operated properly. There is also a higher risk of the defence line being compromised through road user collision with the flood gates.

Summary of changes

Although the scheme will no longer be passive and therefore less resilient as a result of the changes at Locations A, B, C and D; the design solutions in these areas were deemed by Dumfries and Galloway Council to be the best compromise given the competing constraints and interests.

Economic impact of the alignment changes

The four changes to alignment are anticipated to have a neutral impact on scheme costs. The whole life cost will likely be lower at Locations D and potentially higher at locations A, B and C. We do not anticipate the benefit cost ratio changing significantly.

Dumfries and Galloway Council have updated their budgetary figure as follows:

"As part of the Capital Investment Strategy, and the annual reporting to Scottish Government, the Council has calculated a budgetary figure for the Scheme of £18.5 million. This figure is based on an increase in costs to estimate for a mid-point construction of 2026, costs incurred to date, and costs to develop the Scheme to the detailed design stage. This figure was considered, and agreed at the Council's Communities Committee on 2 February 2023, when approval was granted to proceed with the publication of the Scheme.

The figure of £18.5 million, which includes the higher risk Optimism Bias figure of 60% to cover any further cost increases and contingencies, will be used as the published figure in the Scheme Statement to provide a whole life estimate (and includes the cost of Operations/Construction)."