

How is flood risk managed by the Scottish Borders Council?

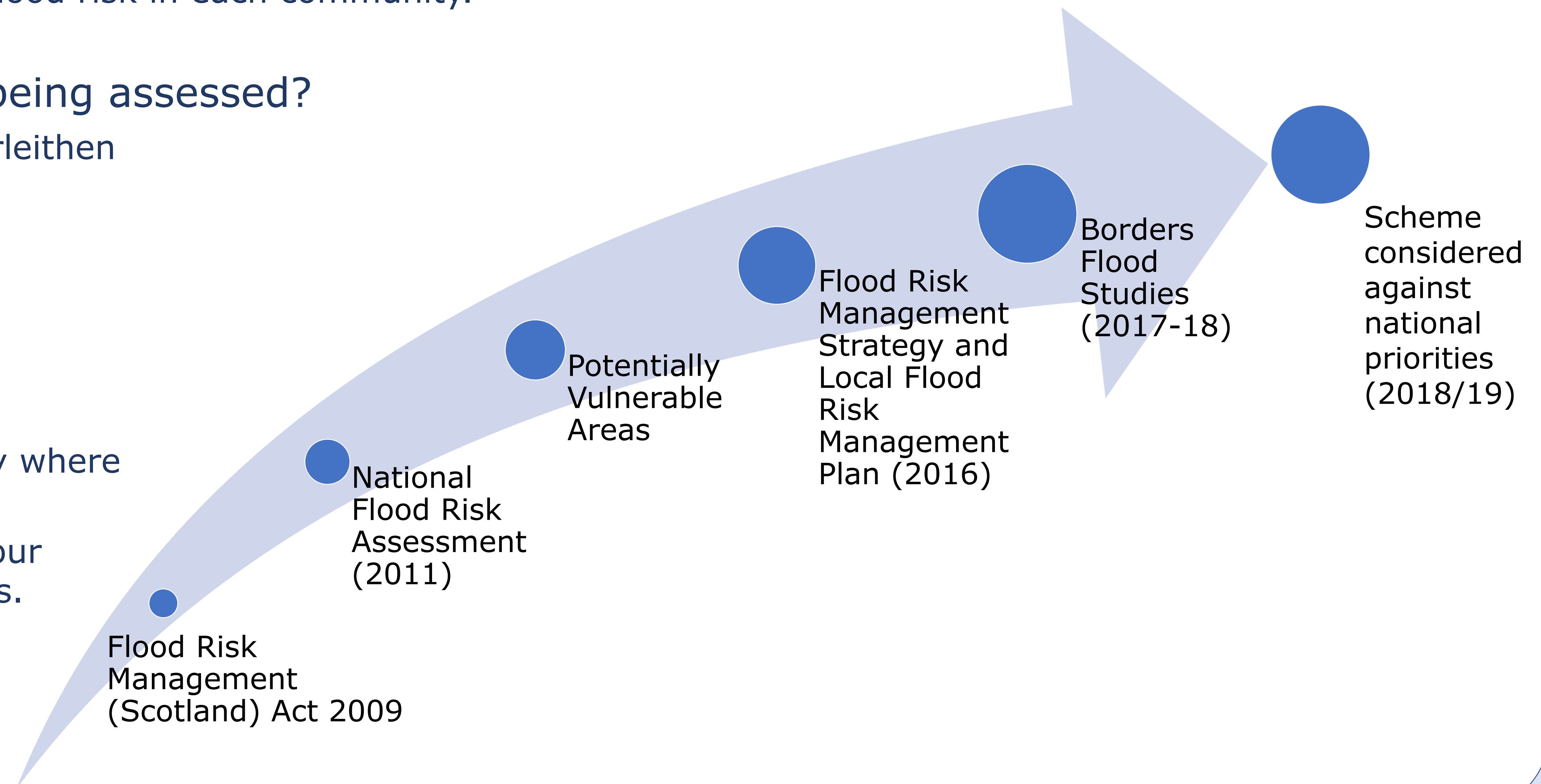
- The Flood Risk Management (Scotland) Act 2009 aims to prioritise flood mitigation across Scotland using a proactive and risk based process for assessing flood risk.
- This approach led to the preparation of SEPA's Flood Risk Management Strategies by SEPA and the Tweed Local Flood Risk Management Plan developed by the Scottish Borders Council as the Lead Local Authority for the Tweed Local Plan District.
- These plans identified specific communities as being at risk and in need of a detailed flood study to help inform the management of flood risk in each community.

Which communities are being assessed?

- **Peebles**, Broughton & Innerleithen
- Newcastleton
- Earlston

How will Flood Protection Schemes be prioritised?

- SEPA will prioritise nationally where funding should be allocated.
- The reports and findings of our study will inform this process.



What are the study objectives?

1) Develop better understanding of flood risk in the community

- Create, update or develop new/existing flood model information;
- Determine existing flood risk;
- Develop improved flood mapping;

2) Develop recommendations for management of flood risk

- Develop a range of options to manage flood risk, including structural and non-structural options;
- Appraise actions to manage flood risk (consider the pros and cons and economic viability for all proposed options);
- Recommend options for the future management of flood risk;

3) Select a preferred approach to manage flood risk in each community and identify recommendations that the Council will take forward

- SEPA will prioritise nationally where funding should be allocated;
- The reports and findings of our study will inform this process.

4) Engage partners and stakeholders

- **Today's consultation.**

Why choose a 200 year standard of protection?

- Scottish Planning Policy requires new build properties to have a 200 year standard of protection
- This standard is accepted as low risk by the flood insurance companies.
- A higher standard of protection will mean the scheme will be considered more favourably by SEPA's scheme prioritisation making funding more likely

What has been done so far?



Flood Review



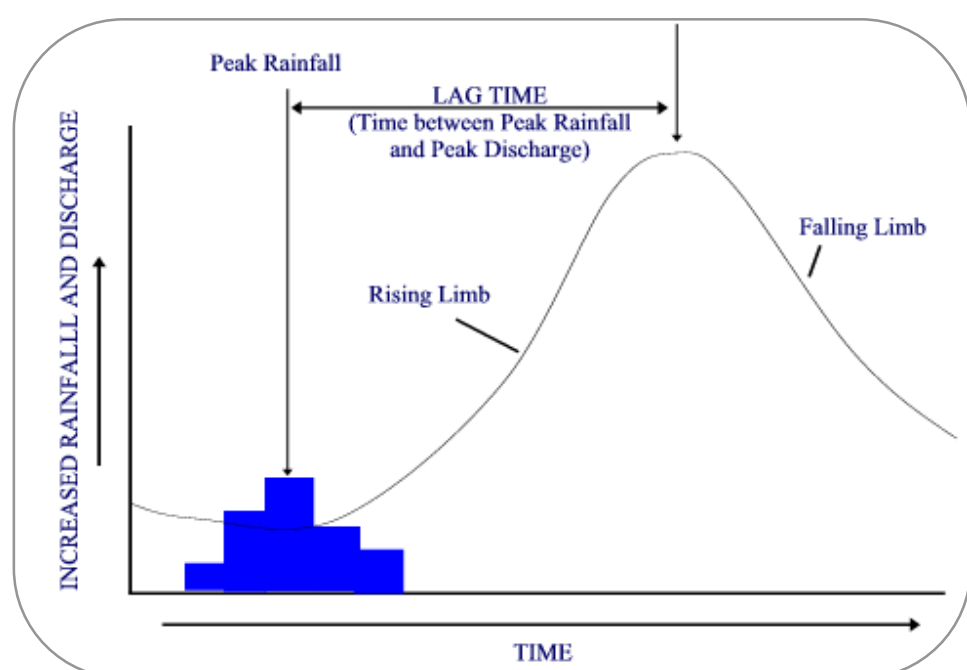
Topographic
surveys



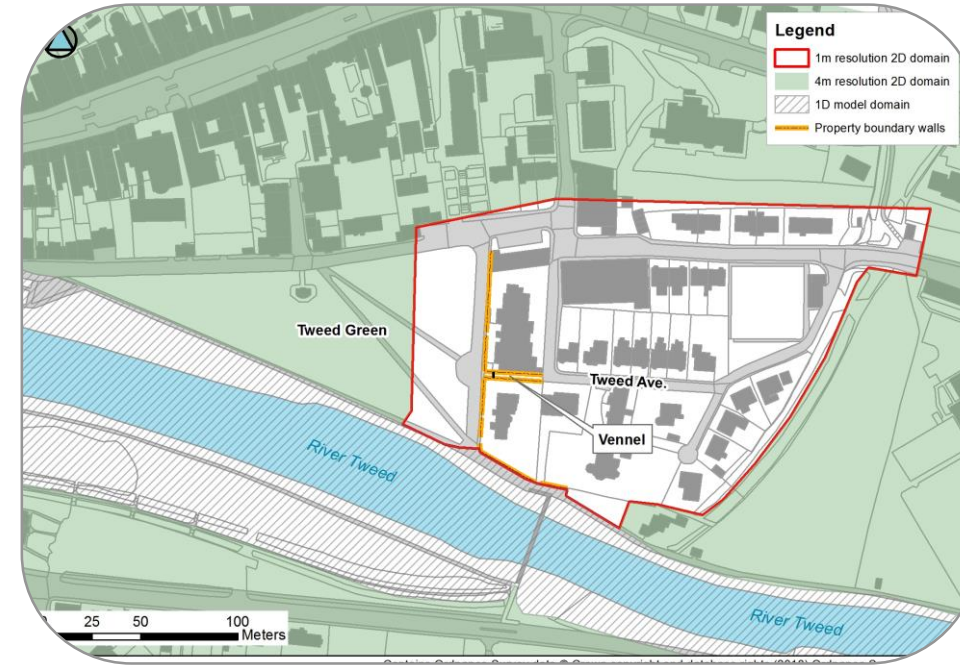
Asset
inspections

The studies aim to better assess current flood risks in the community by undertaking a review of past flood events; generating updated and detailed flood maps, determining the likely risk to different properties; and to propose a set of mitigation measures to reduce the flood risk to an acceptable level.

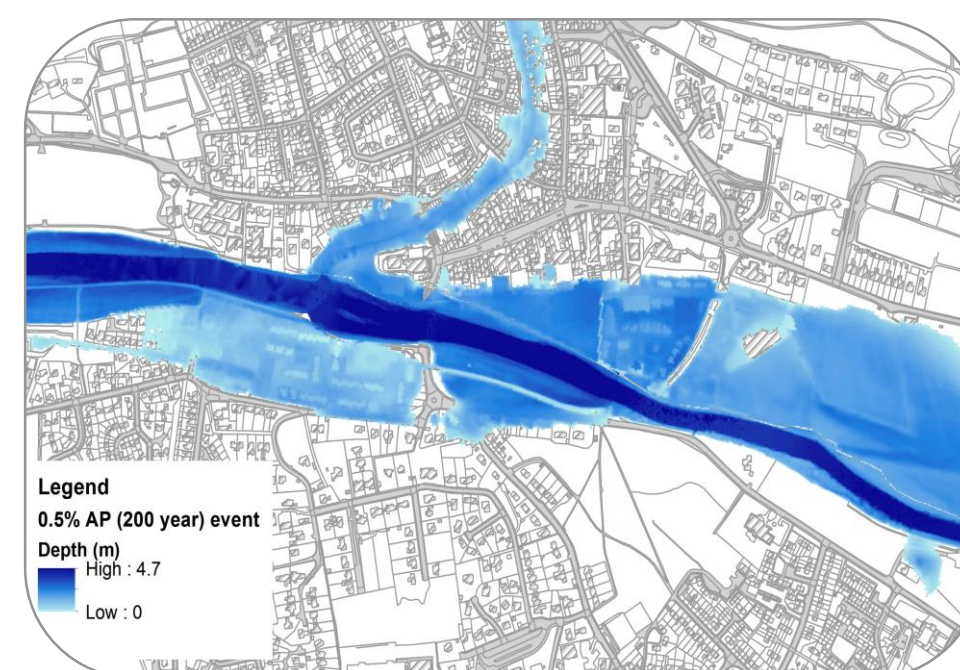
The models developed form a basis for assessing future flood levels, flood mitigation options, detailed design of schemes and the costs to deliver.



Hydrology



Modelling



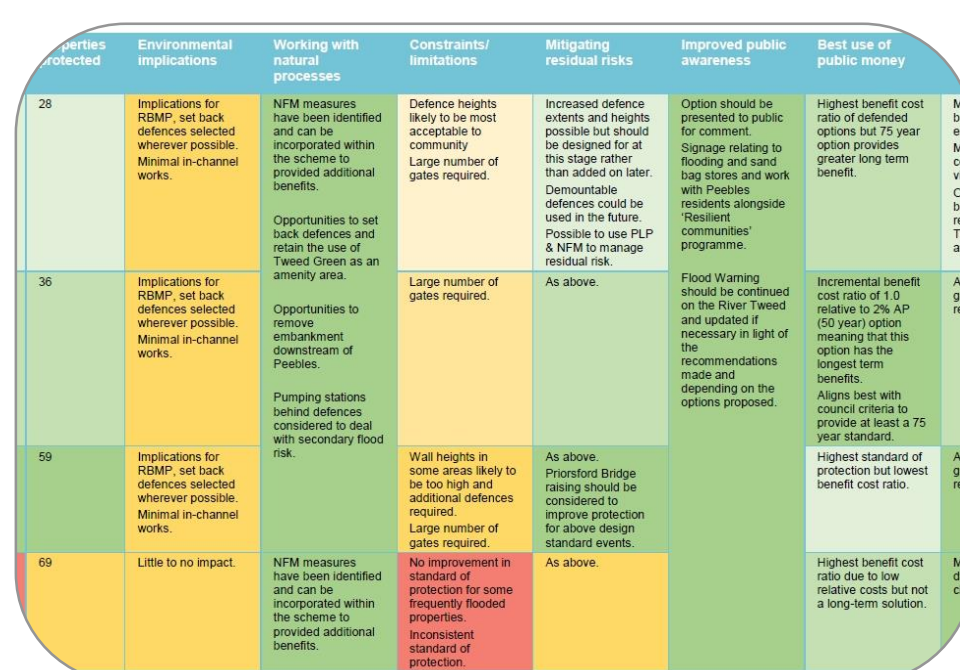
Flood Mapping

Return periods and annual probabilities

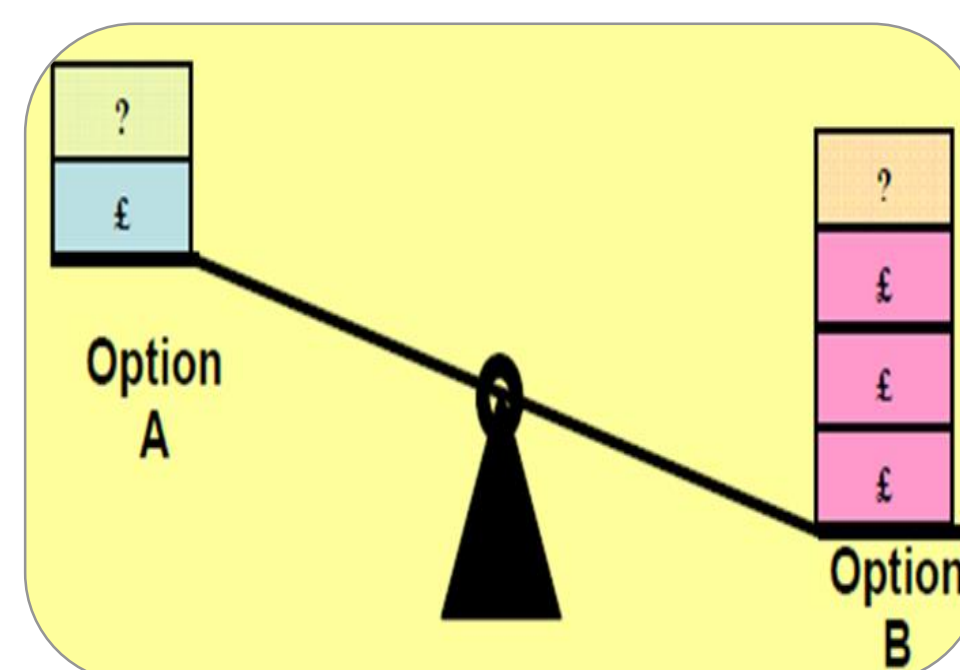
- When a river floods the severity of the flood is known as a 1 in x year flood. This terminology represents the probability of that event occurring in any year.
- For reference, the December 2015 event (Storm Frank) on the River Tweed in Peebles had a 1 in 55 chance of occurring in any year.
- This does not mean that the flood will occur once every 55 years; it could occur tomorrow and again next week, or not for another 200 years. But on average a flood of that severity will occur once every 55 years.
- For example, there is a 1 in 100 (or 1%) chance of a flood exceeding the 100 year flood in any one year.



Properties at
risk

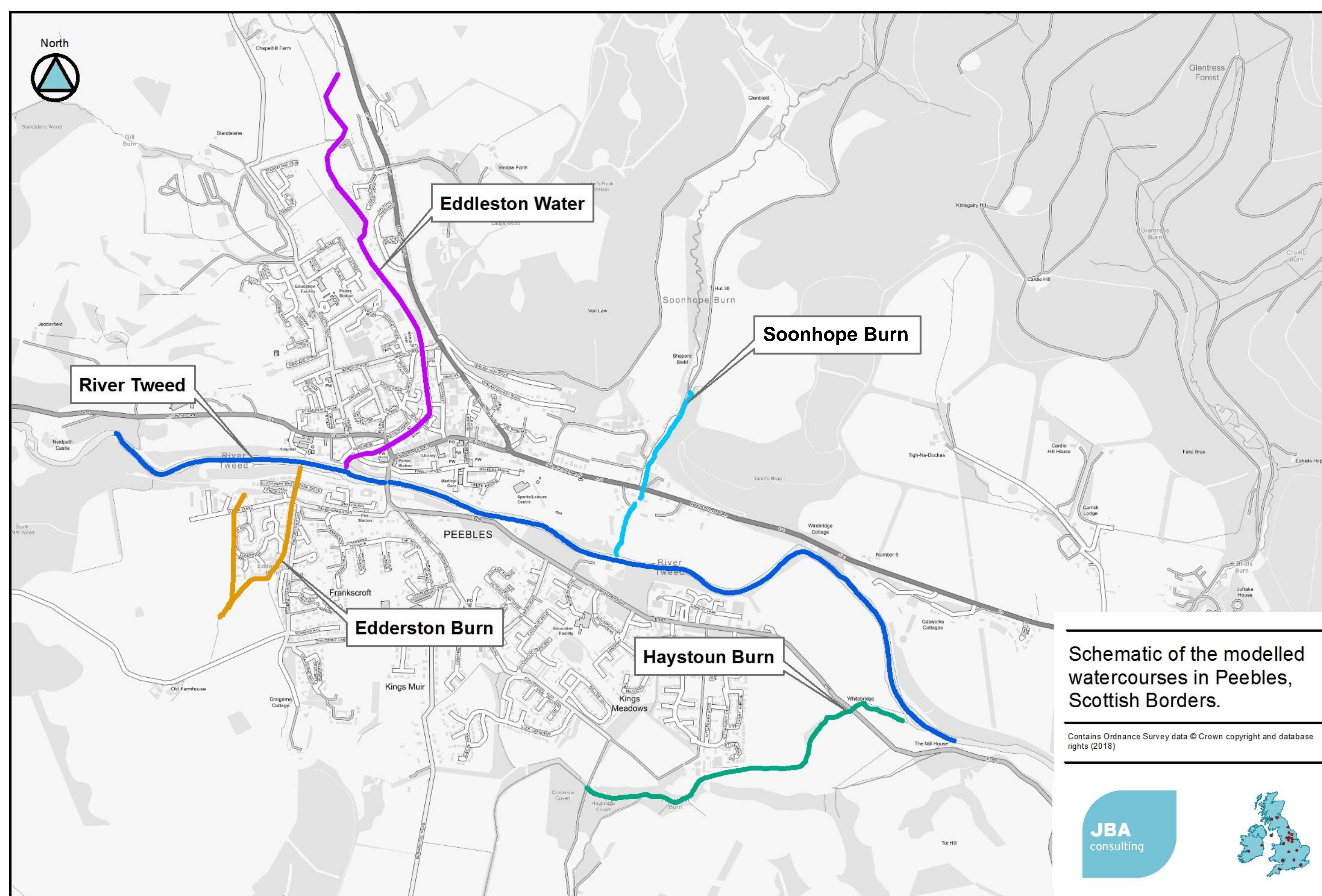


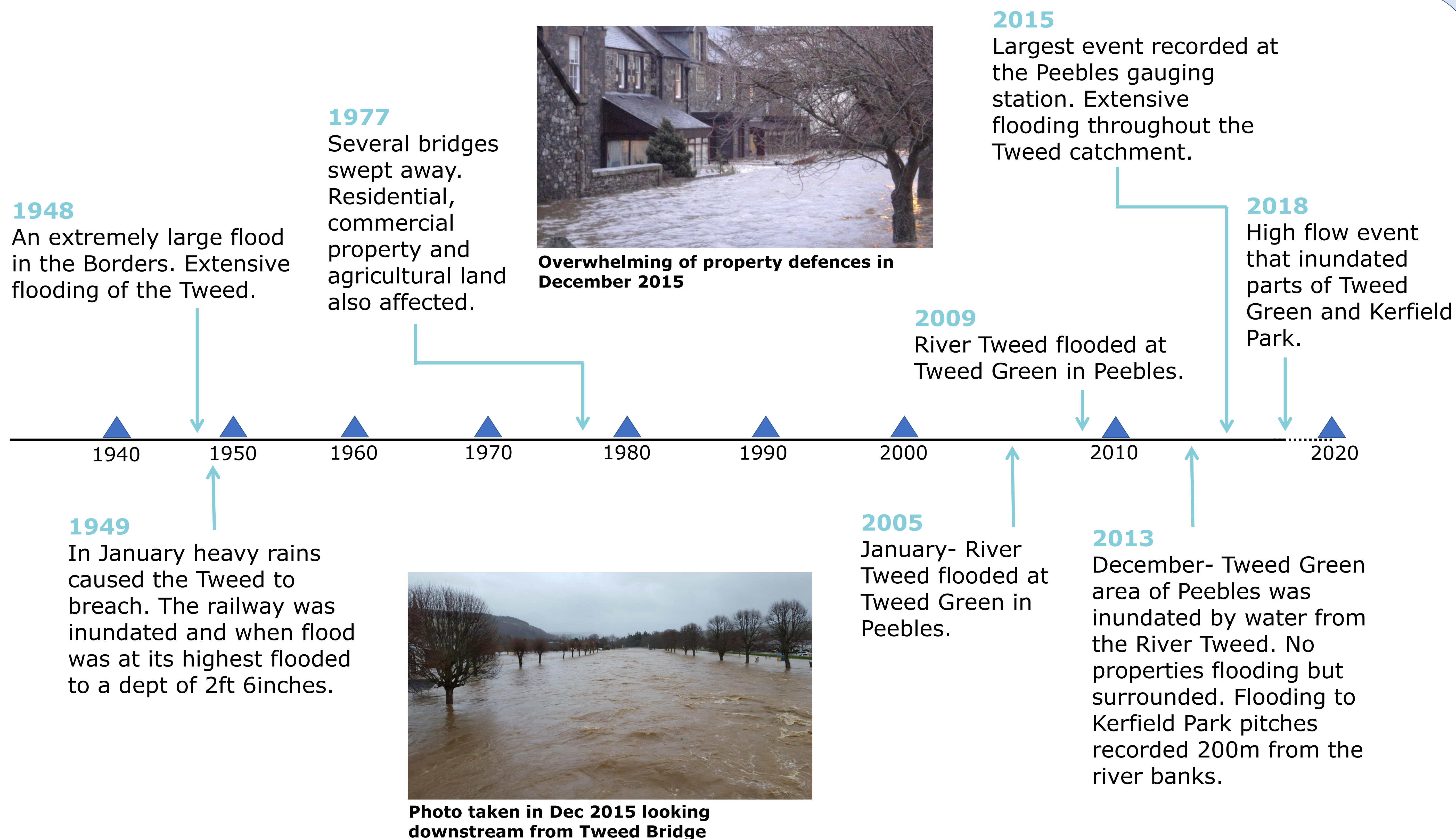
Options
Appraisal



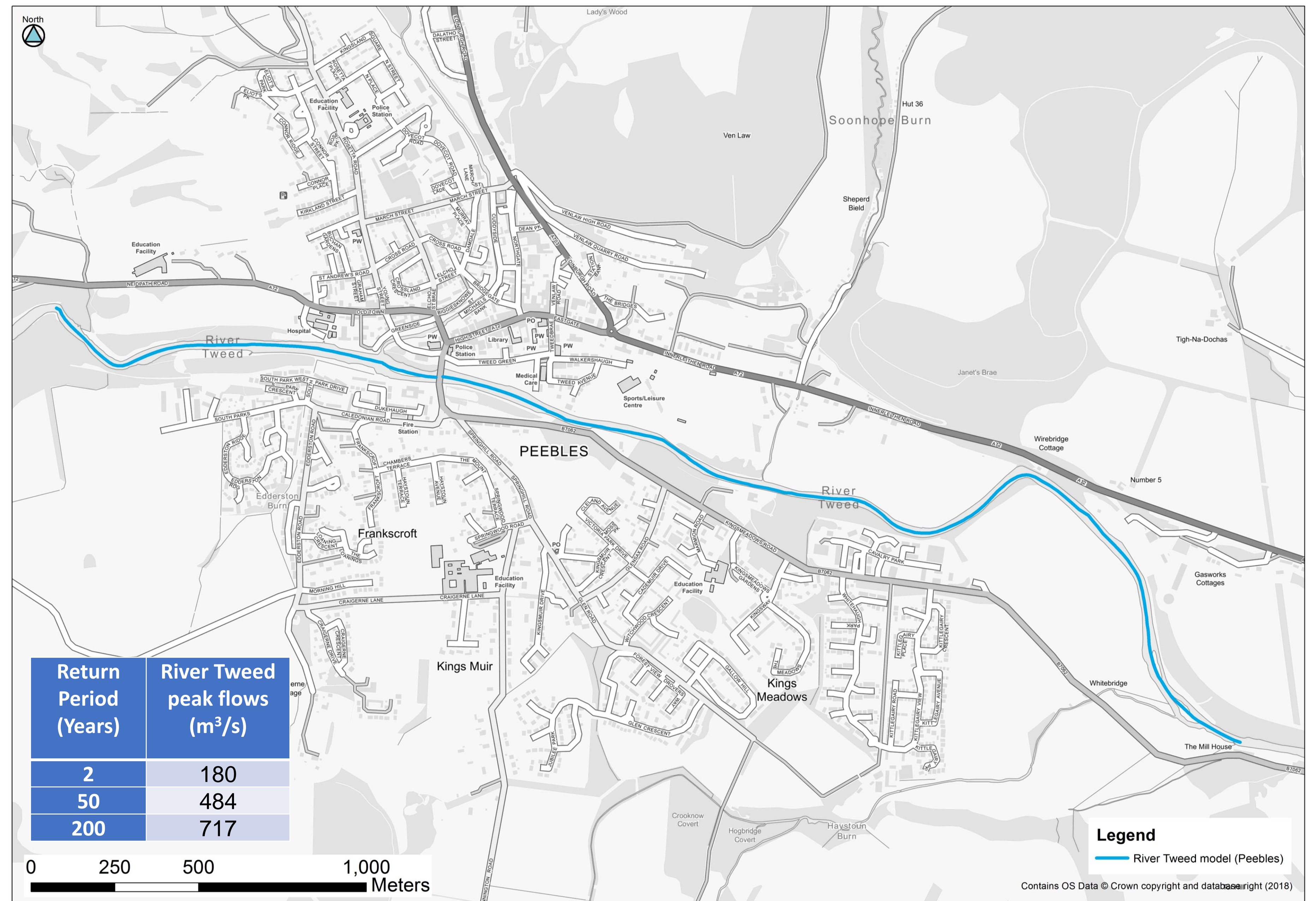
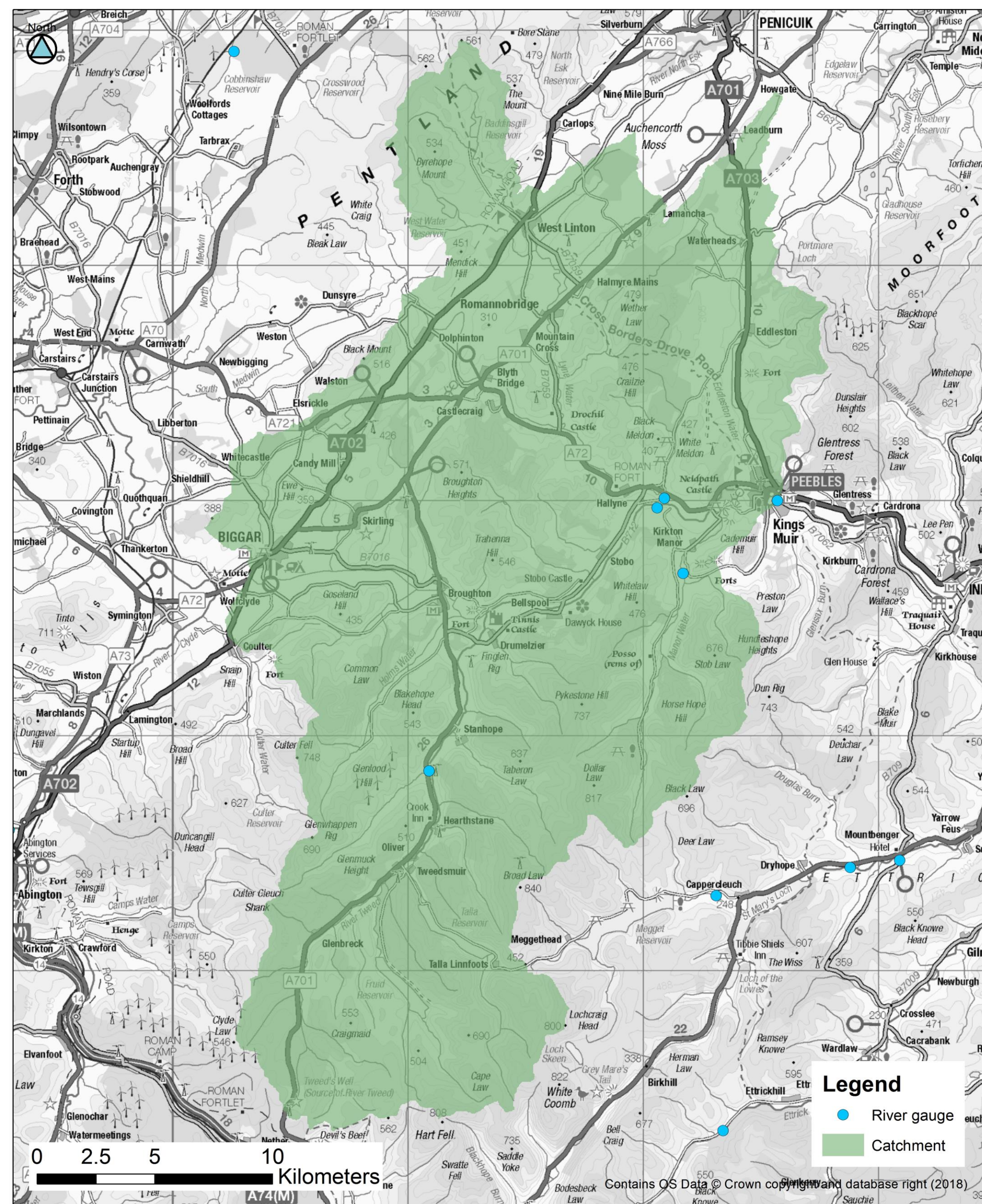
Cost-Benefit

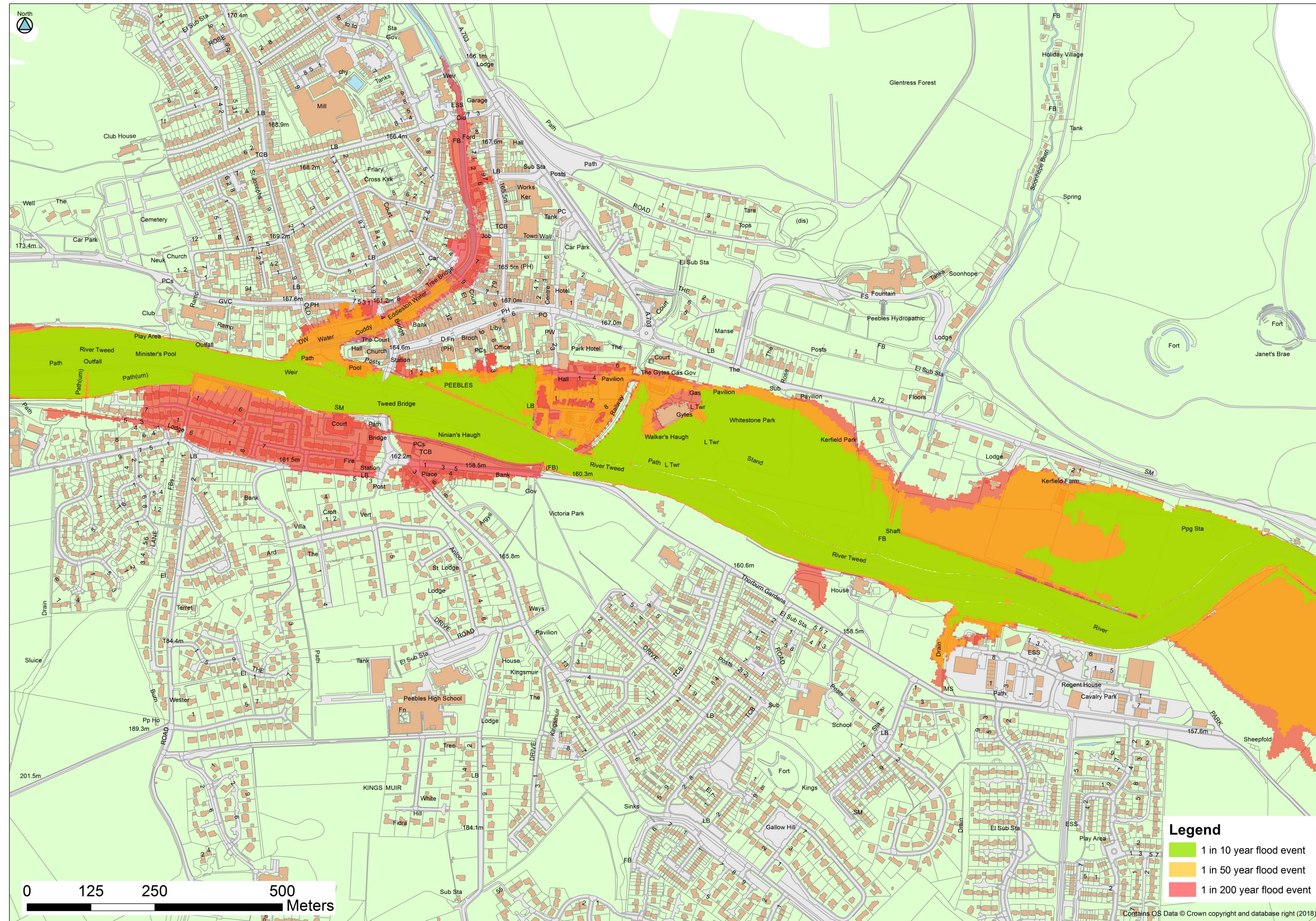
Peebles is at flood risk from the River Tweed, Edderston Burn, Eddleston Water, Soonhope Burn and Haystoun Burn. Each of the watercourses has its own mechanism of flood risk and the individual watercourses were therefore studied independently. The River Tweed is the largest of the assessed watercourses with a catchment area of 700km² followed by the Eddleston Water (70km²), Haystoun Burn (23km²), Soonhope Burn (9.5km²) and finally the Edderston Burn with a catchment area of under 2km². Some of the watercourses such as the Eddleston Water and the River Tweed have a long history of flooding whereas others have little available flood history.





The River Tweed has a catchment area of 700km² including a number of the other watercourses included in this flood study. The largest floods are likely to originate from the River Tweed but these floods do not necessarily flood the highest number of properties compared to the other watercourses. The Tweed was modelled from Peebles to Walkerburn but the main flood risk study focussed on Peebles only. The figures below show the catchment and the length of modelled channel.





Property Type	Number at Risk (1 in 200 year flood)
Residential	135
Commercial	23

How do we create these flood maps?

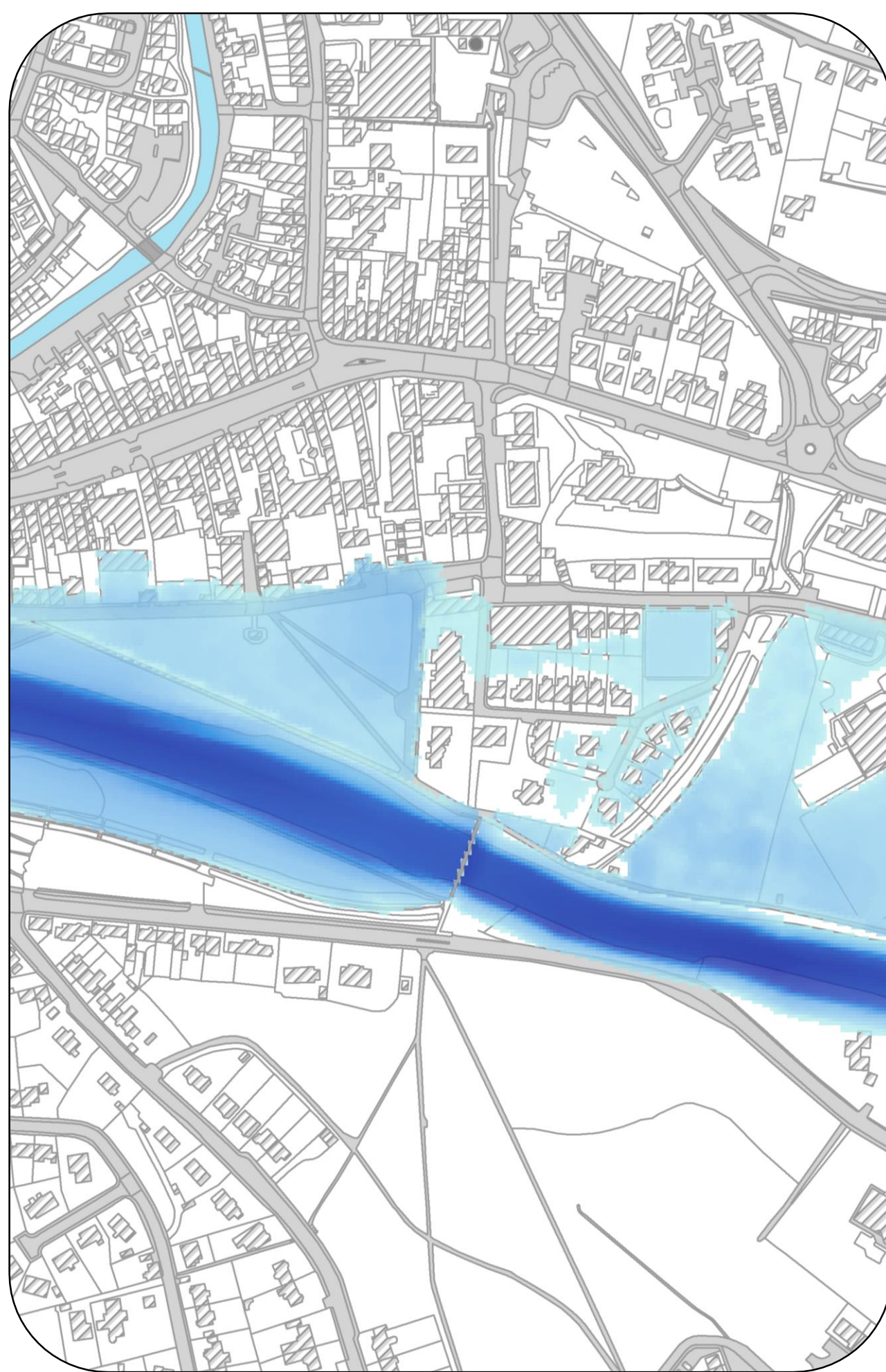
- A physical survey captured the measurements of river channels, banks and structures along each watercourse.
- These measurements were input to a computer model, along with calculated river flows for a range of storm events.
- This model produced a flood outline and estimated flood depths based on a 3D representation of the land surface and buildings. The outcome resulted in a detailed flood map.

What do the maps show?

- The mapping indicates the predicted flooding for a given flood magnitude.
- The 1 in 10 year map shows what is expected to be inundated for a flood that is likely to occur once every 10 years (or with a probability of 10% in any one year).
- The 1 in 200 year represents a flood event with a probability of 0.5% in any year.

Flood mechanisms on the River Tweed

Out of bank flow paths, key structures and constraints were identified. Flood first occurs around Kerfield Park and Tweed Green. Properties on Tweed Green are most frequently affected. Tweed Bridge and Priorsford Bridge have some influence on flood levels during larger floods but overall it is the low-lying floodplains and large volume of flood waters due to the large catchment size that lead to flooding.



Floodplain
flows



Bridges on the
River Tweed



Flood gates and PLP
near the Tweed

Has this flow mechanism been seen before?

Flood water is known to have overtopped the banks in various places throughout Peebles and further downstream.

Reports of historic floods like those in 1948, 1984, 2012 and 2015 show a similarity to our model results.

The aim of the scheme would be to proactively mitigate against flood events with frequent and significant impacts.

River Tweed Options appraisal – Long list of options

The process for selecting flood mitigation options involves assessing a wide range of possible measures and narrowing it down to a short list according to whether the options are technically, environmentally and socially acceptable. Those that are short listed are shown in the following posters. The full list of options assessed is provided below:

- **Relocation** - Relocation or abandonment of properties not usually socially or politically viable.
- **Flood Warning** – Warning on the River Tweed should be maintained.
- **Resistance Measures** – Property level protection is well suited to the shallow flood depths experienced in some flood events but not all on this large watercourse. 39 properties already have property level measures in place.
- **Resilience Measures** - Unlikely to be economically viable.
- **Watercourse Maintenance** – Council should continue the scheduled maintenance regime.
- **Natural Flood Management** – Some opportunities identified within the upper catchment and sub-catchments but unlikely to sufficiently reduce peak flows for large magnitude floods. Further investigation is still required.
- **Storage** – Insufficient space away from houses and roads to store sufficient volumes of flood water.
- **Control structures** – The large structures that would be required on the River Tweed are not feasible.
- **Demountable Defences** – A suite of permanent walls or embankments is more suitable than demountable defences.
- **Direct Defences** – A combination of walls and embankments could contain flows on the watercourse to a high standard of protection.
- **Channel Modification** – Not capable of delivering long-term benefits.
- **Diversion channel** – No suitable route for the diversion.
- **Structure Modification** – Modification of Tweed Bridge and Priorsford Bridge likely to bring some benefit but only in combination with some other flood protection measures.

Most desirable options

Good practice and partial solutions

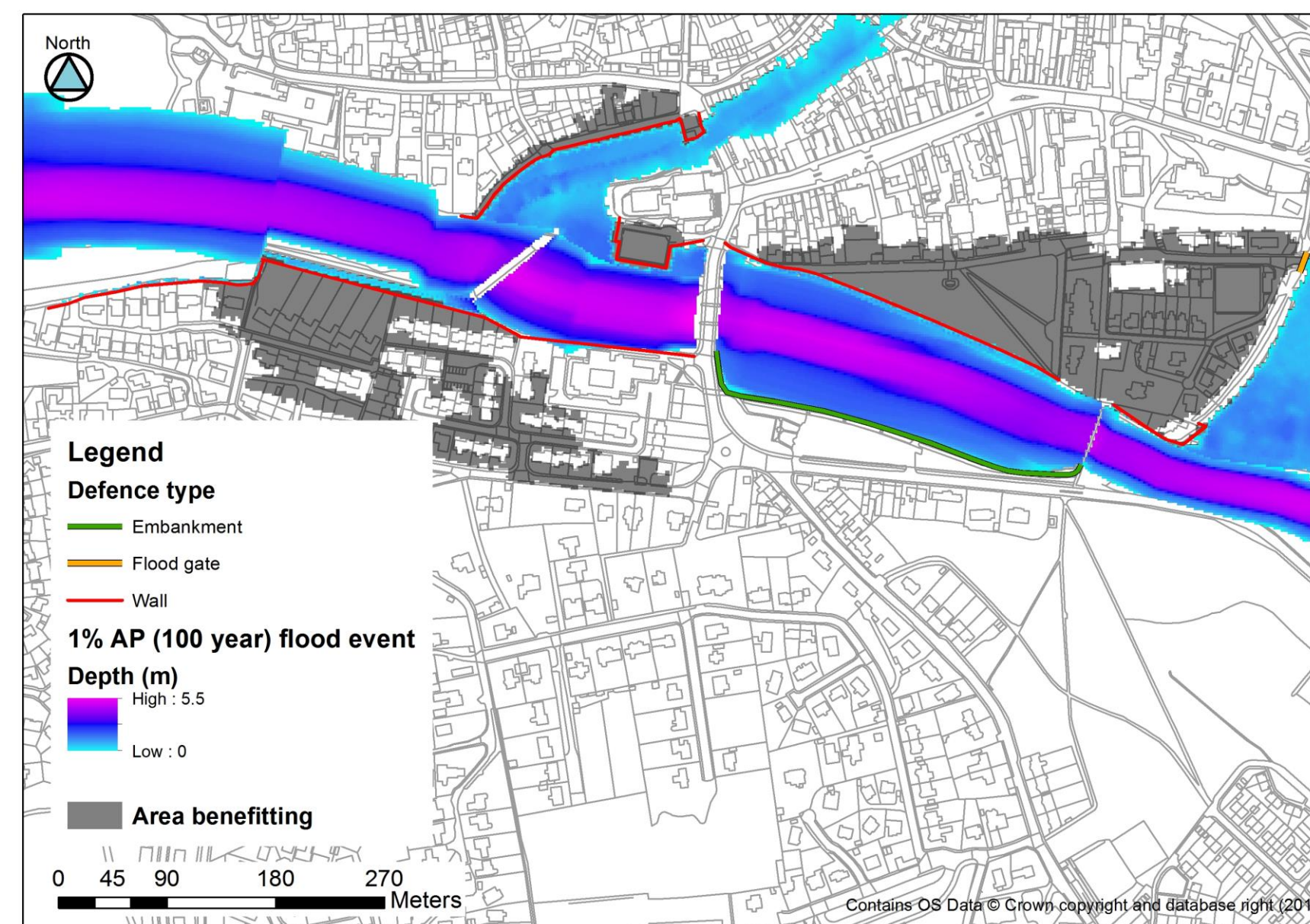
Least desirable options

Option 1: Direct flood defences (walls and embankments)

- Three sub-options have been proposed with increasing standards of protection from 50 to 100 years – The different defence heights required for each standard of protection are shown on the supporting drawings.
- Initial assessment suggests average wall height on Tweed Green would be 1.0-1.3m.
- Climate change adaptation would require longer and taller defences as well as bridge modifications.
- Estimated cost £2.0-4.3m.
- Estimated damage avoided £15.6-16.7m.



Typical example of a flood wall



Proposed flood defences

See adjacent technical drawings for further details of this option.

What are your views on the different standards of protection?

Why not protect against the 1 in 200 year flood?

There are pros and cons to increasing the standard of protection to protect against the 1 in 200 year flood event.

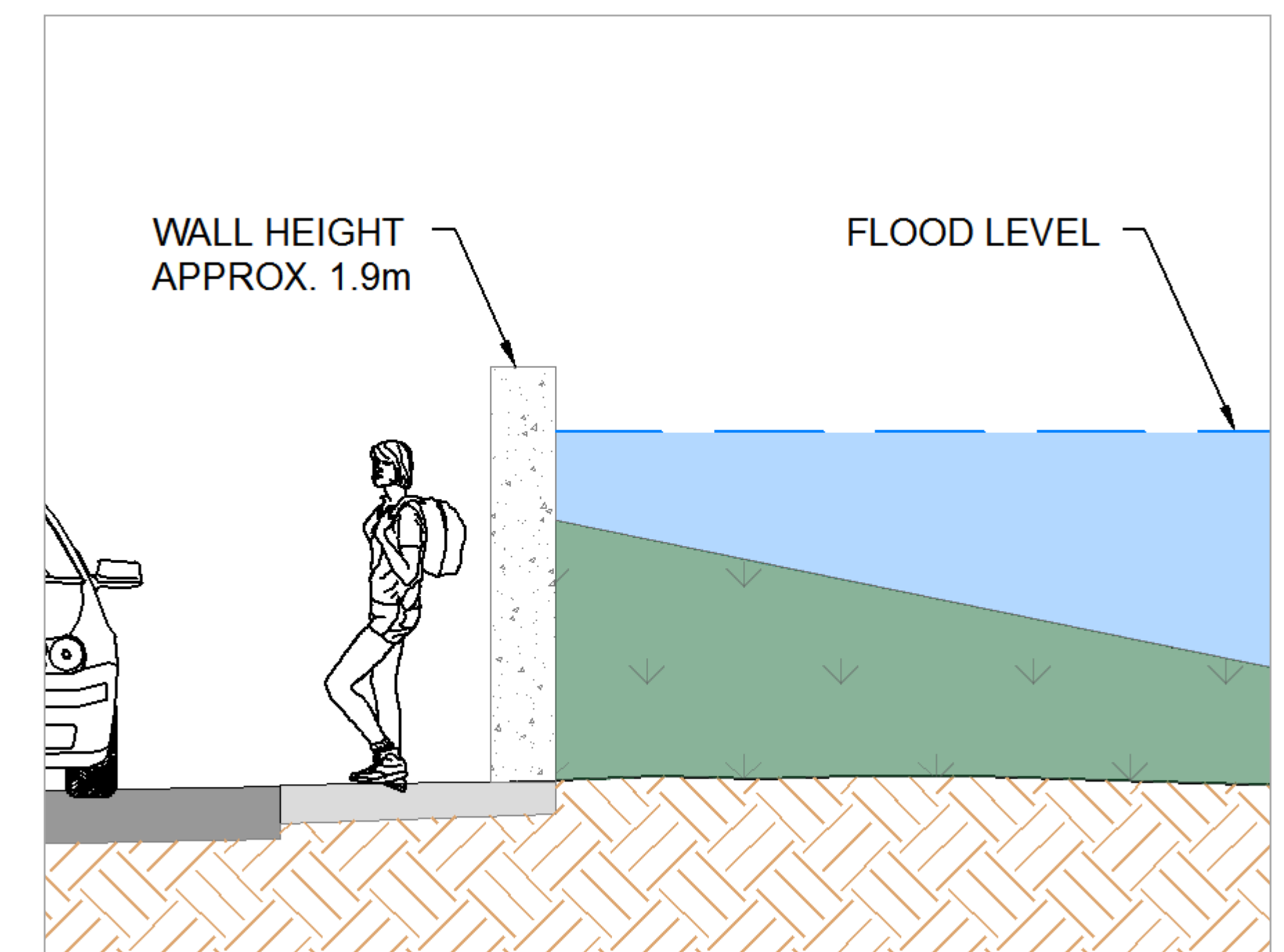
Pros –

- Increased standard of protection
- Reduced flood risk

Cons –

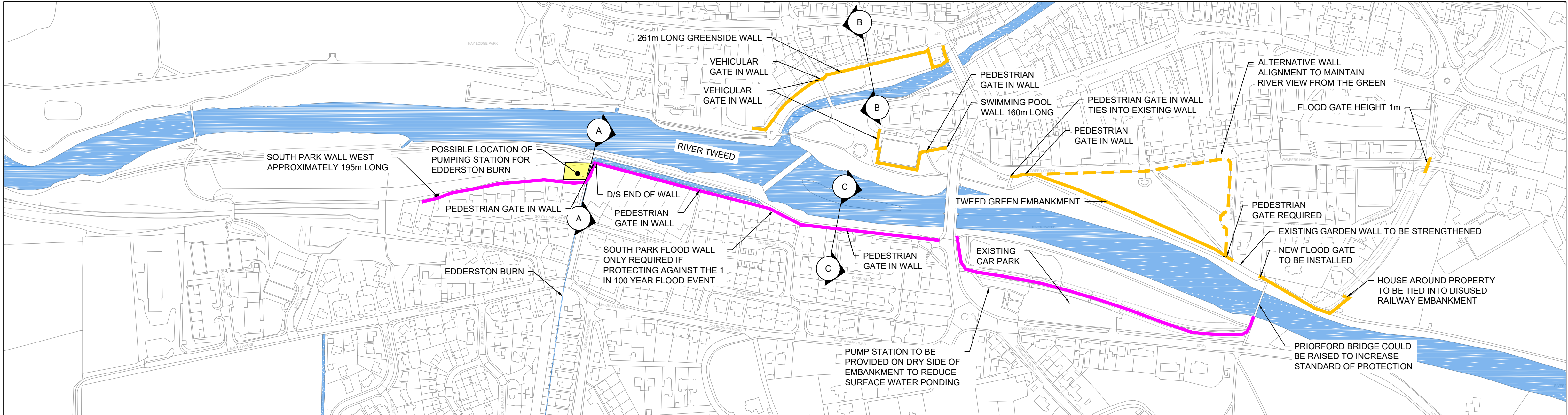
- Unsuitable defence heights for public spaces.

We have discounted protecting to such a high standard for aesthetic reasons as shown below.

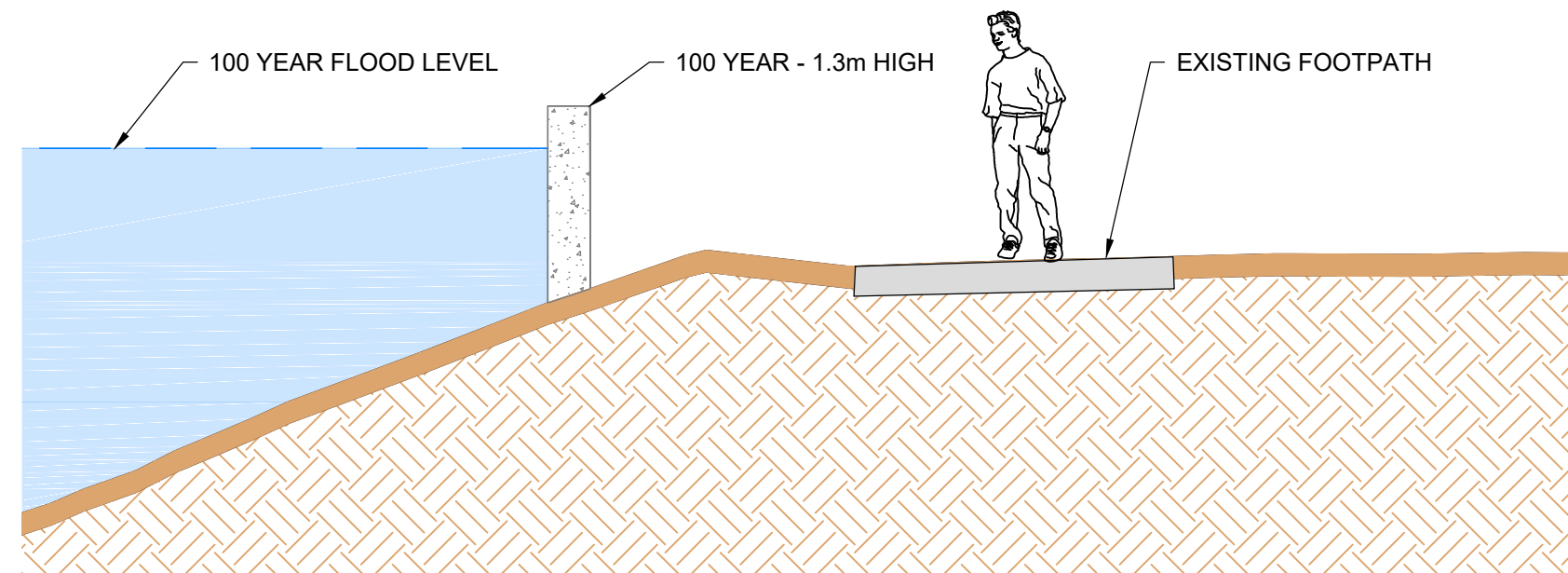


200 year defence on Tweed Green

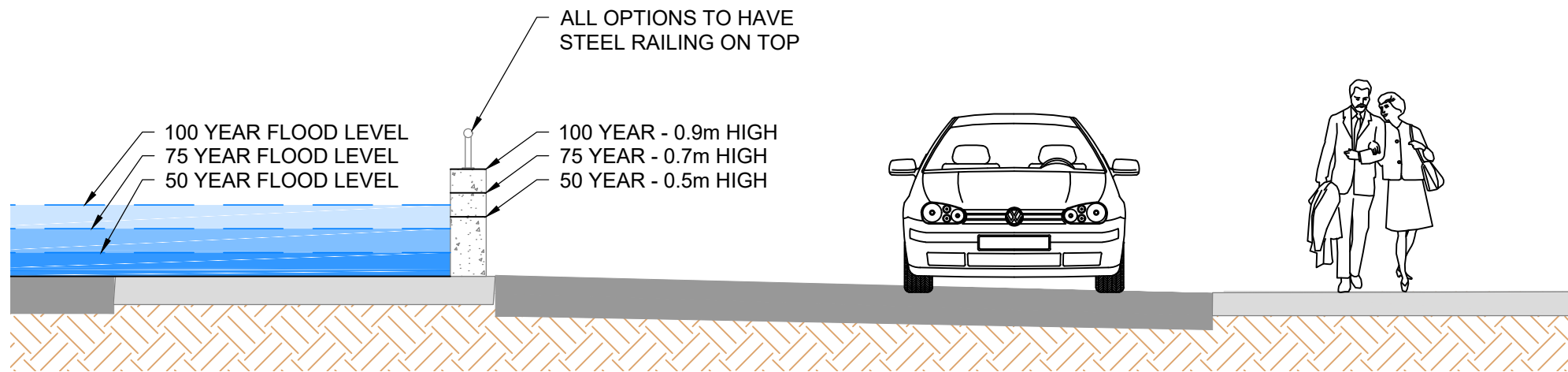
Peebles
Option 1: River Tweed
50-100 Year Direct Defences



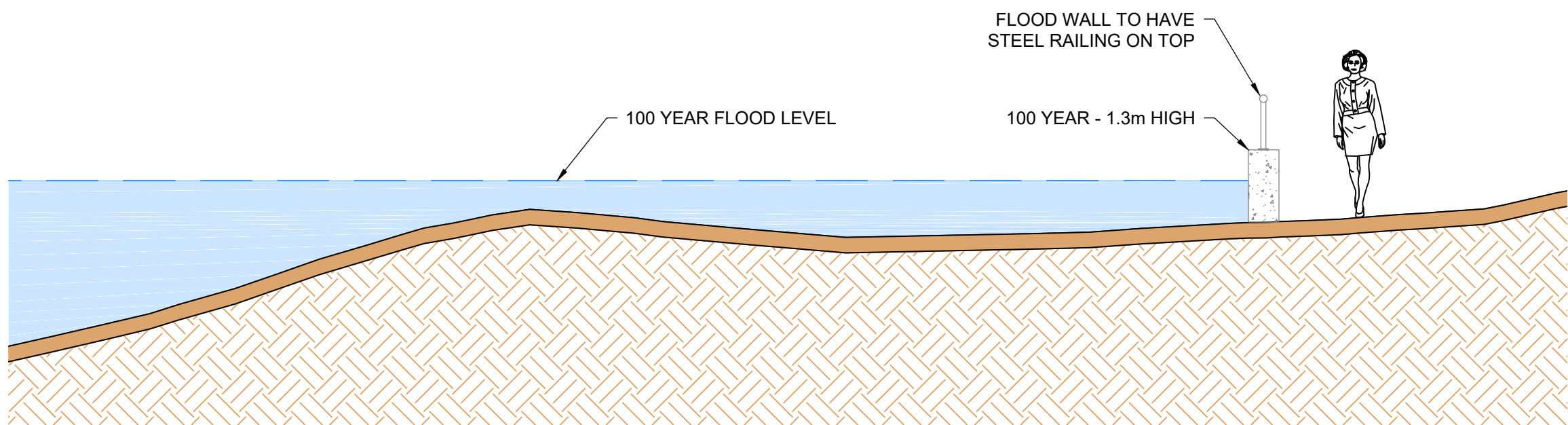
PLAN



SECTION A-A



SECTION B-B



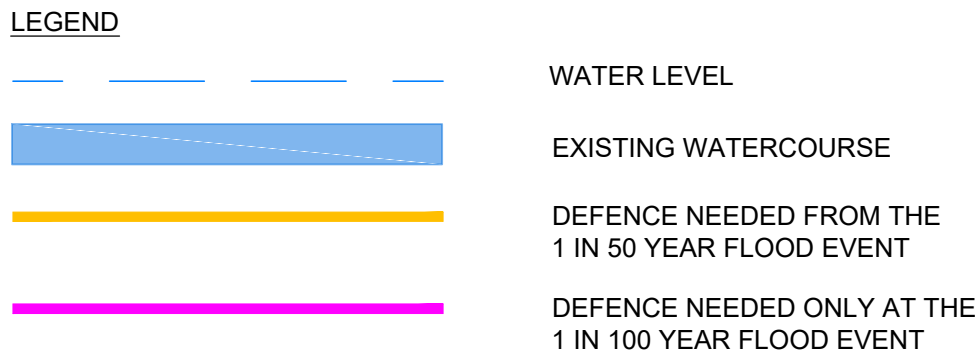
SECTION C-C: SOUTH PARK WALL - ONLY REQUIRED TO PROTECT AGAINST THE 1 IN 100 YEAR FLOOD EVENT



SECTION B-B
As it currently looks



SECTION B-B
Artist interpretation of wall with indicated gate for car park



Comments					
Rev.:	Date	Drawn	Designed	Checked	Approved
Client Approval					
A - Approved					
B - Approved with Revisions					
C - Do Not Use					
Purpose of Issue				Status	S1

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Project

Borders Flood Studies


Title

Peebles
River Tweed: Option 1
Direct Defences
for

Client

M
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MACDONALD

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MACDONALD



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Drawing Number

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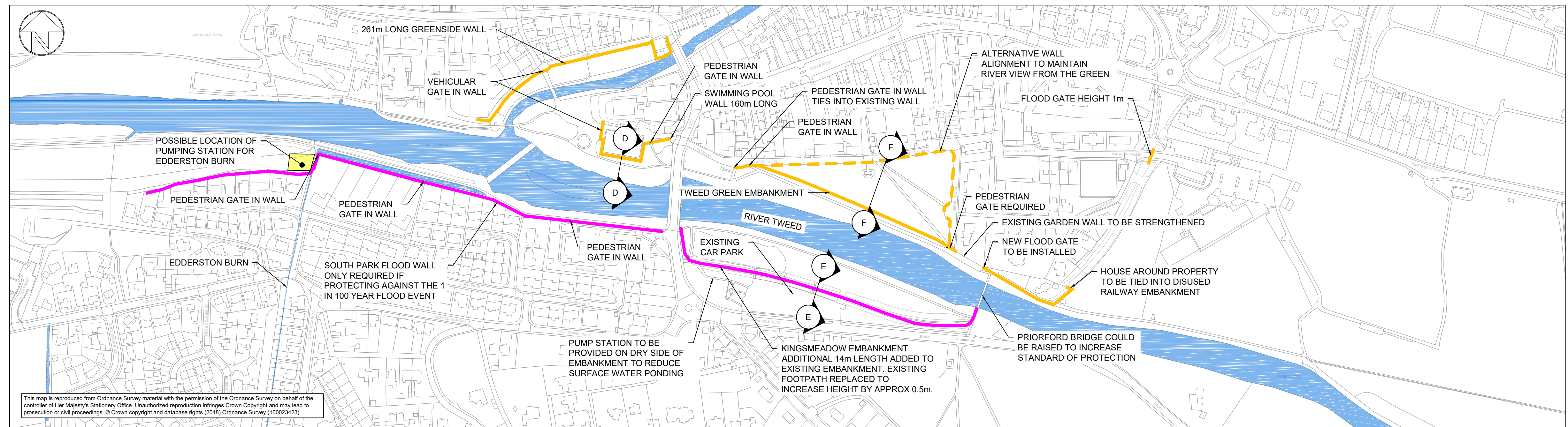
Revision

P02

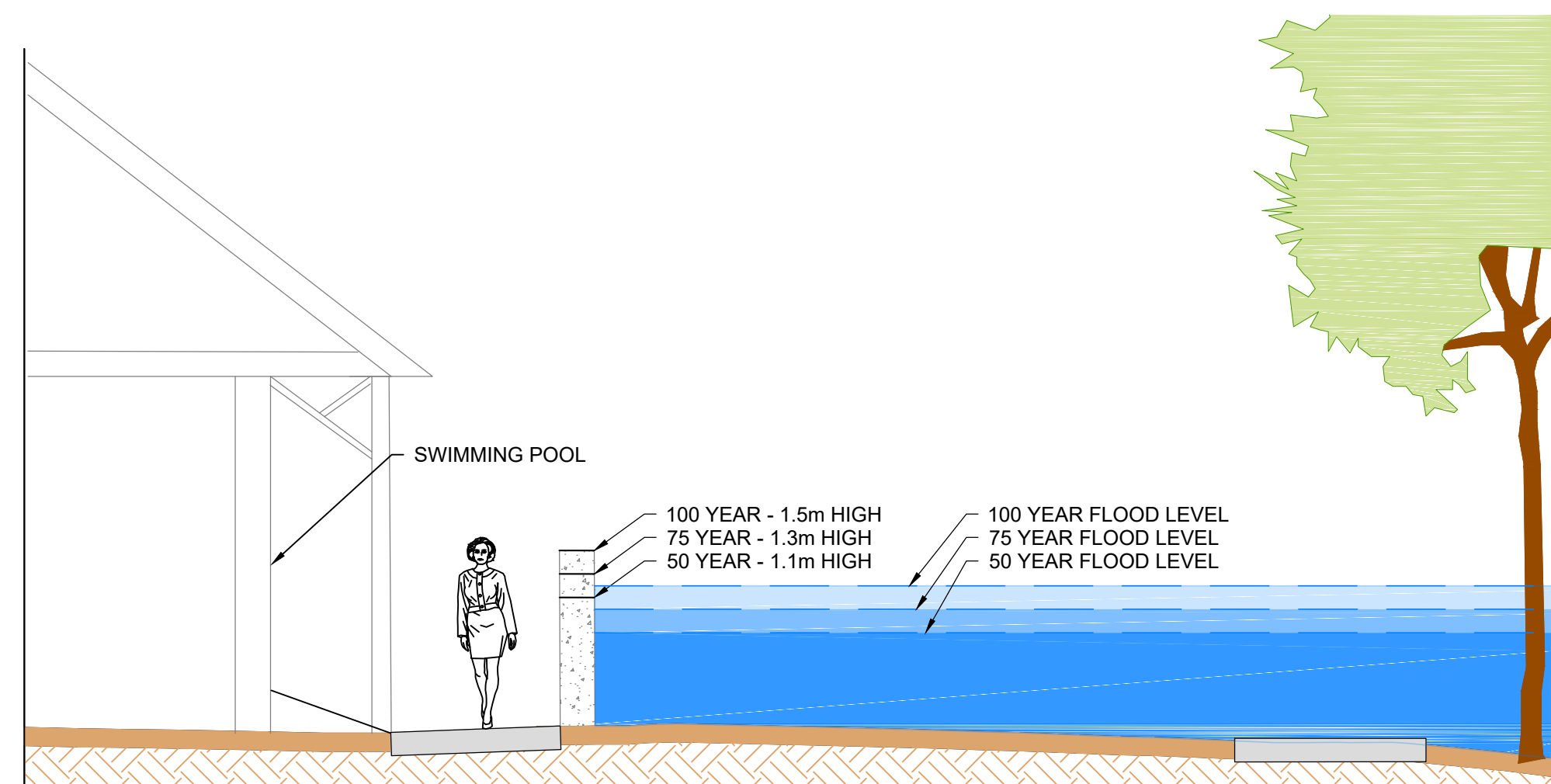
Peebles

Option 1: River Tweed

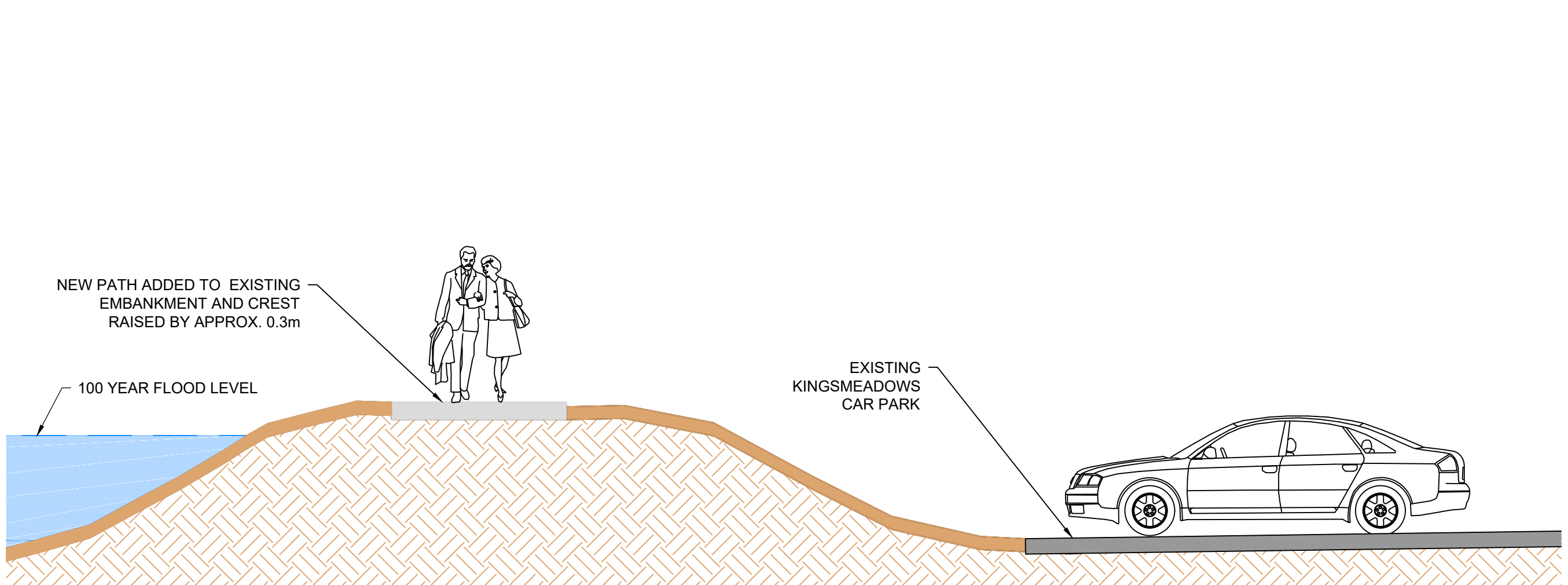
50-100 Year Direct Defences



PLAN

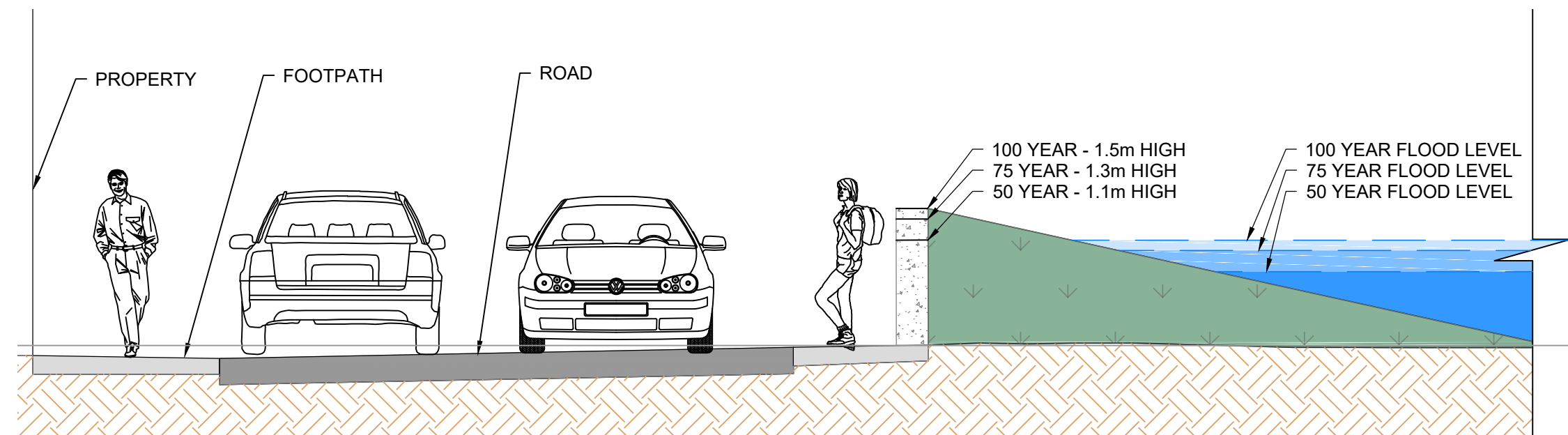


SECTION D-D: SWIMMING POOL

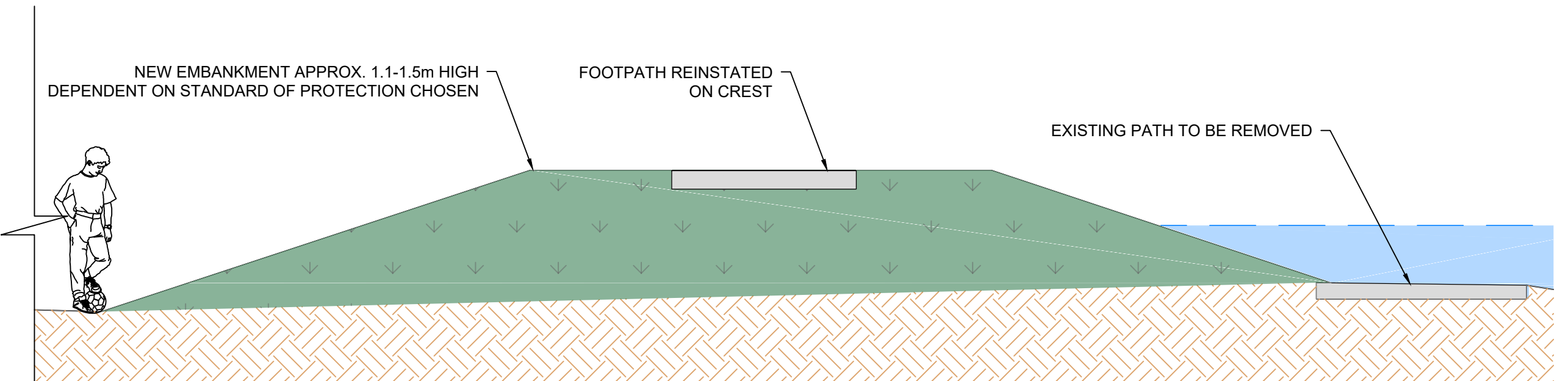


SECTION E-E: KINGSMEADOWS EMBANKMENT

Options for Tweed Green flood defence



SECTION F-F: OPTION 1 - WALL AND EMBANKMENT SET BACK FROM THE RIVER



SECTION F-F: OPTION 2 - EMBANKMENT ON THE RIVER SIDE

OPTION SUMMARY: Direct defences option which provides protection from either 1 in 50, 1 in 75 or 1 in 100 year flood events. Fewer defences and lower defence heights are required for the 1 in 50 year option whereas more defences and taller defences are required to protect against the larger 1 in 100 year event.

LEGEND



- WATER LEVEL
- EXISTING WATERCOURSE
- DEFENCE NEEDED FROM THE 1 IN 50 YEAR FLOOD EVENT
- DEFENCE NEEDED ONLY AT THE 1 IN 100 YEAR FLOOD EVENT

Comments					
Rev.:	Date	Drawn	Designed	Checked	Approved
Client Approval					
A - Approved					
B - Approved with Revisions					
C - Do Not Use					
Purpose of Issue				Status	S1

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consulting

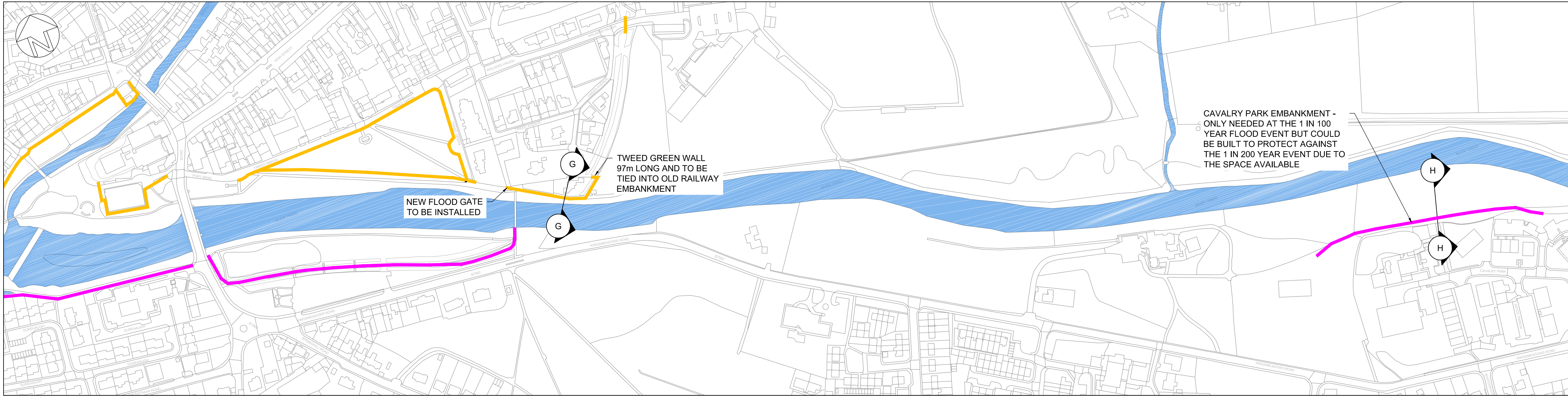
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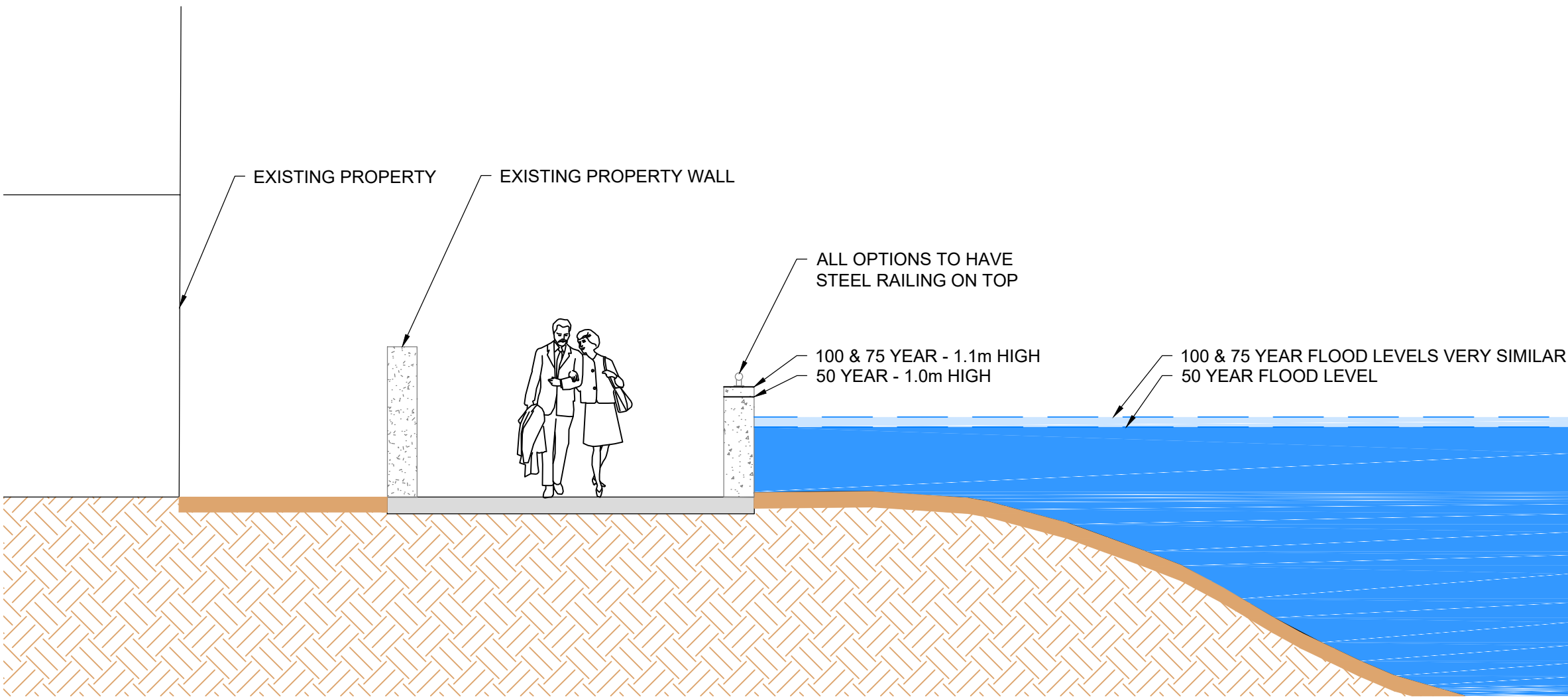
Project	Borders Flood Studies	
Title	Peebles River Tweed: Option 1 Direct Defences for	
Client	 	

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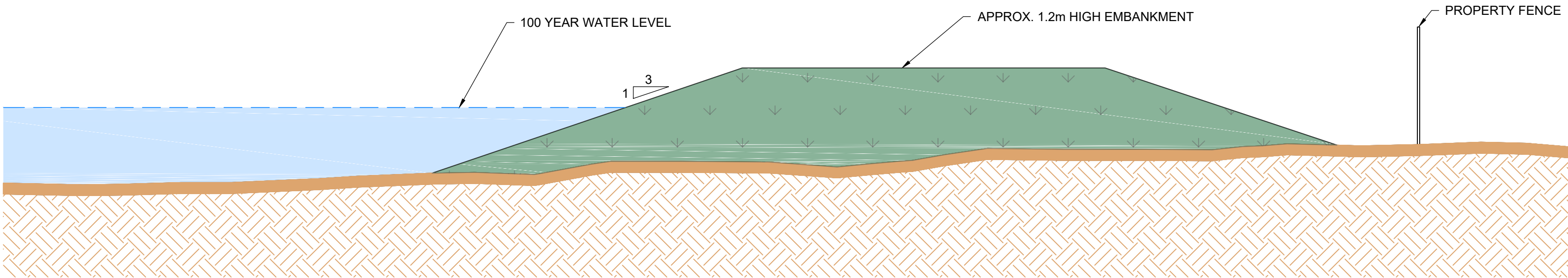
Peebles
Option 1: River Tweed
50-100 Year Direct Defences



PLAN



SECTION G-G



SECTION H-H

LEGEND	
	WATER LEVEL
	EXISTING WATERCOURSE
	DEFENCE NEEDED FROM THE 1 IN 50 YEAR FLOOD EVENT
	DEFENCE NEEDED ONLY AT THE 1 IN 100 YEAR FLOOD EVENT

Comments					
Rev.:	Date	Drawn	Designed	Checked	Approved
Client Approval					
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B - Approved with Revisions					
C - Do Not Use					
Purpose of Issue				Status	S1
Suitable for Coordination					

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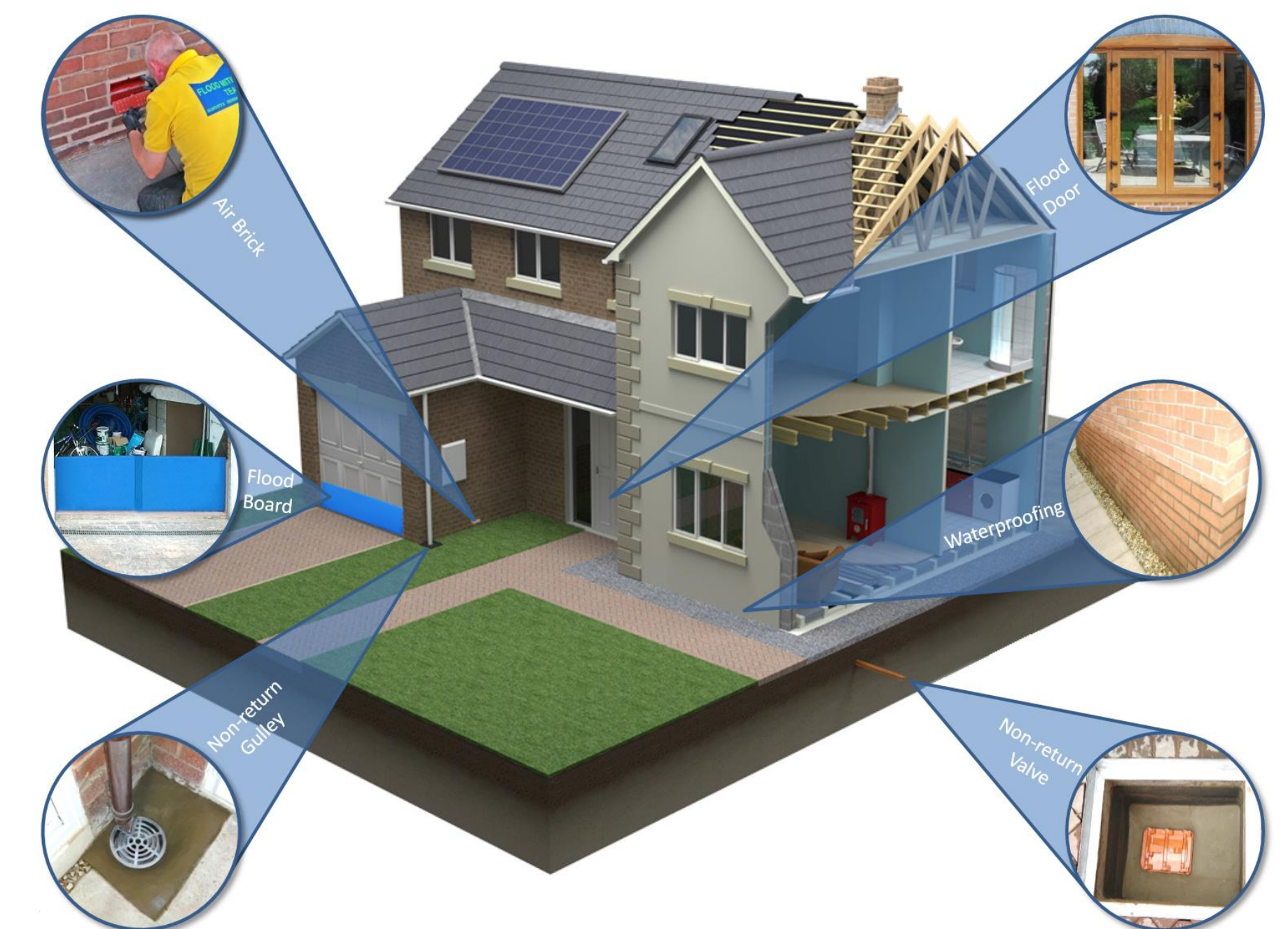
Option 2 - Property Level Protection – River Tweed

PLP is the last form of defence before water gets into a building. Automatic PLP is proposed for each property at risk from the River Tweed that floods to a depth of under 0.6m – 73 residential and 1 non-residential. The property with the lowest standard of protection would be protected to the 1 in 10 year flood event but some others would be protected up to the 1 in 1000 year flood event.

PLP would involve surveying each property to identify entry points and recommend appropriate PLP, but could include self sealing doors, air bricks and non return valves on plumbing.

- Estimated cost £1.8m
- Estimated damage avoided £14.2m

Standard of protection map – indicating the existing level of protection of each property



Examples of how Property Level Protection can mitigate the risks of flood inundation (image courtesy of Whitehouse Construction Co. Ltd)

Can we remove the sediment?

1) Is gravel causing a flood risk problem?

In the past sediment in some watercourses in the Border towns was intermittently removed. Furthermore, in some locations it is believed that the bed level of rivers is rising as a result of a long term build up of silt and gravel. Whilst sediment does build up locally, these deposits are not new and the formation and erosion of sediment in Peebles is a **natural process** balanced over thousands of years.

2) Why is sediment in rivers important?

River sediments and their movements form **important habitats for plants, fish and animals**. The removal of sediment can lead to a loss of, or damage to these habitats. Sediment removal can disturb the natural equilibrium of a river which can cause **serious problems with river stability**, often leading to erosion downstream.

3) Would removal of sediment or the gravel island reduce the flood risk?

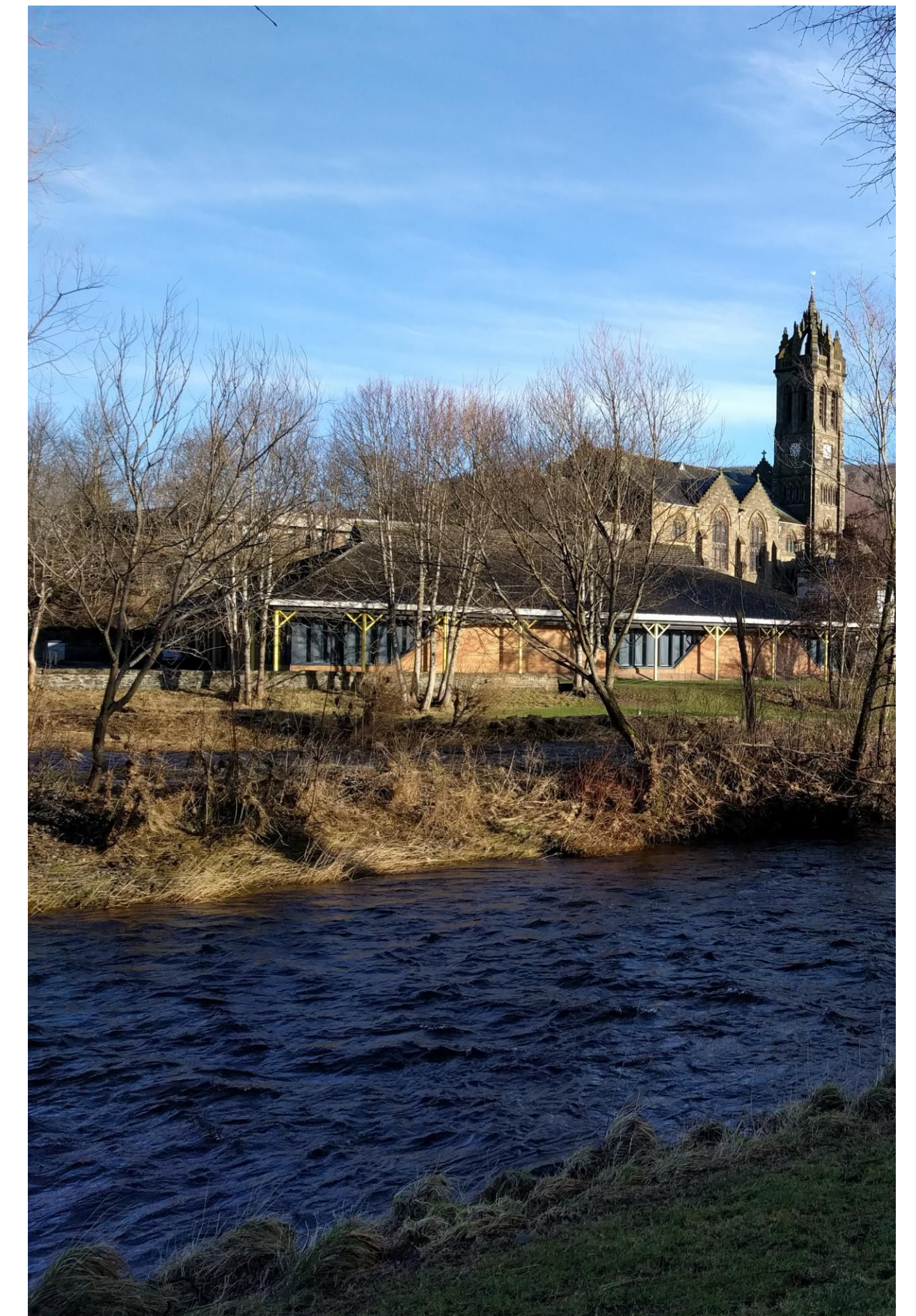
While sediment removal appears a straight forward solution to flooding, evidence indicates that it does not work on large rivers moving at pace. Our assessment has shown that on the River Tweed there would be little benefit in reducing river bed levels through sediment removal. Additionally, during a flood the water will move material downstream and fill in any dredged areas back to their original level very quickly. **Removal of the gravel island has previously been tested and no significant reduction in flood levels was identified.**

The reasons why wide-scale bed modification is not actively undertaken are as follows:

- Any additional conveyance created by a lowered river channel is **very quickly lost**.
- It is **not considered a sustainable option**; expensive **repeat works** are required to maintain bed levels.
- **Additional bank stabilisation** works may also be required. In many locations this may require **construction of walls** down to bed level, **removal of riparian land** (gardens) and extensive rock armour.
- Sediment removal carried out in watercourses requires **regulatory legislation** enforced by SEPA and would require sufficient evidence to support any such applications for removal.

4) What else could be done?

We have looked at a number of other options to mitigate the flood risk to Peebles from all watercourses. This includes options for natural flood management in the upper catchments that may help to manage sediment transport into the downstream reaches. Further modelling is required to investigate the benefits of these options.



Summary of short listed options

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
Direct Defences (2% AP - 50 year)	28	Implications for RBMP, set back defences selected wherever possible. Minimal in-channel works.	NFM measures have been identified and, subject to further investigation, could be incorporated within the scheme to provided additional benefits. Further modelling and discussion with landowners is required to determine the most appropriate measures and locations for these works and the benefits they may provide.	Defence heights likely to be most acceptable to community Large number of gates required.	Increased defence extents and heights possible but should be designed for at this stage rather than added on later. Demountable defences could be used in the future. Possible to use PLP & NFM to manage residual risk.	Option should be presented to public for comment. Signage relating to flooding and sand bag stores and work with Peebles residents alongside 'Resilient communities' programme.	Highest benefit cost ratio of defended options but 75 year option provides greater long term benefit.
Direct Defences (1.33% AP - 75 year)	36	Implications for RBMP, set back defences selected wherever possible. Minimal in-channel works.	Opportunities to set back defences and retain the use of Tweed Green as an amenity area.	Large number of gates required.	As above.	Flood Warning should be continued on the River Tweed and updated if necessary in light of the recommendations made and depending on the options proposed.	Incremental benefit cost ratio of 1.0 relative to 2% AP (50 year) option meaning that this option has the longest term benefits. Aligns best with council criteria to provide at least a 75 year standard.
Direct Defences (1% AP - 100 year)	59	Implications for RBMP, set back defences selected wherever possible. Minimal in-channel works.	Opportunities to remove embankment downstream of Peebles. Pumping stations behind defences considered to deal with secondary flood risk.	Wall heights in some areas likely to be too high and additional defences required. Large number of gates required.	As above. Priorsford Bridge raising should be considered to improve protection for above design standard events.		Highest standard of protection but lowest benefit cost ratio.
PLP (10% AP – 10 year)	74	Little to no impact.	NFM measures have been identified and, as explained above, could be incorporated within the scheme to provided additional benefits.	No improvement in standard of protection for some frequently flooded properties. Inconsistent standard of protection.	As above.		Highest benefit cost ratio due to low relative costs but not a long-term solution.

Negative Neutral Positive

Preferred Options and recommendations

The preferred option for Peebles is the direct defences option protecting to a 75 year flood event.

The PLP option could be extended beyond those properties that are already covered by the existing PLP scheme.

The short term recommendations are:

- Awareness raising for sandbag stores and flooding in general.
- Monitor bank erosion and carry out repairs where necessary.
- Manage vegetation on the banks and in-channel.

What can we do in terms of natural flood management?

What is natural flood management?

Natural flood management (NFM) is when natural processes are used to reduce the risk of flooding by slowing flows and storing water within the catchment. It is however difficult to quantify the reduction in flow that these types of measures can deliver. NFM also offers additional wider benefits by restoring habitats and improving water quality.

NFM opportunities were first identified by examination of aerial photography and were confirmed with a site visit at sample locations.

The NFM measures which have been proposed for the Tweed catchment include:

- Upland drain blocking
- Working within the banks (buffer strips, debris dams)
- Woodland planting including in gully's
- Sediment management.

The Council will need to investigate the potential benefits before working with other parties on developing these options further.



Typical example of a meandered channel

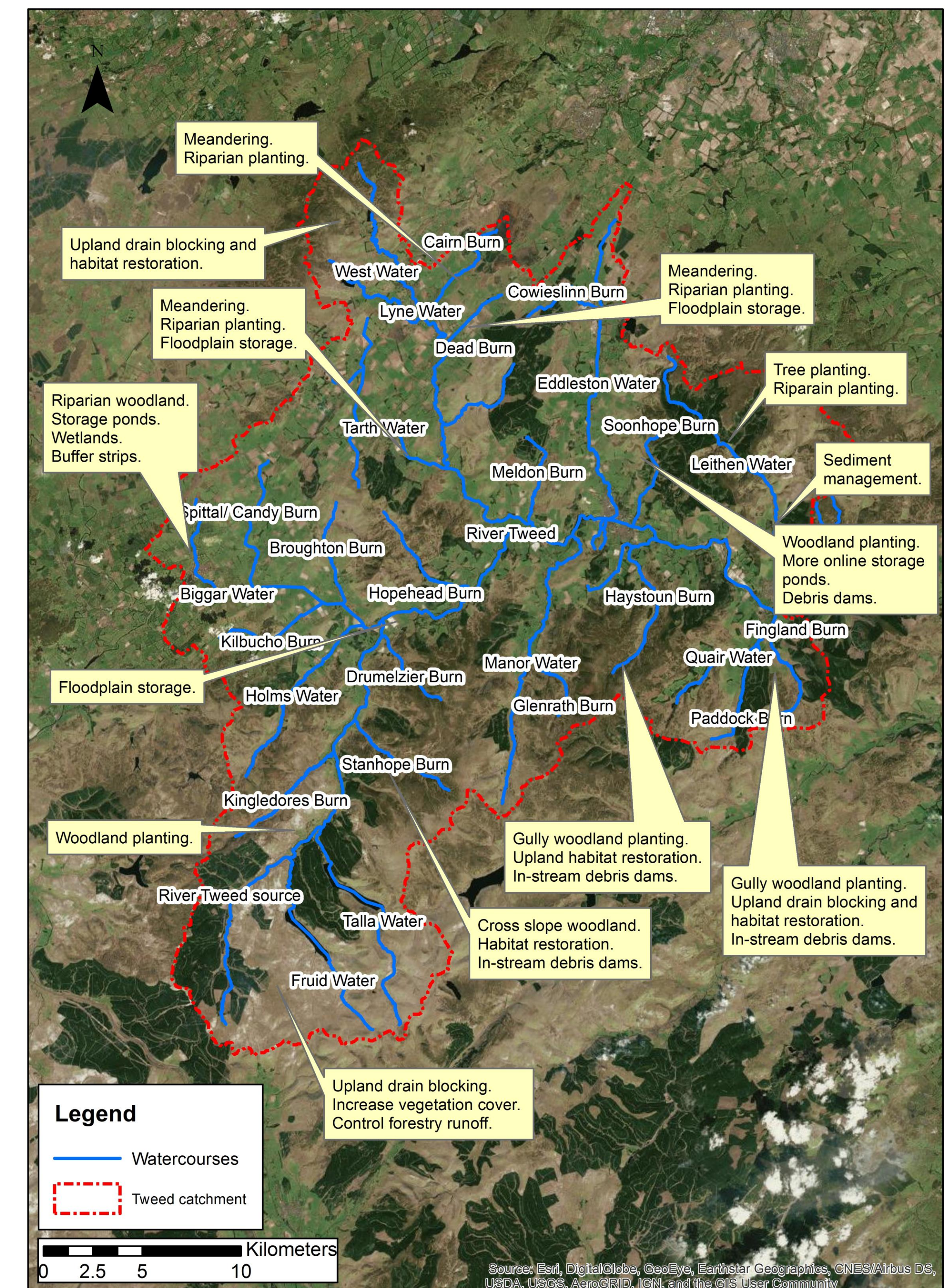


Typical example of in-channel debris barrier

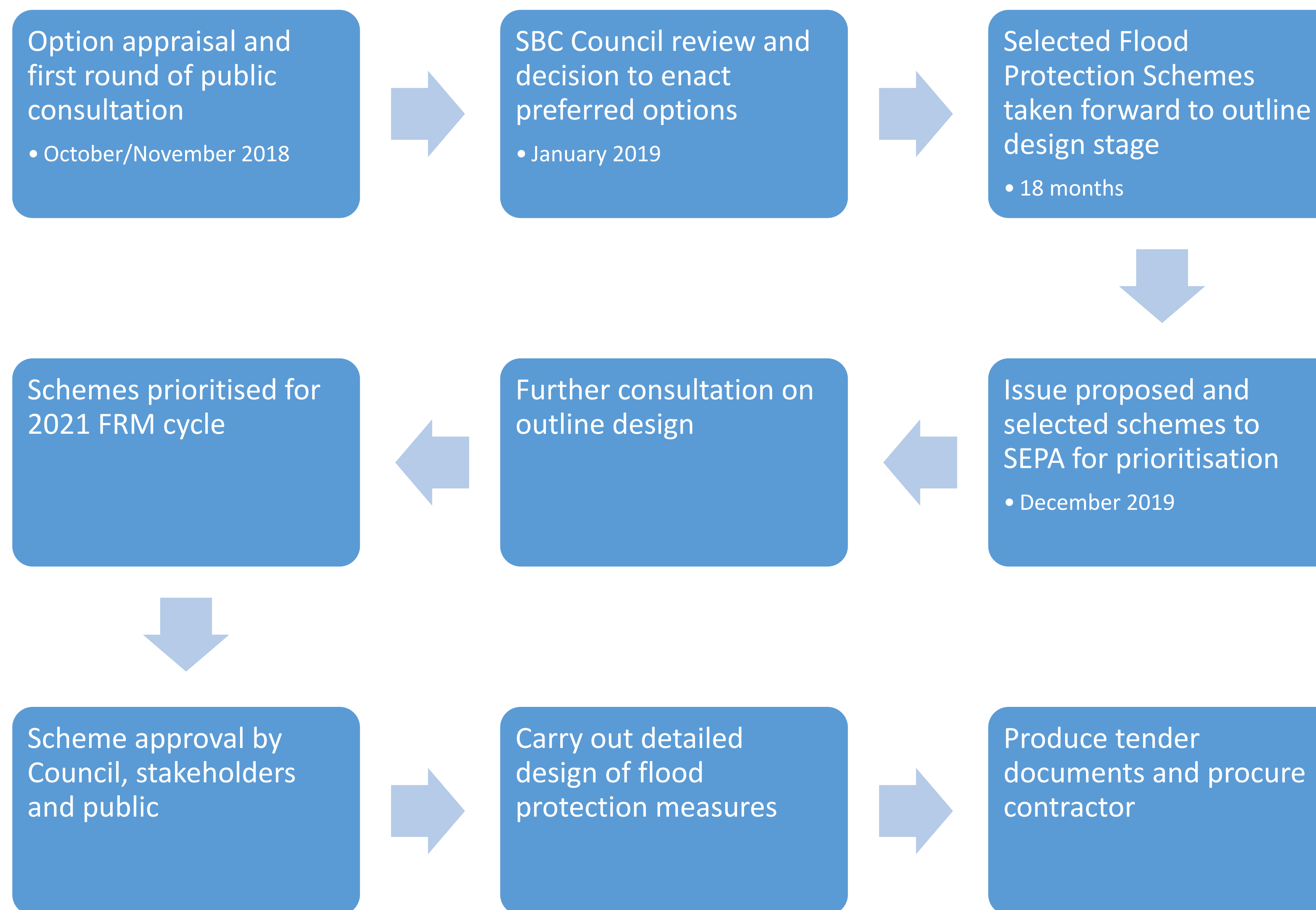


Typical example of young woodland

Location and type of measures suggested for the River Tweed catchment



The following sets out the Council wide steps required to progress preferred options to a Flood Protection Scheme



These posters and further information are available at: www.bordersfloodstudies.com