

How is flood risk managed by the Scottish Borders Council?

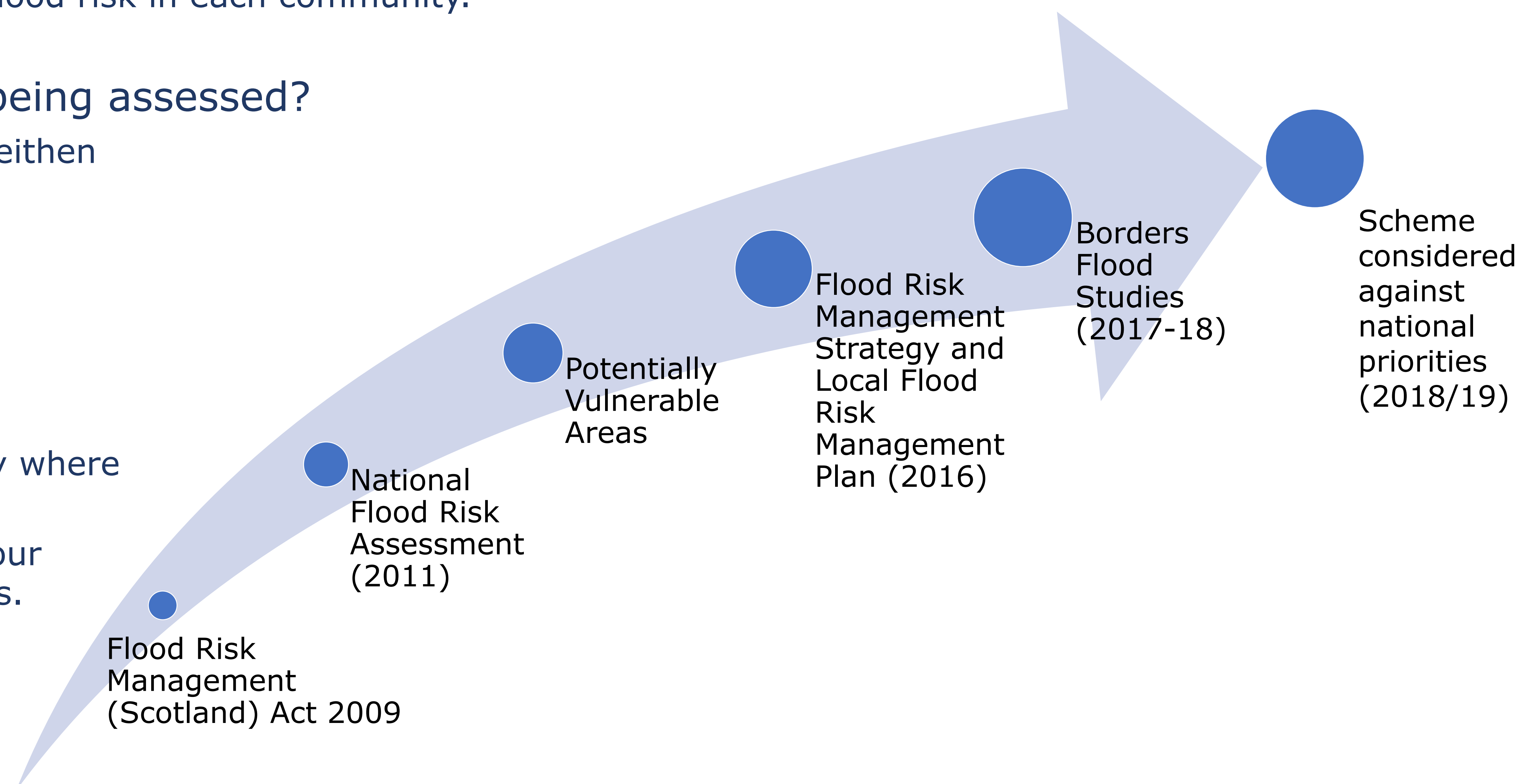
- The Flood Risk Management (Scotland) Act 2009 aims to prioritise flood mitigation across Scotland using a proactive and risk based process for assessing flood risk.
- This approach led to the preparation of SEPA's Flood Risk Management Strategies by SEPA and the Tweed Local Flood Risk Management Plan 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?

- Broughton, Peebles & 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 an 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



Flood Review



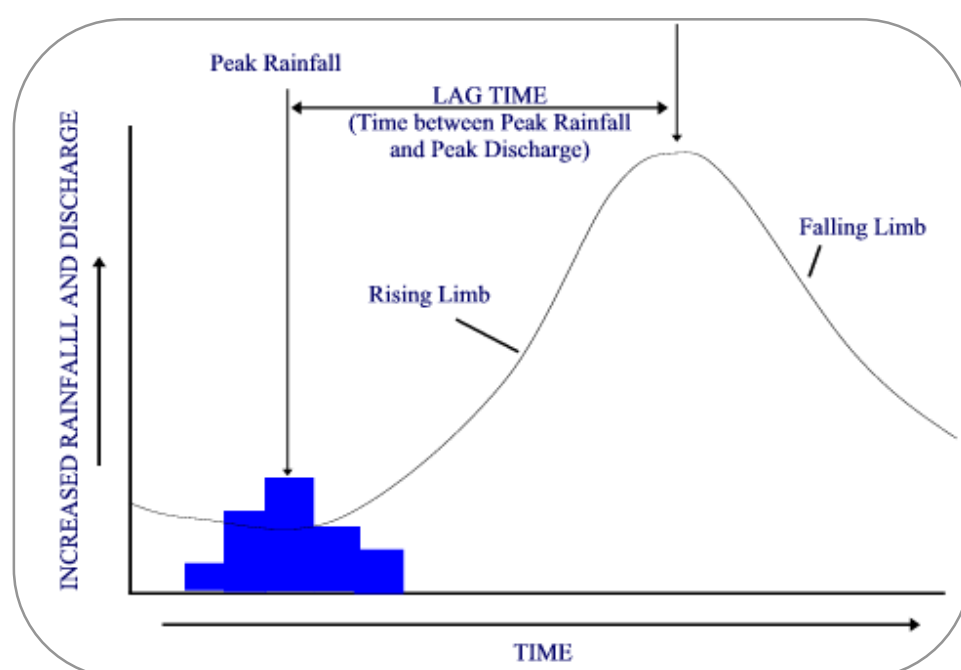
Topographic
surveys



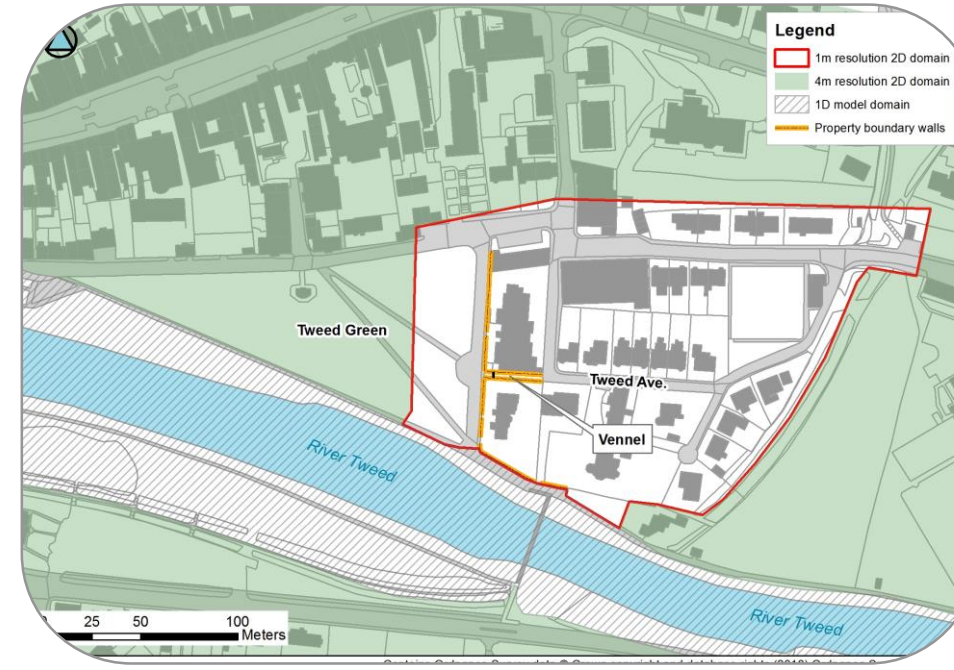
Asset
inspections

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.

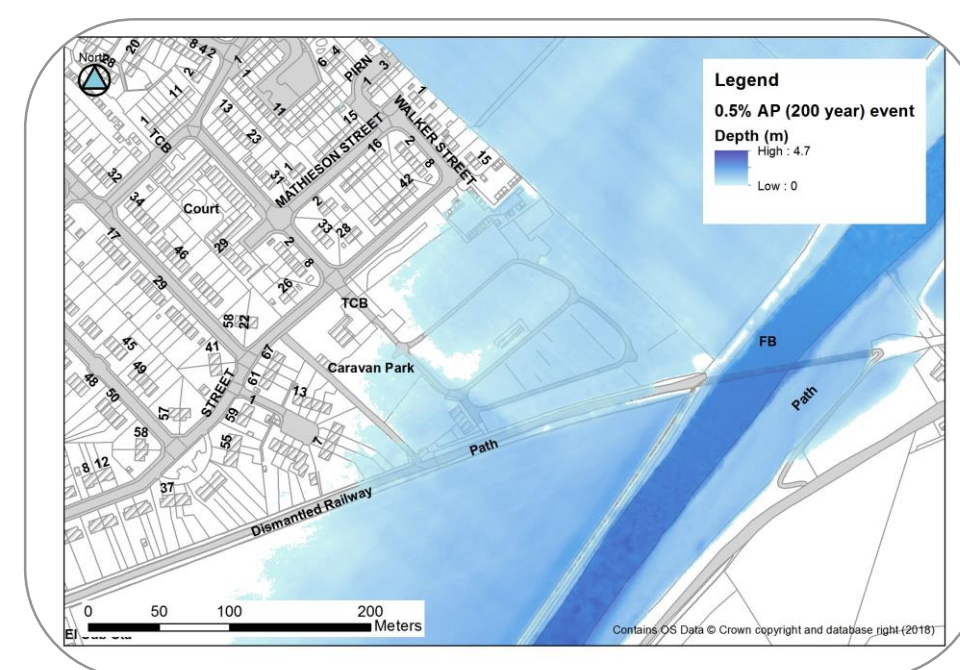
The models developed form a basis for assessing future flood levels, flood mitigation options, detailed design of schemes and the costs to deliver.



Hydrology



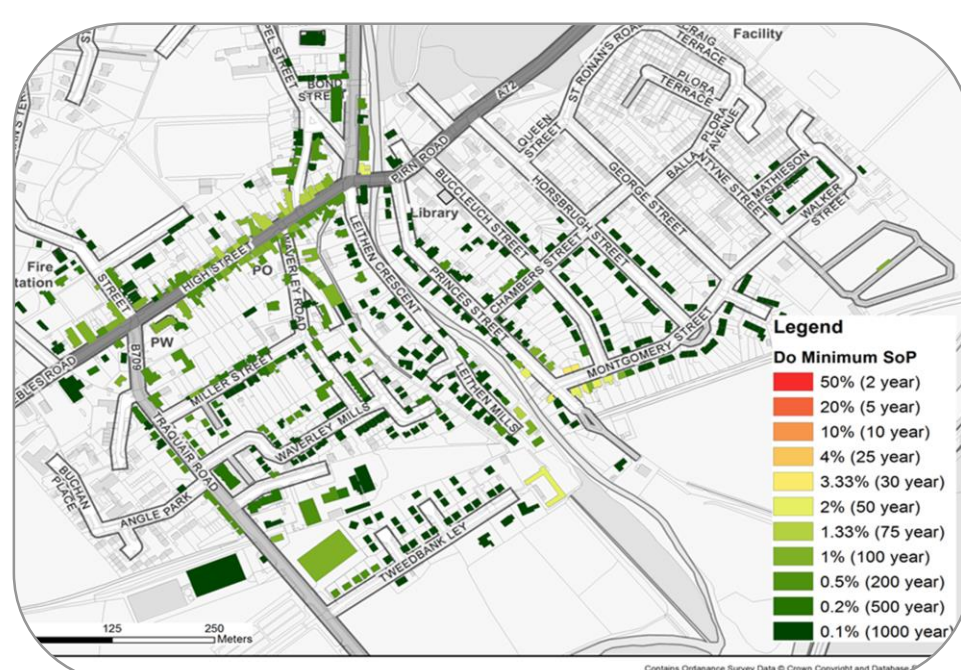
Modelling



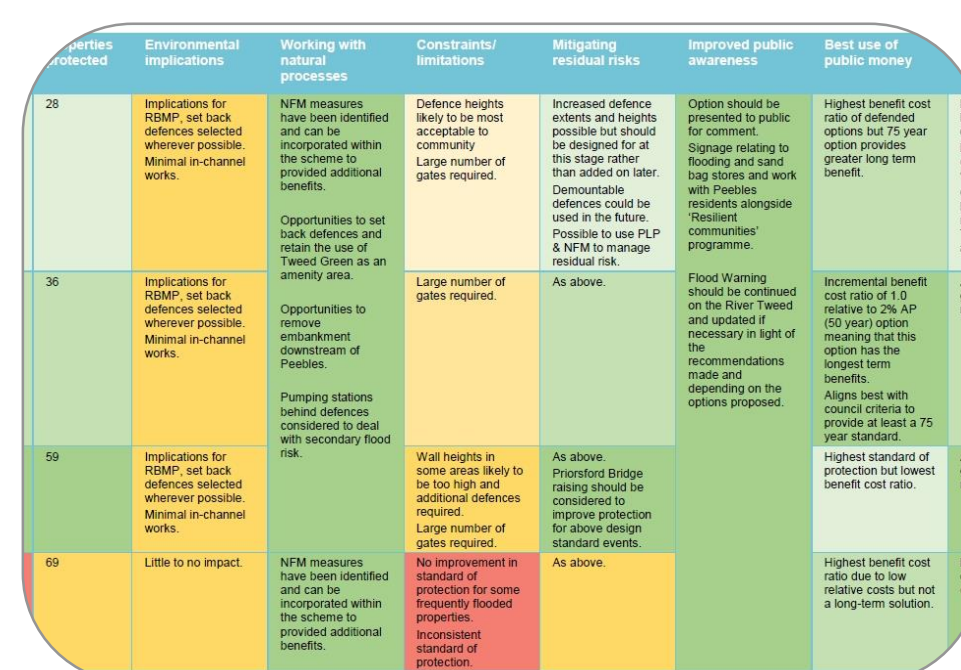
Flood Mapping

Return periods and annual probabilities

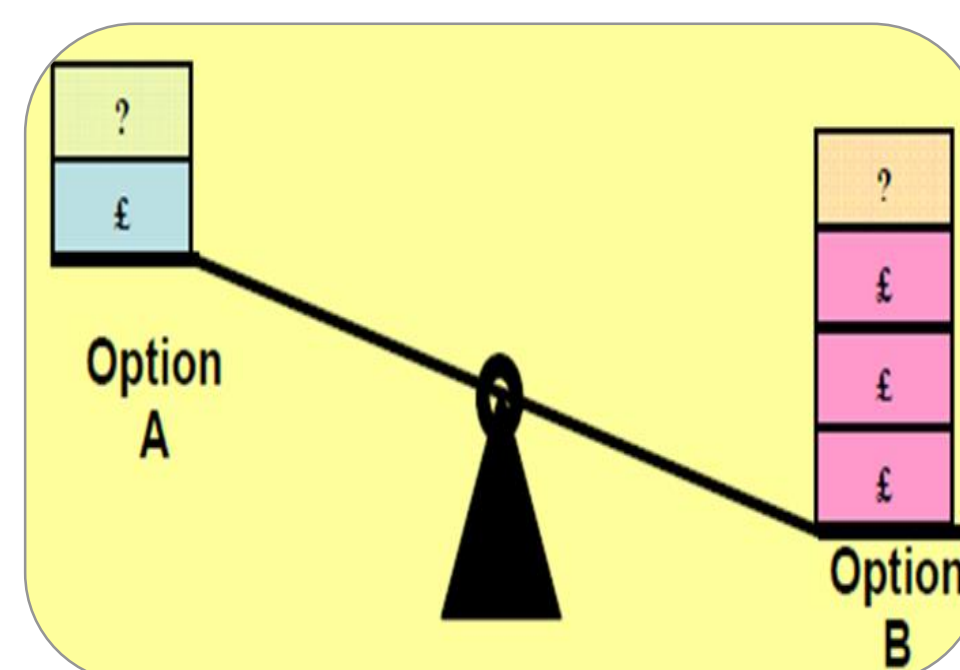
- When a river floods the severity of the flood is known as a 1 in x year flood. This terminology represents the probability of that event occurring in any year.
- For reference, the December 2015 event (Storm Frank) in Peebles had a 1 in 55 chance of occurring in any year.
- This does not mean that 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

1948

Large flood events on the River Tweed in Peebles. River Tweed '17 feet above normal'. The low lying parts of Peebles was inundated.



Photo courtesy of Margaret Maxwell via Border Telegraph

2002

Flooding on Montgomery Street, at least one house was inundated. Flooding of Princes Street from the Leithen Water.

2012

SEPA reported flooding in the Innerleithen area.

2016

"Torrential downpours left several streets in Innerleithen under a foot of water" Border Telegraph

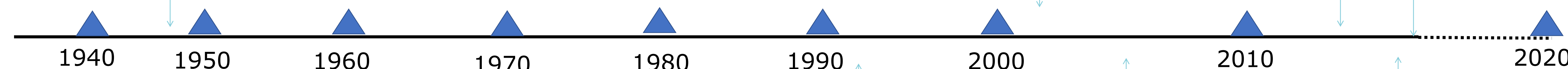


Photo courtesy of M Mconnachie of SEPA

1994

Flooding at Montgomery Street, at least one house was inundated

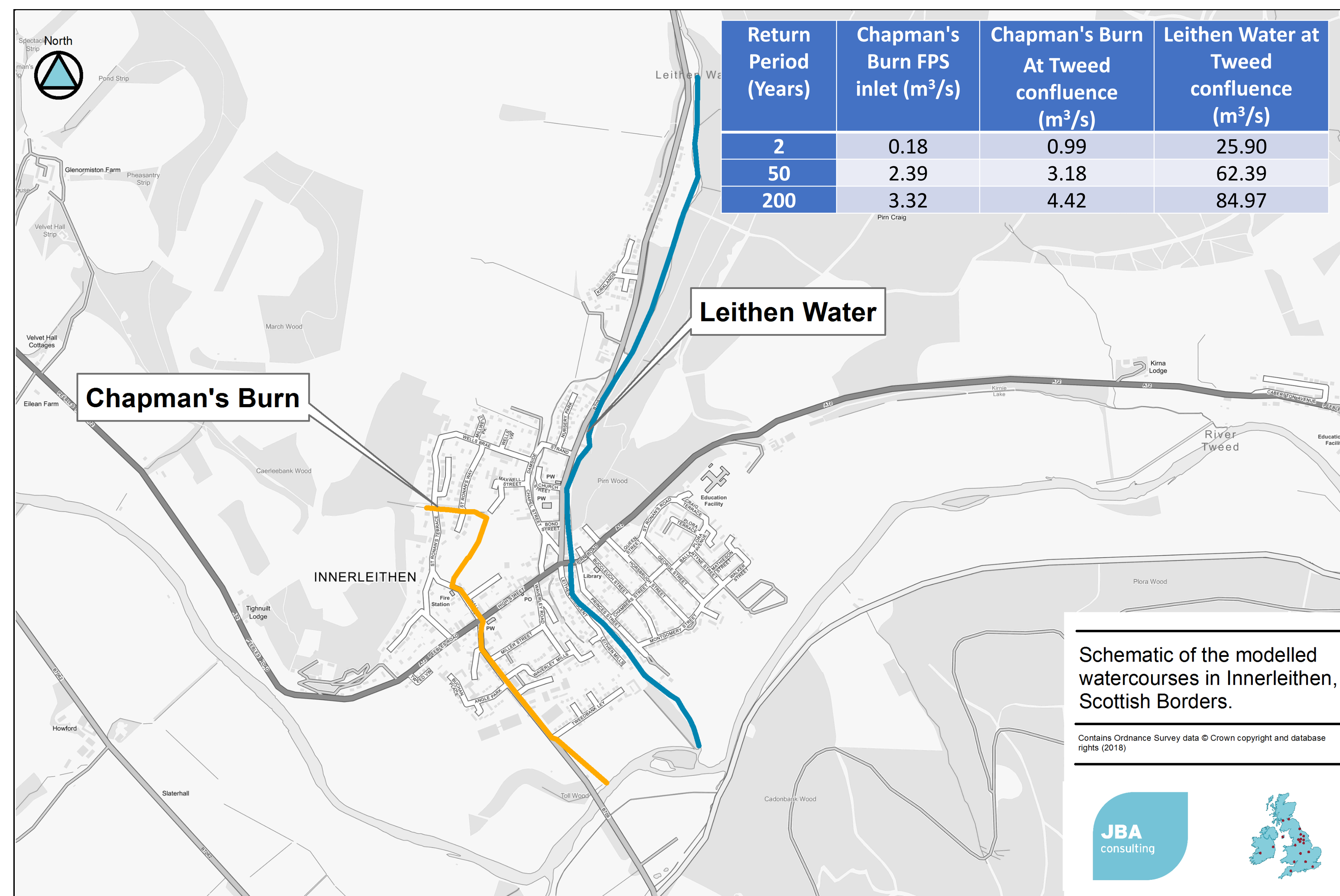
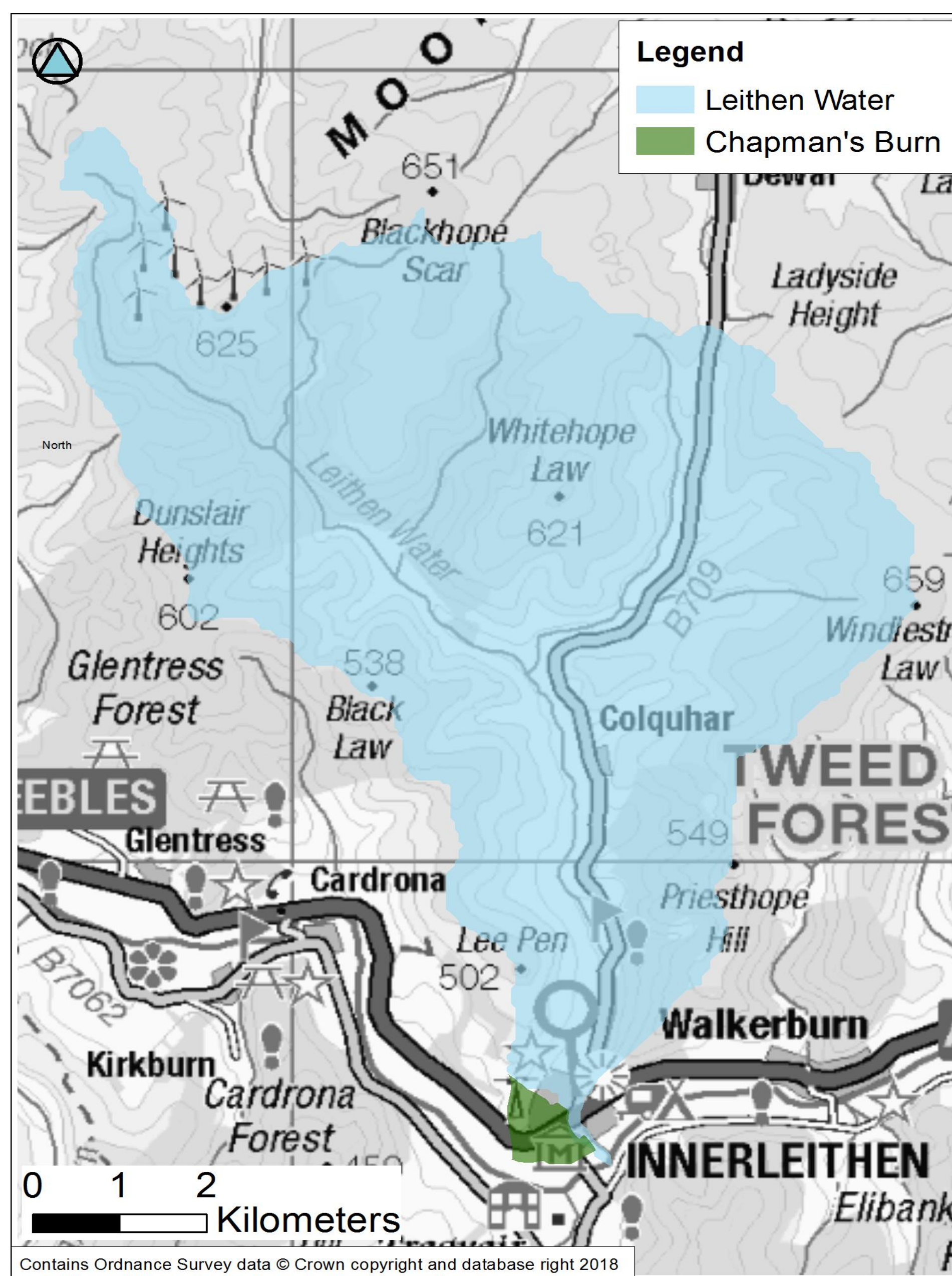
2005

SEPA commented the general area was subject to flooding from the River Tweed. Other sources of flooding attributed to the Leithen Water.

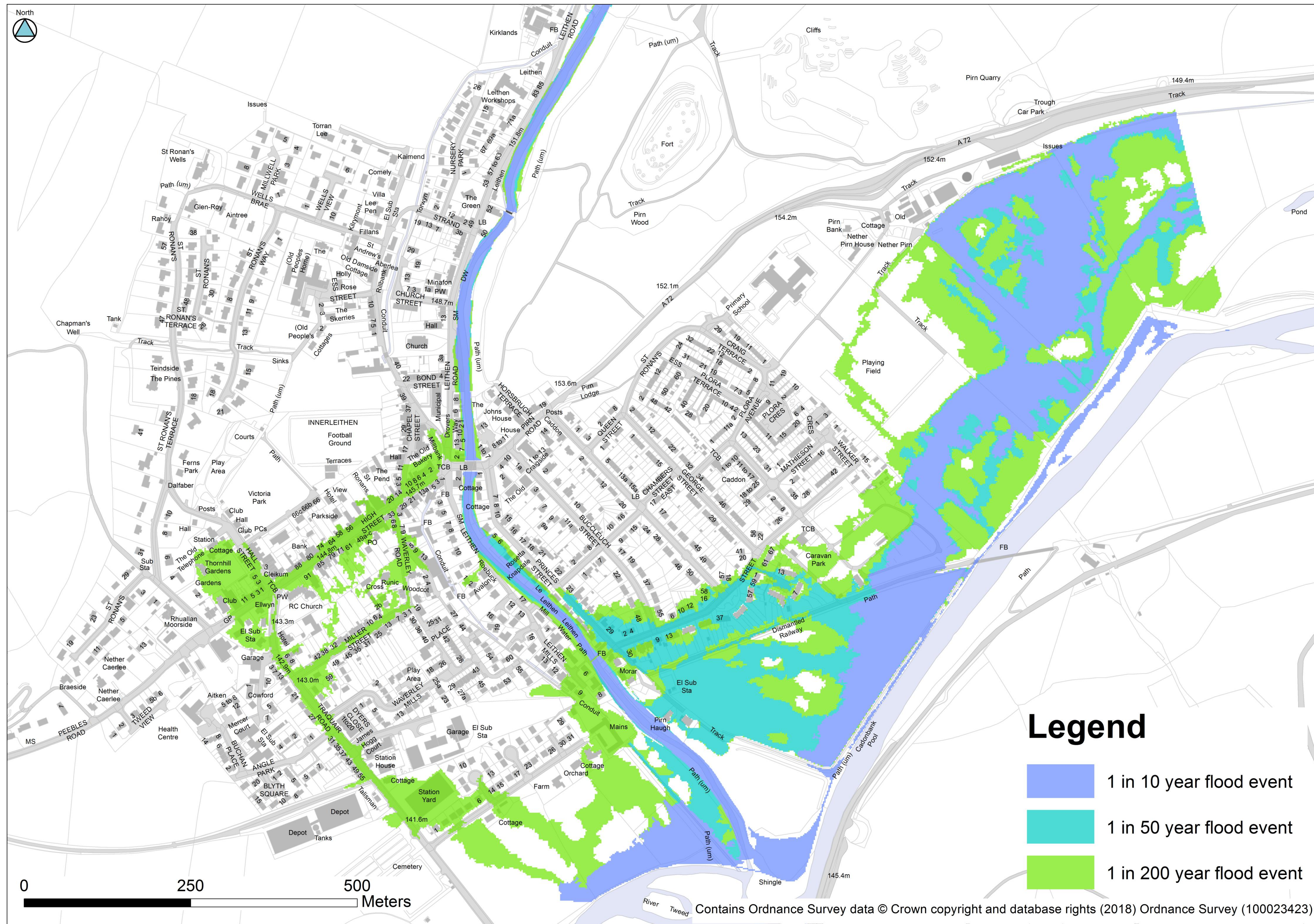
2015

Walkerburn was impacted by the flood event on the 5th and 30th December with various non-residential properties located on the floodplain flooded (E.g. Rugby Club and fishing hut).

Innerleithen is at flood risk from the Leithen Water and Chapman's Burn. Flood risk to properties from the River Tweed was assessed and found to be minimal. Innerleithen is the much larger of the two assessed watercourses with a catchment area of 58 km². Chapman's Burn, with a catchment area of just 0.7 km², is a small watercourse which is culverted for the majority of its length. Chapman's Burn is predicated to flood more frequently than the Leithen Water. The figures below shows the watercourses catchment's and the length of modelled channel.



Flood mapping – Leithen Water



Property Type	Number at Risk (1 in 200 year flood)
Residential	37
Commercial	11

How do we create these flood maps?

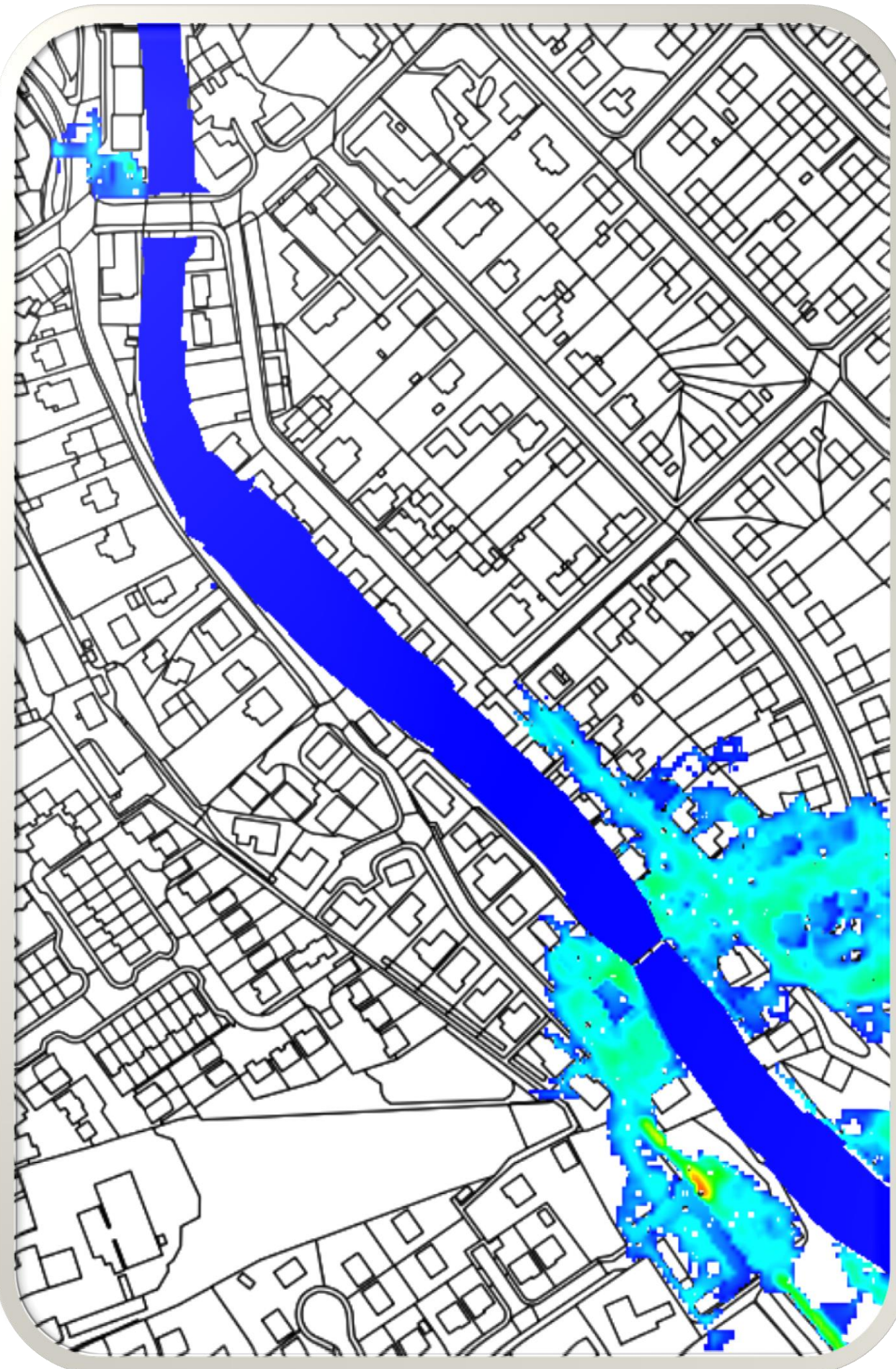
- A physical survey captured the measurements of river channels, banks and structures along each watercourse.
- These measurements were input into a computer model, along with calculated river flows for a range of storm events.
- This model produced a flood level which was then applied to a 3D representation of the land surface and buildings. The outcome resulted in a detailed flood map of river flooding in Broughton

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 & key constraints on Leithen Water

Out of bank flow paths, key structures and constraints were identified. Flood flow from the Leithen Water is first seen along Princes Street, south of Chambers Street and proceeds to flow east along Montgomery Street. As the water level continues to rise flood water escapes from the west bank immediately upstream of the A72 Road Bridge. This water flows west along High Street and effects numerous properties.



Complex out of bank flows



Existing walls



Bridges that constrain flows



Has this flow mechanism been seen before?

The only known flood which overtopped the Leithen Water banks' is the 1948 flood, however the details on this event are limited.

Since 1948 Innerleithen has developed considerably.

The aim of the scheme is to be proactive and mitigate against floods like or in excess of the 1948 flood.

Can we remove the gravel?

1) Is gravel causing a flood risk problem?

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

2) Why is sediment in rivers important?

River sediment 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 gravel 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 flood levels could be reduced if the bed level was lowered by 0.5m. However, during a flood, the water will move material downstream and deposit in any lowered sections, filling the section back to its original level very quickly. **This was observed in the Bowmont Water** in August 2009 when the river level was lowered by 1m; it was refilled after a flood by September.

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

- Any additional conveyance created by a lowered river channel is therefore **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 **unsightly concrete walls** may be needed or **removal of riparian land** (gardens) and extensive rock armour.
- Lowering the bed level on the Leithen Water would require a significant and **regular removal of sediment via the local road network**.
- 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 risks on the Leithen Water, including options for natural flood management in the upper catchment that may help to manage the sediment transport into the downstream reaches. Further modelling is required to investigate the benefits of these options.



Leithen Water Options appraisal – Long list of options

The process for selecting options assesses a wide range of possible options, which are narrowed 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** – The existing flood warning system on the Leithen Water should be developed further.
- **Resilience Measures** - Unlikely to be economically viable due to number of properties at risk.
- **Resistance Measures** – Property level protection is well suited to defend against shallow flood depths
- **Diversion channel** – Insufficient available space.
- **Watercourse Maintenance** – Council should continue the scheduled maintenance regime.
- **Demountable Defences** – A permanent wall is more suitable due to limited warning time.
- **Storage** – Option investigated but discounted due to lack of a suitable location.
- **Natural Flood Management** – NFM opportunities throughout the Leithen Water catchment have been identified.
- **Structure Modification** – Bridges or culverts restrict flow on both watercourses which contributes to flood risk but removing the bridges is not sufficient to prevent flooding by itself. A coarse debris screen located upstream of the town could help to prevent future blockage of bridges from floating flood debris.
- **Direct Defences** – A combination of walls and/or embankments can contain flow to the watercourse.
- **Channel Modification** – Insufficient space to widen the channel, deepening the channel is unsustainable.

Least desirable options

Good practice and partial solutions

Most desirable options

Leithen Water– Short Listed Options

Option 1: Property Level Protection (PLP)

- Automatic property level protection installed in 47 properties (of 48) to protect against the 200 year flood event. PLP shall involve surveying each property to identify entry points and recommend appropriate PLP, but could include self sealing door and air vents and non return valves on plumbing.
- Estimated cost £1.5m
- Estimated damage avoided £5.1m



Typical example of PLP

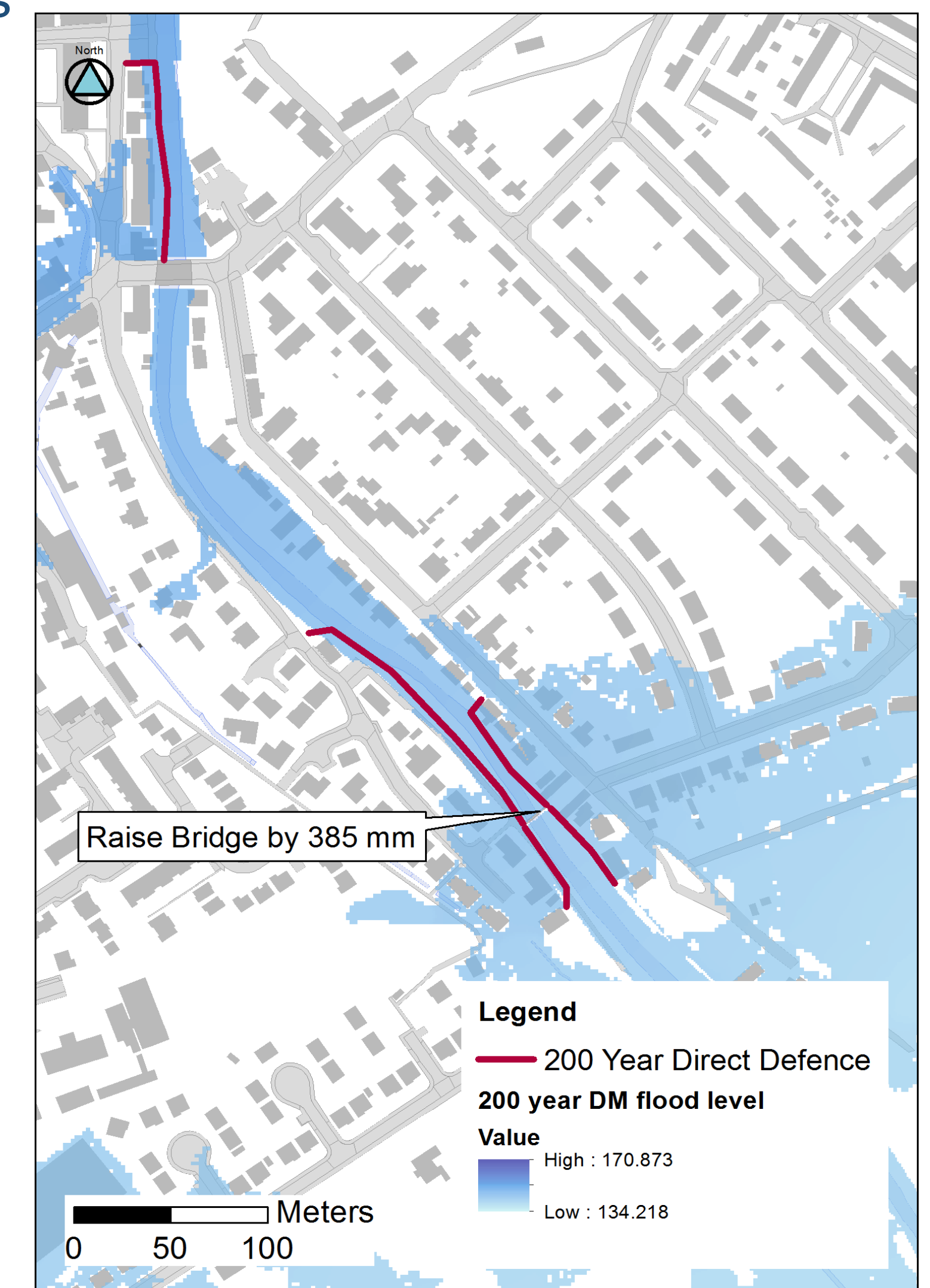
Option 2: Construct flood walls

- This option provides a 200 year standard of protection to those properties who would flood above floor level for the 200 year event. This keeps the wall to the minimum length and avoids placing a wall across numerous gardens.
- Average wall height between 450 mm and 900 mm with freeboard.
- Total combined wall length 450m.
- Raise footbridge by Montgomery Street by approximately 400 mm.
- Includes installation of in channel coarse debris screen.
- Climate change adaptation would require significantly longer walls and raising of road bridge.
- Estimated cost £1.2m
- Estimated damage avoided £5.2m



Typical example of a flood wall

See adjacent technical drawings for further option details

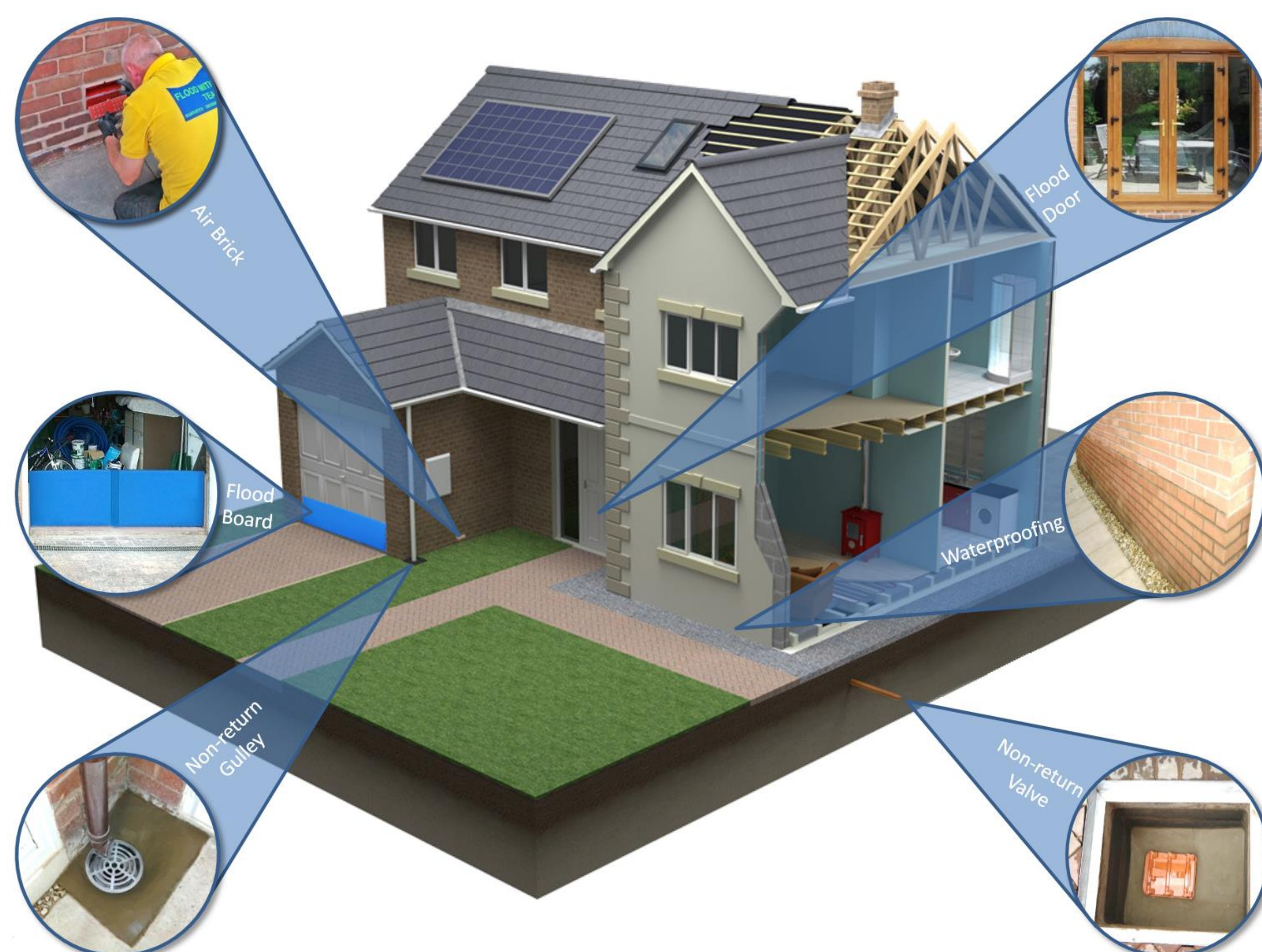


Proposed flood wall plan

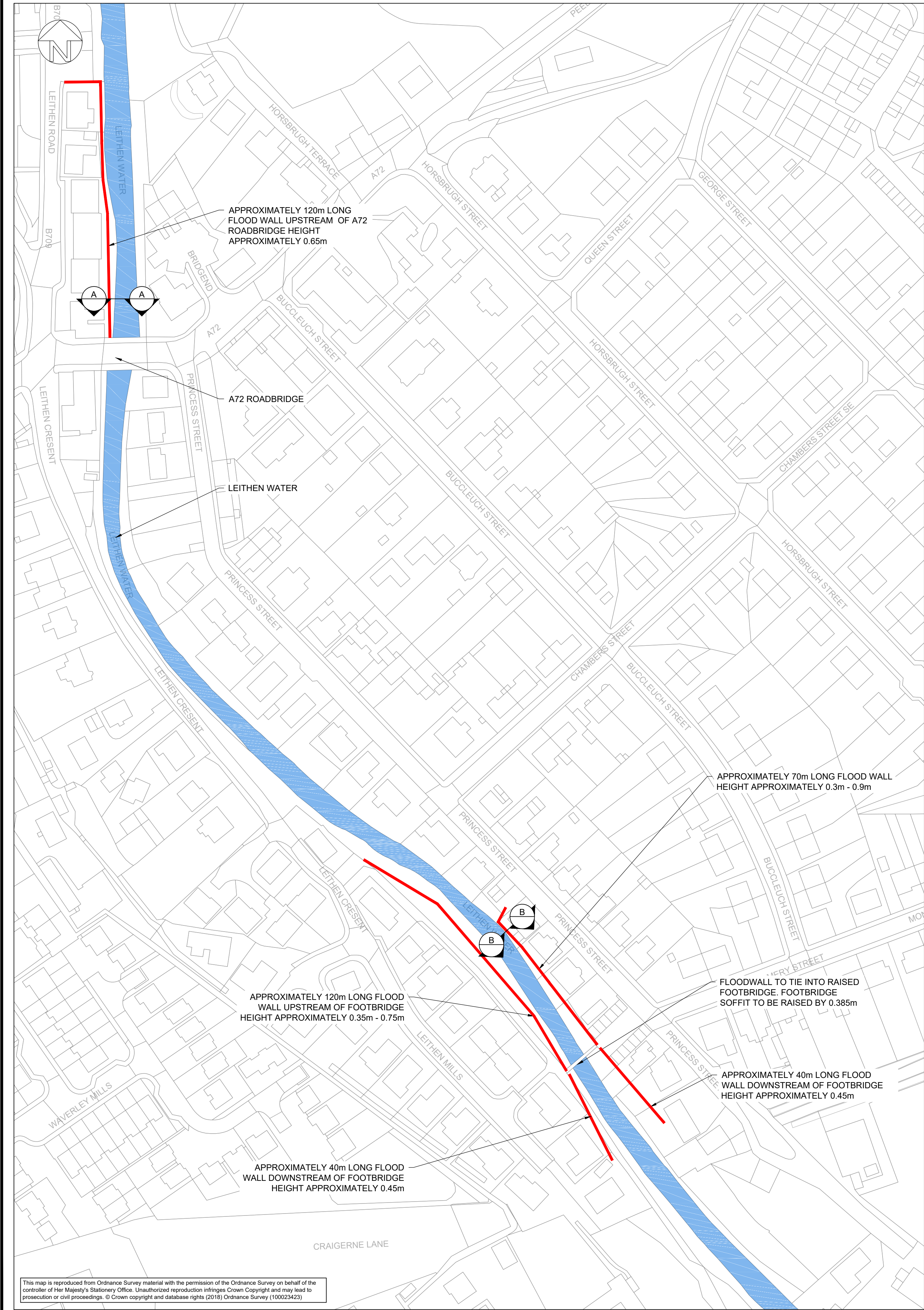
Option 1 - Property level Protection – Leithen Water

PLP is the last form of defence before water gets into the building. Automatic PLP is proposed for each residential property - 36 in total and 11 non residential properties. It can protect these properties to the 200 year flood event. The standard of protection (SOP) map indicates the existing level of protection to each property in the flood study.

Standard of protection map



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



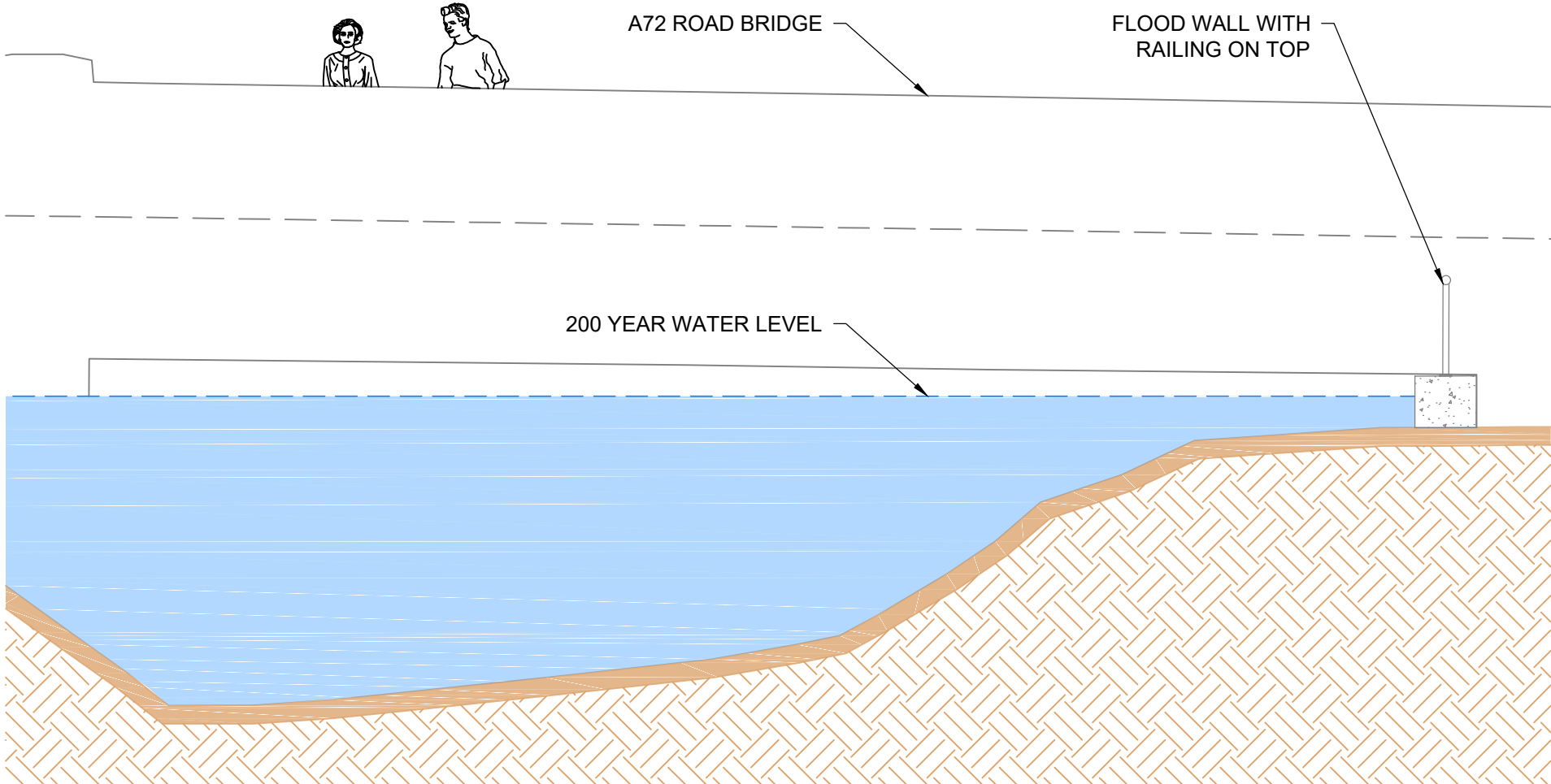
This map is reproduced from Ordnance Survey material with the permission of the Ordnance Survey on behalf of the controller of Her Majesty's Stationery Office. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or civil proceedings. © Crown copyright and database rights (2018) Ordnance Survey (100024223)

PLAN
1:1000

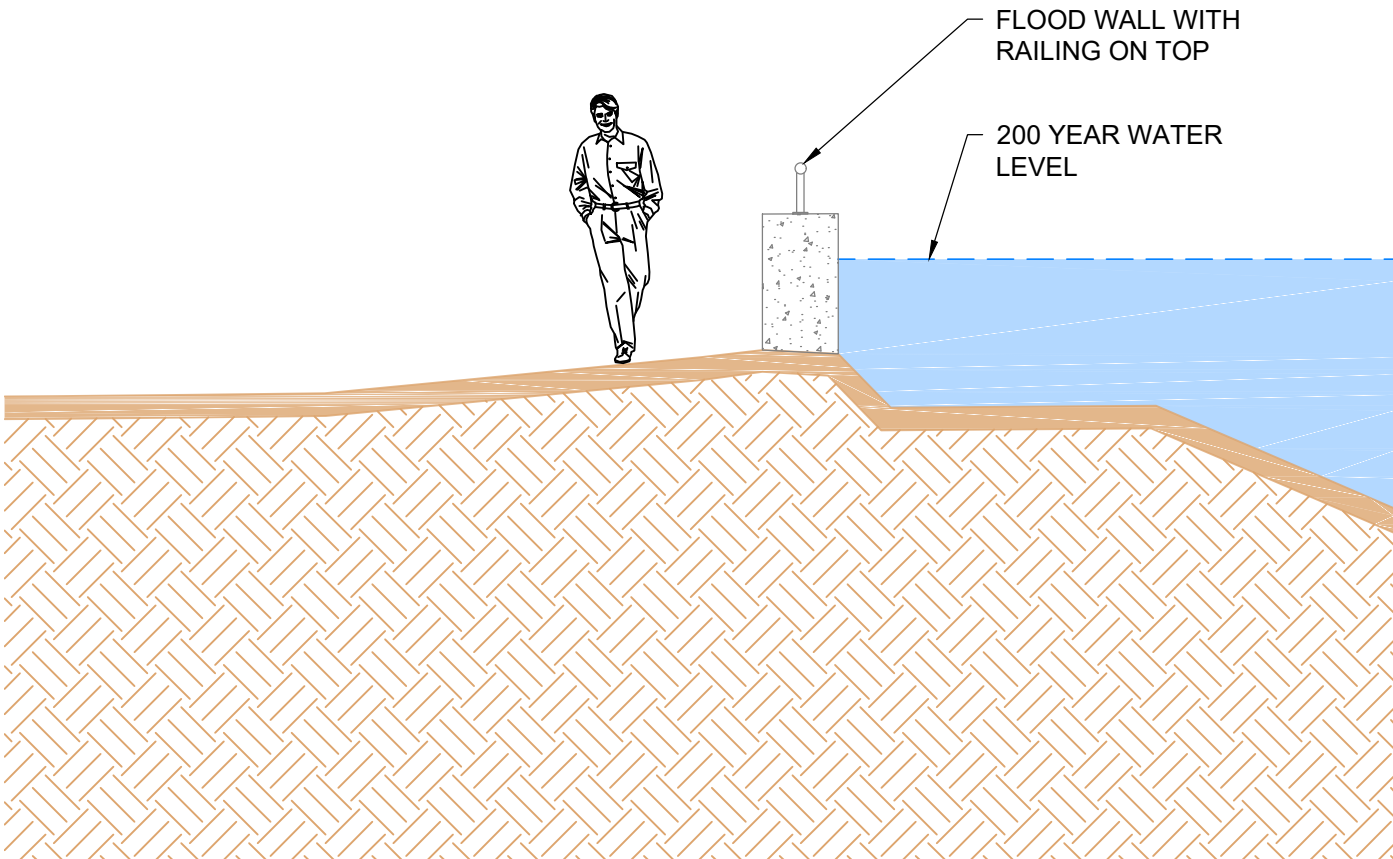
Innerleithen

Option 2: Leithen Water

200 Year Direct Defences



SECTION A-A
1:50



SECTION B-B
1:50

OPTION SUMMARY. Construction of direct defences along the length of the Leithen Water to the alignments shown. Defences to be set back where possible, but constrained by road and property boundaries. Option based on the 1 in 200 year flood. The current layout is the minimum wall length required to protect properties which currently flood to a depth above floor level. Flooding to gardens and depths below floor level are anticipated.

LEGEND	
—	WALL DEFENCE
—	EXISTING WATERCOURSE

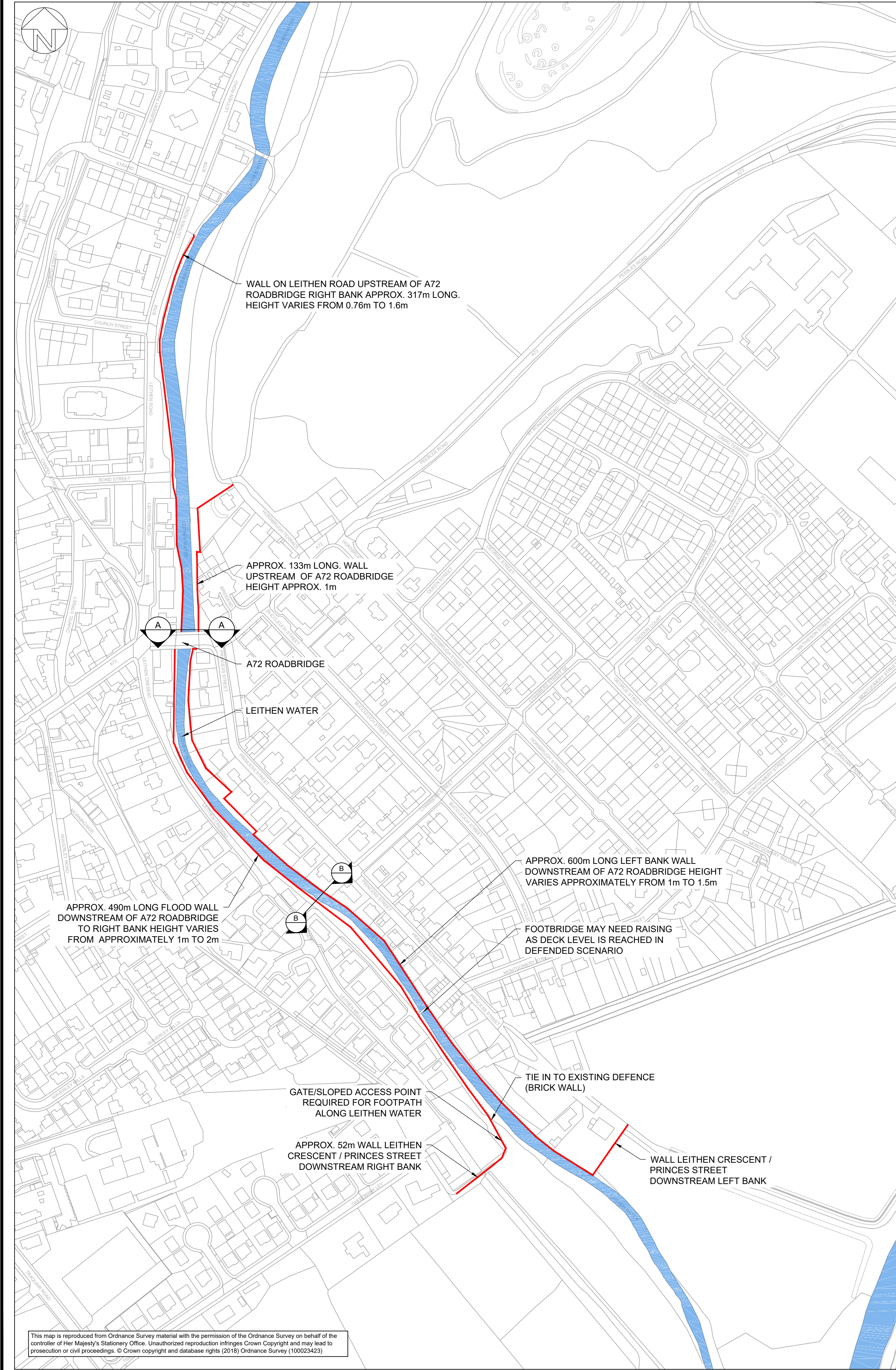
P02	Comments		Background mapping transparency reduced							
Rev.:	Date	02/10/18	Drawn	BH	Designed	JG	Checked		Approved	
Client Approval										
A - Approved										
B - Approved with Revisions										
C - Do Not Use										
Purpose of Issue									Status	
Suitable for Coordination										S1

Unit 2.1
Quantum Court
Research Avenue South
Heriot Watt University
Edinburgh
EH14 4AP
United Kingdom
www.jbaconsulting.com
t +44 (0)131 3192940
f +44 (0)845 8627772
e info@jbaconsulting.com

Offices at Colshill, Doncaster, Edinburgh, Exeter, Glasgow, Haywards Heath, Isle of Man, Leeds, Limerick, Newcastle upon Tyne, Newport, Peterborough, Saltair, Skipton, Tadcaster, Thirsk, Wallingford and Warrington

Project		Borders Flood Studies	
Title		Innerleithen Leithen Water: Option 2 200 Year direct defences	
Client		for	

The property of this drawing and design vested in Jeremy Benn Associates Ltd. It shall not be reproduced in whole or in part, nor disclosed to a third party, without the prior written consent of Jeremy Benn Associates Ltd.			
Scale As Shown @ A1	Drawn:	B Henderson	20/09/18
	Designed:	J Garrett	19/09/18
	Checked:		
	Approved:		
Project Number: 2017s5526			
Drawing Number			Revision
AEM-JBAU-IL-LW-IM-C-1401			P02



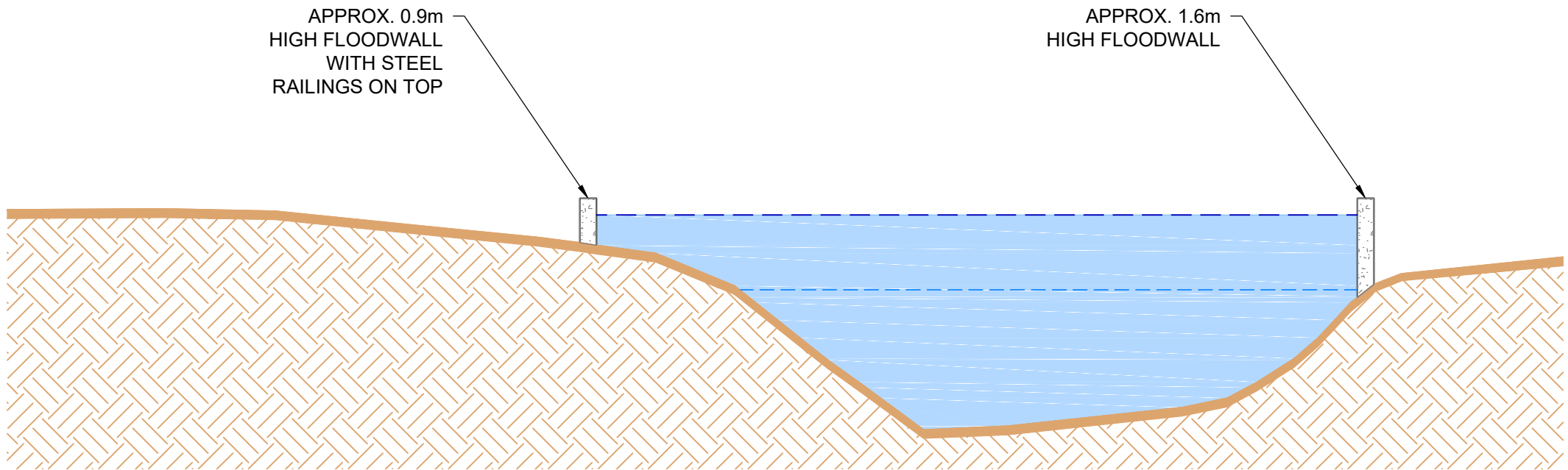
PLAN
1:2000

Innerleithen

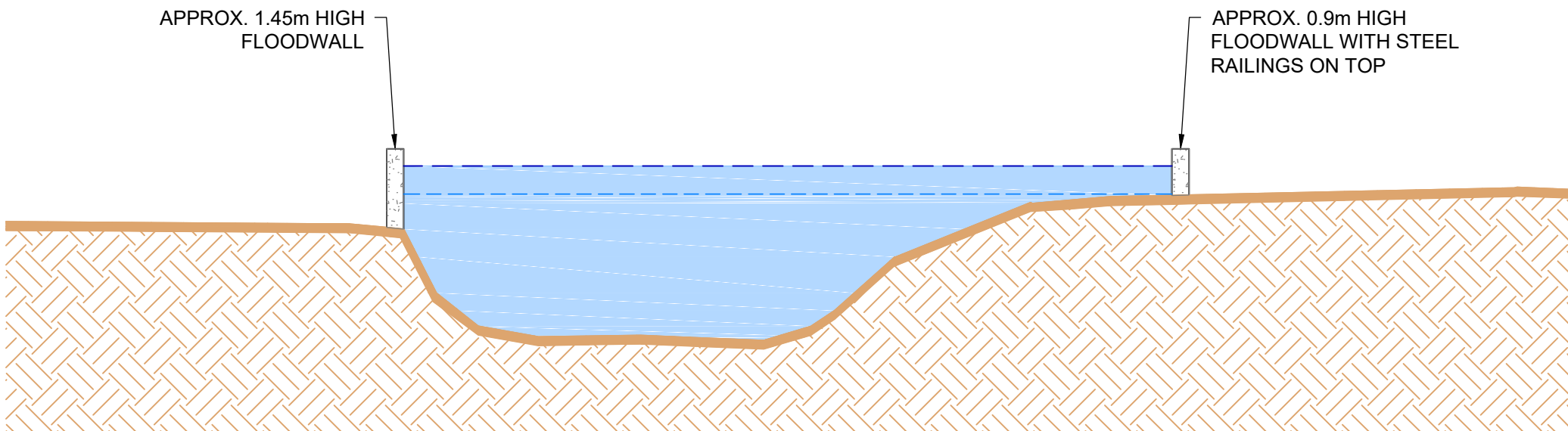
Option 2: Leithen Water

200 Year + Climate Change

Direct Defences



SECTION A-A
1:200



SECTION B-B
1:200

OPTION SUMMARY. Construction of direct defences along the length of the Leithen Water to the alignments shown. Defences to be set back where possible, but constrained by road and property boundaries. Option based on the 1 in 200 year flood with an allowance for climate change. Reductions in wall heights would be possible if a lower standard was selected or if the inclusion of climate change was omitted and addressed later through alternative measures.

LEGEND	
	EXISTING GROUND LEVEL
	200 YEAR FLOOD LEVEL
	200+CC FLOOD LEVEL
	WALL DEFENCE
	EXISTING WATERCOURSE

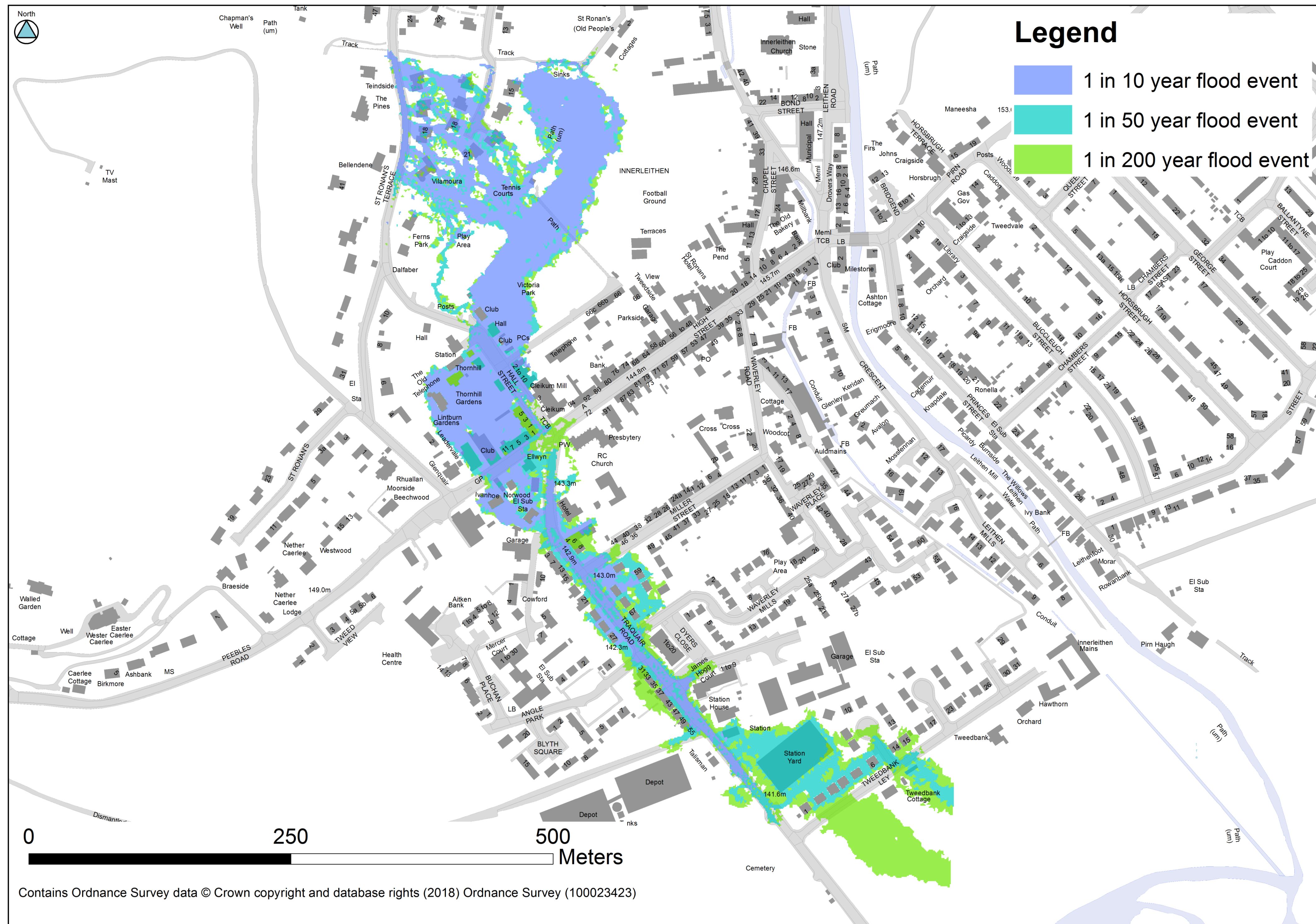
P02	Comments		Background mapping transparency reduced							
	Date	02/10/18	Drawn	BH	Designed	TF	Checked	AP	Approved	
Client Approval										
A - Approved										
B - Approved with Revisions										
C - Do Not Use										
Purpose of Issue									Status	S1
Suitable for Coordination										

Unit 2.1
Quantum Court
Research Avenue South
Heriot Watt University
Edinburgh
EH14 4AP
United Kingdom
www.jbaconsulting.com
t +44 (0)131 3192940
f +44 (0)845 8627772
e info@jbaconsulting.com

Project	Borders Flood Studies	
Title	Innerleithen Leithen Water: Option 2 200 + CC Year direct defences for	
Client		

The property of this drawing and design vested in Jeremy Benn Associates Ltd. It shall not be reproduced in whole or in part, nor disclosed to a third party, without the prior written consent of Jeremy Benn Associates Ltd.		
Scale	Drawn: B Henderson	15/03/18
As Shown @ A1	Designed: T Fletcher	12/02/18
	Checked: A Pettit	16/07/18
	Approved:	
Project Number:	2017s5526	
Drawing Number	AEM-JBAU-IL-LW-IM-C-1300	
		Revision P02

Flood mapping – Chapman's Burn



Property Type	Number at Risk (1 in 200 year flood)
Residential	23
Commercial	8

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 into a computer model, along with calculated river flows for a range of storm events.
- This model produced a flood level which was then applied to a 3D representation of the land surface and buildings. The outcome resulted in a detailed flood map of river flooding in Broughton

What do the maps show?

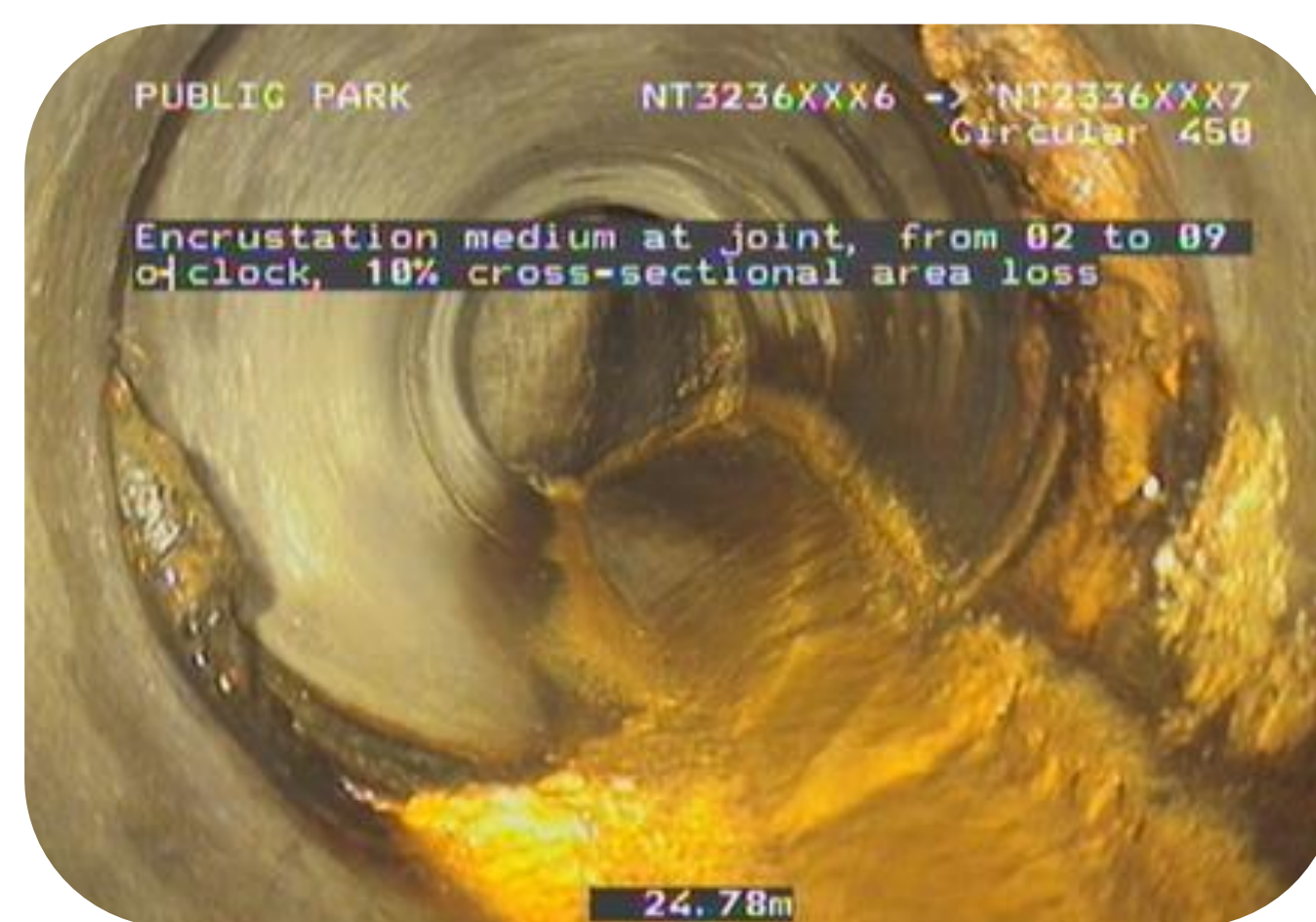
- The mapping indicates the predicted flooding for a given flood magnitude.
- The 1 in 10 year map shows what is expected to be inundated for a flood that is likely to occur once every 10 years (or with a probability of 10% in any one year).
- The 1 in 200 year represents a flood event with a probability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

Flood mechanisms & key constraints on Chapman's Burn

Out of bank flow paths, key structures and constraints were identified. Flood flow from Chapman's Burn emerges from The culvert on St Ronan's Terrace and at the entrance to the existing FPS culvert. Soon after the culvert's manholes are surcharged in numerous places, starting with the manholes on Hall Street.



Complex out of bank flows



Culvert condition



Culverts that constrain flow

Improved flood estimation

We are aware that flooding from the Chapman's Burn watercourse or culvert has not been observed, therefore, we recommend the following short term options:

- Installation of a flow gauge to provide a better flow estimates
- Installation of telemetry to monitor water level
- Improved channel conveyance

Chapman's Burn options appraisal – long list of options

The process for selecting options assesses a wide range of possible options, which are narrowed 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** – Flooding from Chapman's Burn happens too quickly to provide sufficient warning.
- **Resilience Measures** - Unlikely to be economically viable due to number of properties at risk.
- **Resistance Measures** – Property level protection is well suited to shallow flood depths from both watercourses
- **Diversion channel** – Insufficient available space.
- **Watercourse Maintenance** – Council should continue the scheduled maintenance regime.
- **Demountable Defences** – A permanent wall or embankment is more suitable than demountable defences.
- **Storage** – Victoria Park could be utilised to temporally store water in a flood event.
- **Natural Flood Management** – No additional NFM opportunities were identified in Chapman's catchment.
- **Structure Modification** – Upgrading the existing Flood Protection Scheme culvert can significantly reduce flood risk.
- **Direct Defences** – A combination of walls or embankments can contain flows on the watercourses.
- **Channel Modification** – Chapman's Channel can be deepened to help contain the flow.

Least desirable options

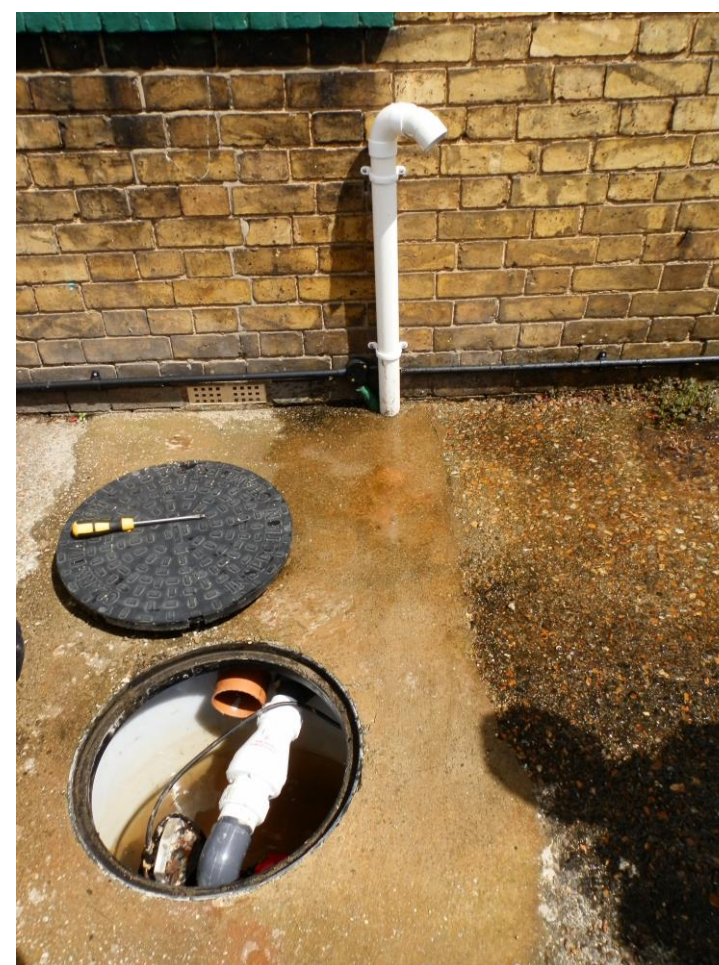
Good practice and partial solutions

Most desirable options

Chapman's Burn– Short Listed Options

Option 1: Property Level Protection (PLP)

- Automatic property level protection installed in 24 properties (of 31) to protect residential properties against the 200 year flood event. PLP shall involving surveying each property to identify entry points and recommend appropriate PLP, but could include self sealing door and air vents and non return valves on plumbing.
- Estimated cost £0.6m
- Estimated damage avoided £2.4m



Typical example of PLP

Option 3: Improve channel and culvert conveyance

- 200 year standard of protection
- Replacement of St Ronan's Terrace culvert and deepening of Chapman's Burn channel.
- Replacement of existing Flood Protection Scheme culvert with enlarged culvert from inlet to outlet.
- Approximately 1.1 km of culvert will be replaced running along Hall Street and Traquair Road.
- Estimated cost £6.5m
- Estimated damage avoided £4.3m



Typical example of a new culvert

Option 4: Improve channel conveyance and off-line storage

- 200 year standard of protection.
- Replacement of St Ronan's Terrace culvert and deepening of Chapman's Burn channel
- Convert Victoria Park into a temporary storage basin during flood flows
- Install non-return value on existing culvert and seal each manhole
- Estimated cost £3.4m
- Estimated damage avoided £4.3m

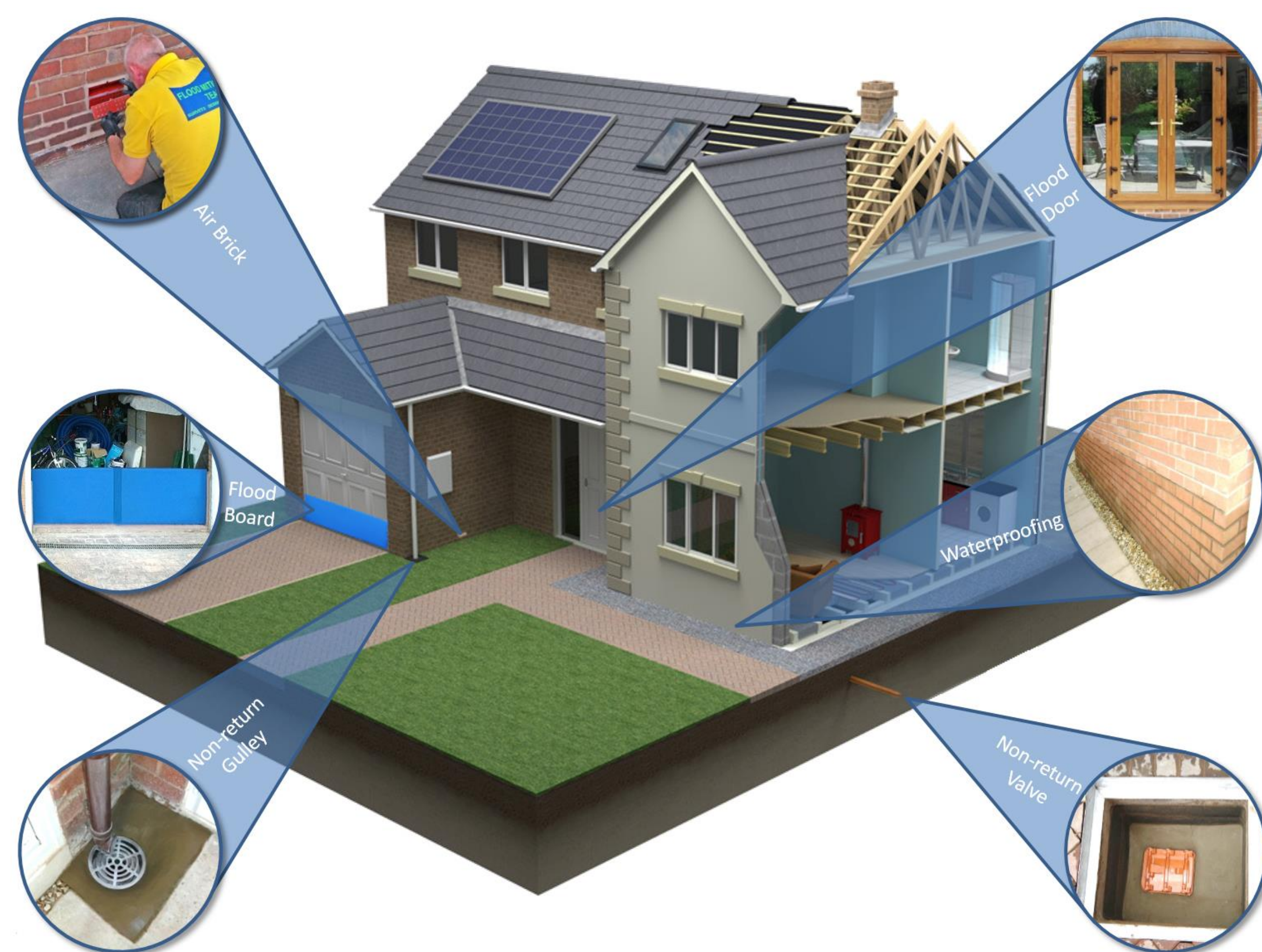


Typical example of off-line storage

See adjacent technical drawings
for further option details

Option 1 - Property level Protection – Chapman's Burn

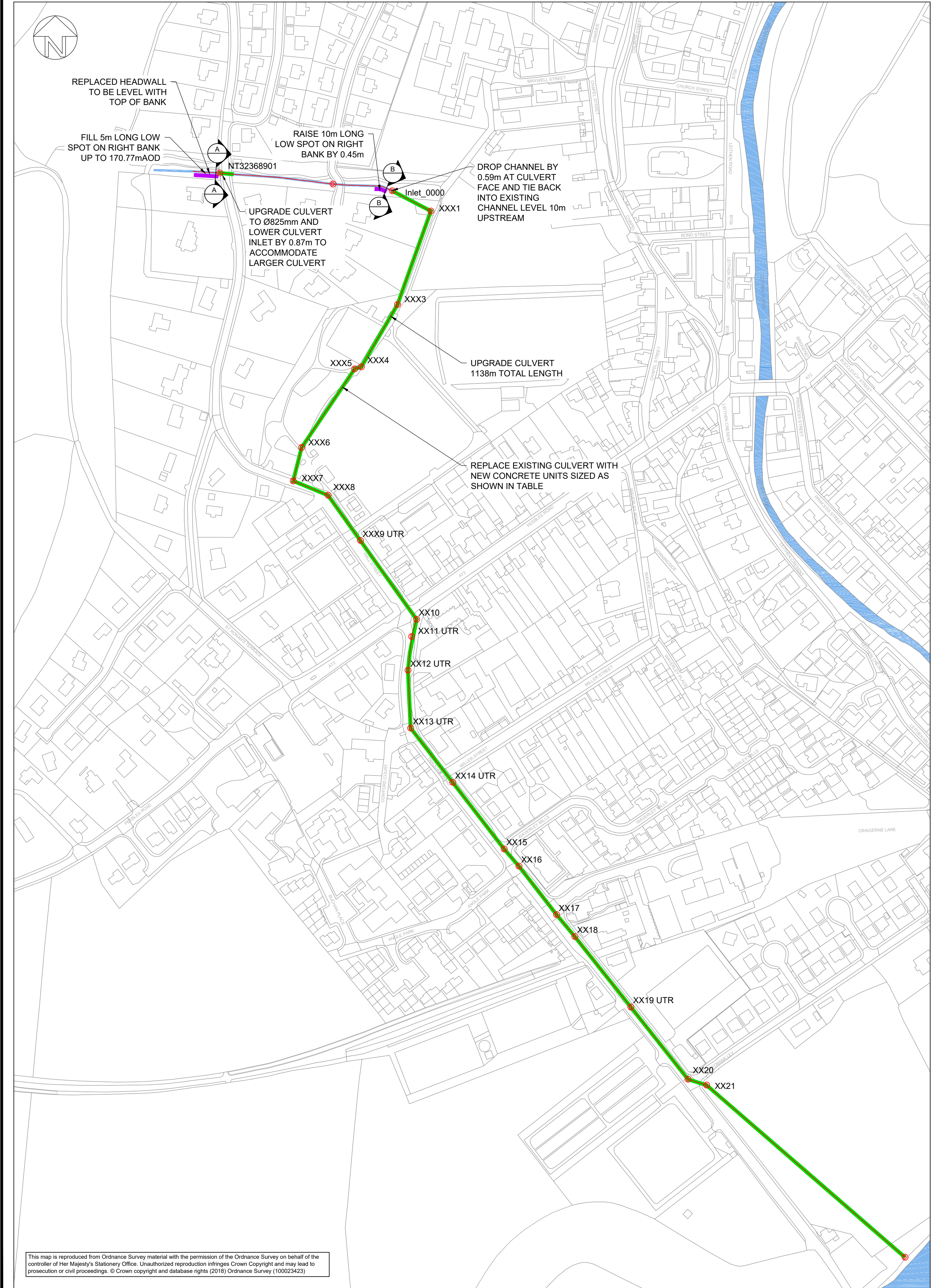
PLP is the last form of defence before water gets into the building. Automatic PLP is proposed for each residential property - 23 in total and 1 non residential property. It can protect these properties to the 200 year flood event. The standard of protection (SOP) map indicates the existing level of protection to each property in the flood study.



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

Standard of protection map





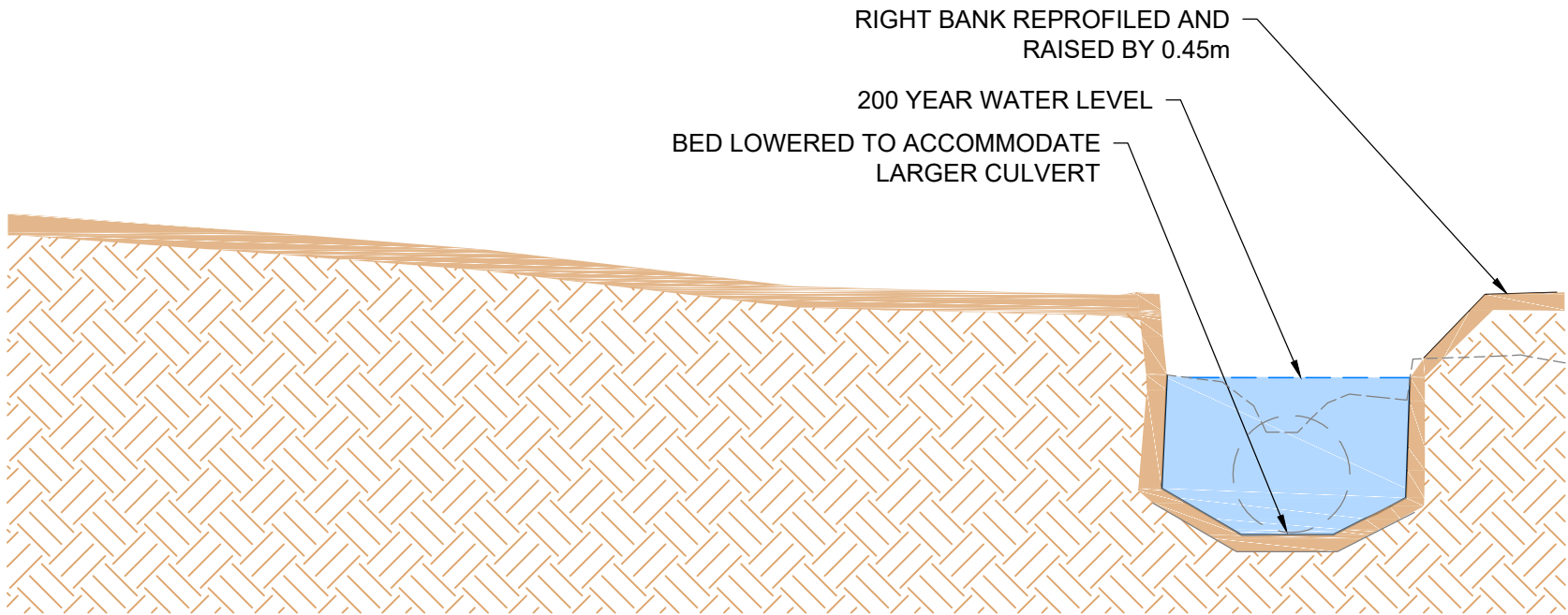
PLAN
1:2000

Innerleithen

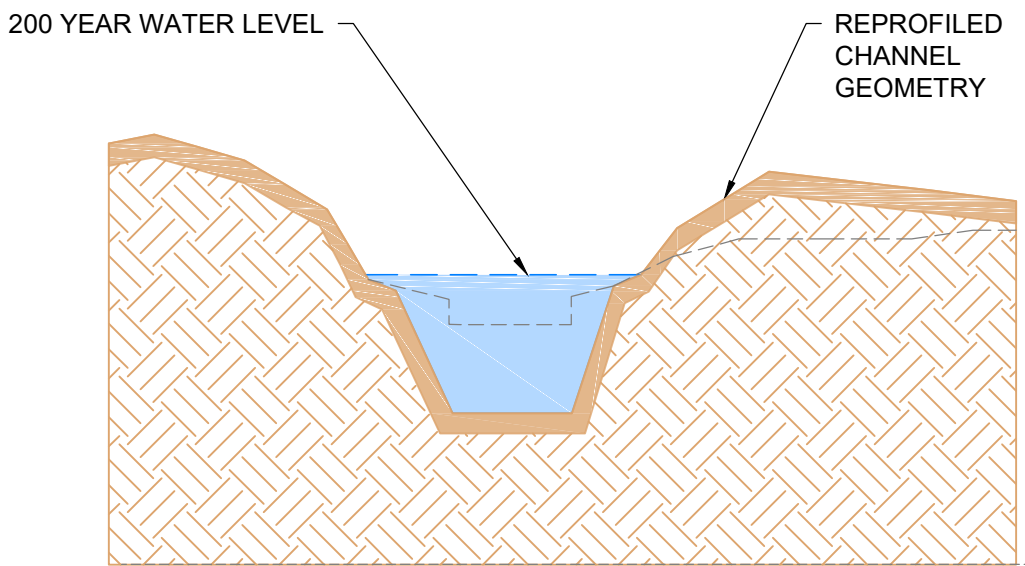
Option 3: Chapmans Burn

200 Year Culvert Upgrade & Improved Channel Conveyance

REPLACEMENT CULVERTS		
Manhole	Existing Culverts	Proposed Culverts
ID Number	Diameter (mm)	Diameter (mm)
NT32368901	280	850
Inlet_0000	300	1200
XXX1	300	900
XXX3	450	900
XXX4	450	900
XXX5	450	900
XXX6	450	900
XXX7	600	900
XXX8	600	900
XXX9 UTR	600	1200
XX10	600	1350
XX11 UTR	600	1350
XX12 UTR	600	1350
XX13 UTR	600	1350
XX14 UTR	600	1350
XX15	600	1350
XX16	600	1500
XX17	600	1500
XX18	600	1500
XX19 UTR	675	1500
XX20	675	1500
XX21	675	1500



SECTION A-A
1:50



SECTION B-B
1:50

OPTION SUMMARY. Improve conveyance of open channel and upgrade existing FPS culvert to provide a 1 in 200 year standard.

In this case the small culvert under St Ronans Terrace needs to be upgraded to a 850 mm culvert.

Upper headwall (ST Ronans Terrace) could be raised slightly to 170.77 mAOD + freeboard from 170.51 mAOD and low section on right and left bank filled to the same level.

Drop channel over 10m on approach to FPS culvert inlet, raise right bank by approximately 150mm + freeboard in the region of section Chap_009.

Upgrade FPS culvert as shown in the table provided.

- LEGEND
- EXISTING GROUND LEVEL
 - FINISHED GROUND LEVEL
 - 200 YEAR FLOOD LEVEL
 - UPGRADED CULVERT
 - RAISED EMBANKMENT
 - STORM WATER SEWER
 - EXISTING WATERCOURSE
 - MANHOLE / CULVERT INLET

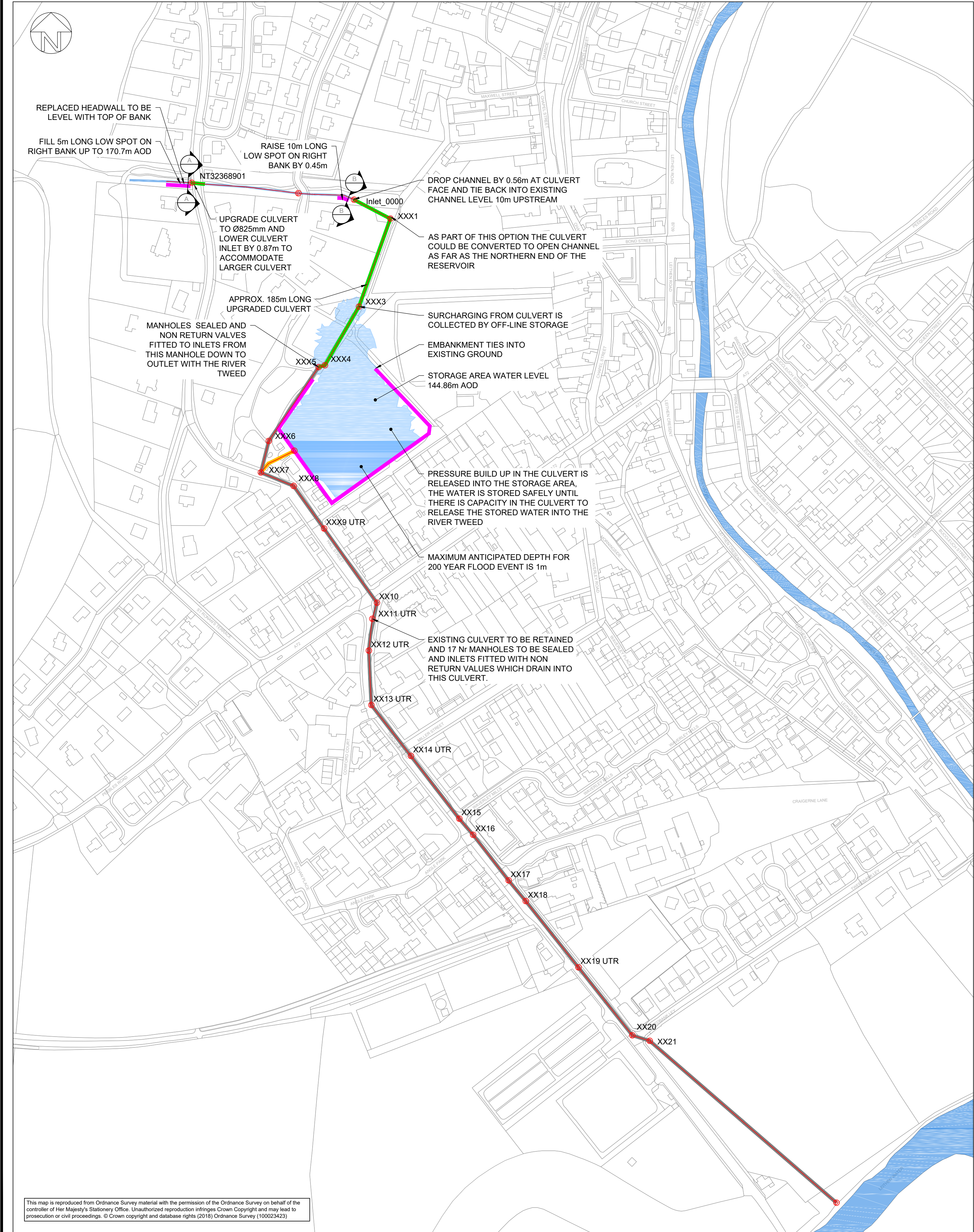
P02	Comments		Background mapping transparency reduced and manhole / culvert inlets altered							
Rev.:	Date	02/10/18	Drawn	BH	Designed	JG	Checked	AP	Approved	
Client Approval										
A - Approved										
B - Approved with Revisions										
C - Do Not Use										
Purpose of Issue									Status	S1
Suitable for Coordination										

JBA
consulting

Unit 2.1
Quantum Court
Research Avenue South
Heriot Watt University
Edinburgh
EH14 4AP
United Kingdom
www.jbaconsulting.com
+44 (0)131 3192940
+44 (0)845 8627772
info@jbaconsulting.com

Offices at Colleshill, Doncaster, Edinburgh, Exeter, Glasgow, Haywards Heath, Isle of Man, Leeds, Limerick, Newcastle upon Tyne, Newport, Peterborough, Saltair, Skipton, Tadcaster, Thirsk, Wallingford and Warrington

Project		Borders Flood Studies	
Title		Innerleithen: Option 3 Chapman's Burn 200 Year Culvert upgrade with improved channel conveyance	
Client		for	
M M MOTT MACDONALD		 Scottish Borders COUNCIL	
The property of this drawing and design vested in Jeremy Benn Associates Ltd. It shall not be reproduced in whole or in part, nor disclosed to a third party, without the prior written consent of Jeremy Benn Associates Ltd.			
Scale	As Shown @ A1		Drawn: A Coad 13/02/18 Designed: J Garrett 12/02/18 Checked: A Pettit 12/07/18 Approved:
Project Number:		2017s5526	
Drawing Number		Revision	
AEM-JBAU-IL-CB-IM-C-1100		P02	



PLAN
1:2000

Innerleithen

Option 4: Chapmans Burn

200 Year Storage with Channel Reprofilng, Sealed Manholes and New Upgraded Culvert

REPLACEMENT CULVERTS			
Manhole	Existing Culverts	Proposed Culverts	Sealed Manhole
ID Number	Diameter (mm)	Diameter (mm)	
Inlet_0000	300	1200	No
XXX1	300	900	No
XXX3	450	900	No
XXX4	450	600	No
XXX5	450	600	Yes
XXX6	450	600	Yes
XXX7	600	600	Yes
XXX8	600	600	Yes
XXX9 UTR	600	600	Yes
XX10	600	N/A	Yes
XX11 UTR	600	N/A	Yes
XX12 UTR	600	N/A	Yes
XX13 UTR	600	N/A	Yes
XX14 UTR	600	N/A	Yes
XX15	600	N/A	Yes
XX16	600	N/A	Yes
XX17	600	N/A	Yes
XX18	600	N/A	Yes
XX19 UTR	675	N/A	Yes
XX20	675	N/A	Yes
XX21	675	N/A	Yes
NT32368901	280	900	No
Cha_0049BU	850	N/A	No

OPTION SUMMARY. Option aims to acheive a 1 in 200 year standard through the combination of upstream channel/culvert improvements, upgrading of existing FPS culverts from the culvert entrance to Hall Street, the creation of a flood storage area to minimise culvert upgrades in the downstream section. Manholes would also need to be sealed. Option to open up upper section of the culvert.

- LEGEND
- EXISTING GROUND LEVEL
 - FINISHED GROUND LEVEL
 - 200 YEAR FLOOD LEVEL
 - NEW CULVERT CONNECTION TO STORAGE AREA
 - UPGRADED CULVERT
 - SEALED CULVERT
 - RAISED EMBANKMENT
 - CULVERT ALIGNMENT
 - NEW STORAGE AREA
 - MANHOLE / CULVERT INLET

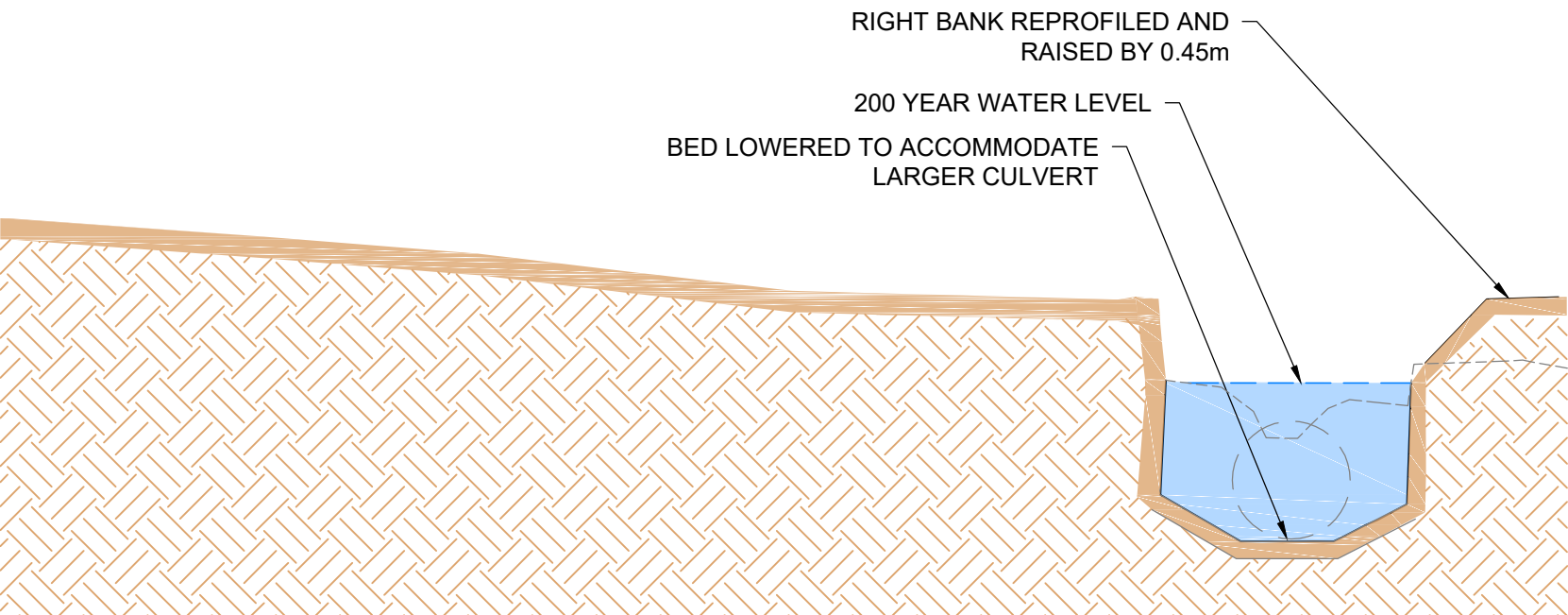
P02	Comments		Background mapping transparency reduced and manhole / culvert inlets altered							
	Date	02/10/18	Drawn	BH	Designed	JG	Checked	AP	Approved	
Client Approval										
A - Approved										
B - Approved with Revisions										
C - Do Not Use										
Purpose of Issue									Status	S1
Suitable for Coordination										

JBA
consulting

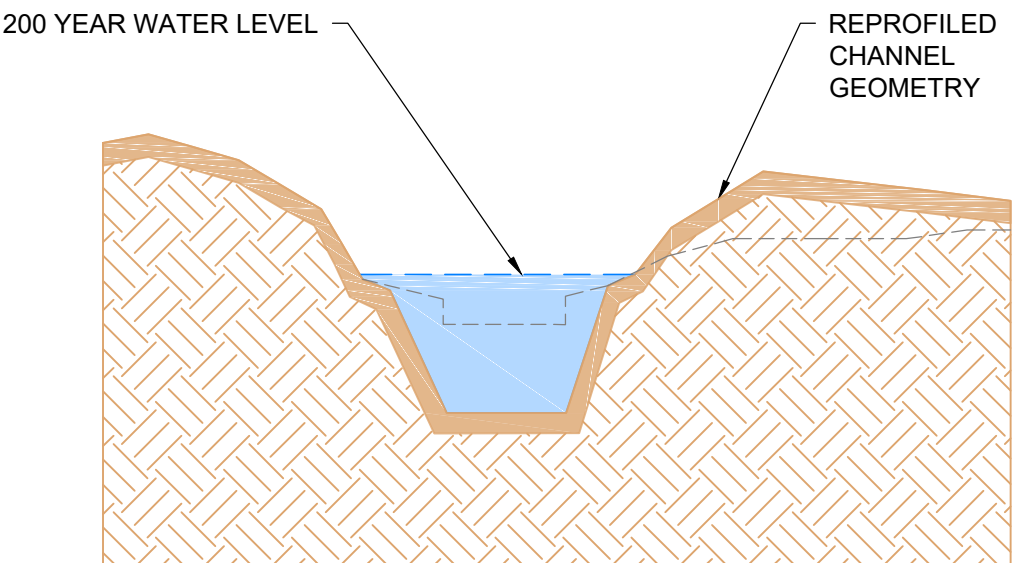
Unit 2.1
Quantum Court
Research Avenue South
Heriot Watt University
Edinburgh
EH14 4AP
United Kingdom
www.jbaconsulting.com
+44 (0)131 3192940
+44 (0)845 8627772
info@jbaconsulting.com

Offices at Colshill, Doncaster, Edinburgh, Exeter, Glasgow, Haywards Heath, Isle of Man, Leeds, Limerick, Newcastle upon Tyne, Newport, Peterborough, Saltair, Skipton, Tadcaster, Thirsk, Wallingford and Warrington

Project		Borders Flood Studies	
Title		Innerleithen: Option 4 Chapman's Burn 200 Year SoP Storage with Channel Reprofiting, Sealed Manholes and New Upgraded Culvert Plan for	
Client		M M MOTT MACDONALD  Scottish Borders COUNCIL	
The property of this drawing and design vested in Jeremy Benn Associates Ltd. It shall not be reproduced in whole or in part nor disclosed to a third party, without the prior written consent of Jeremy Benn Associates Ltd.			
Scale	As Shown @ A1	Drawn: A Coad	13/02/18
		Designed: J Garrett	12/02/18
		Checked: A Pettit	12/07/18
		Approved:	
Project Number: 2017s5526			
Drawing Number		Revision	P02
AEM-JBAU-IL-CB-IM-C-1200			

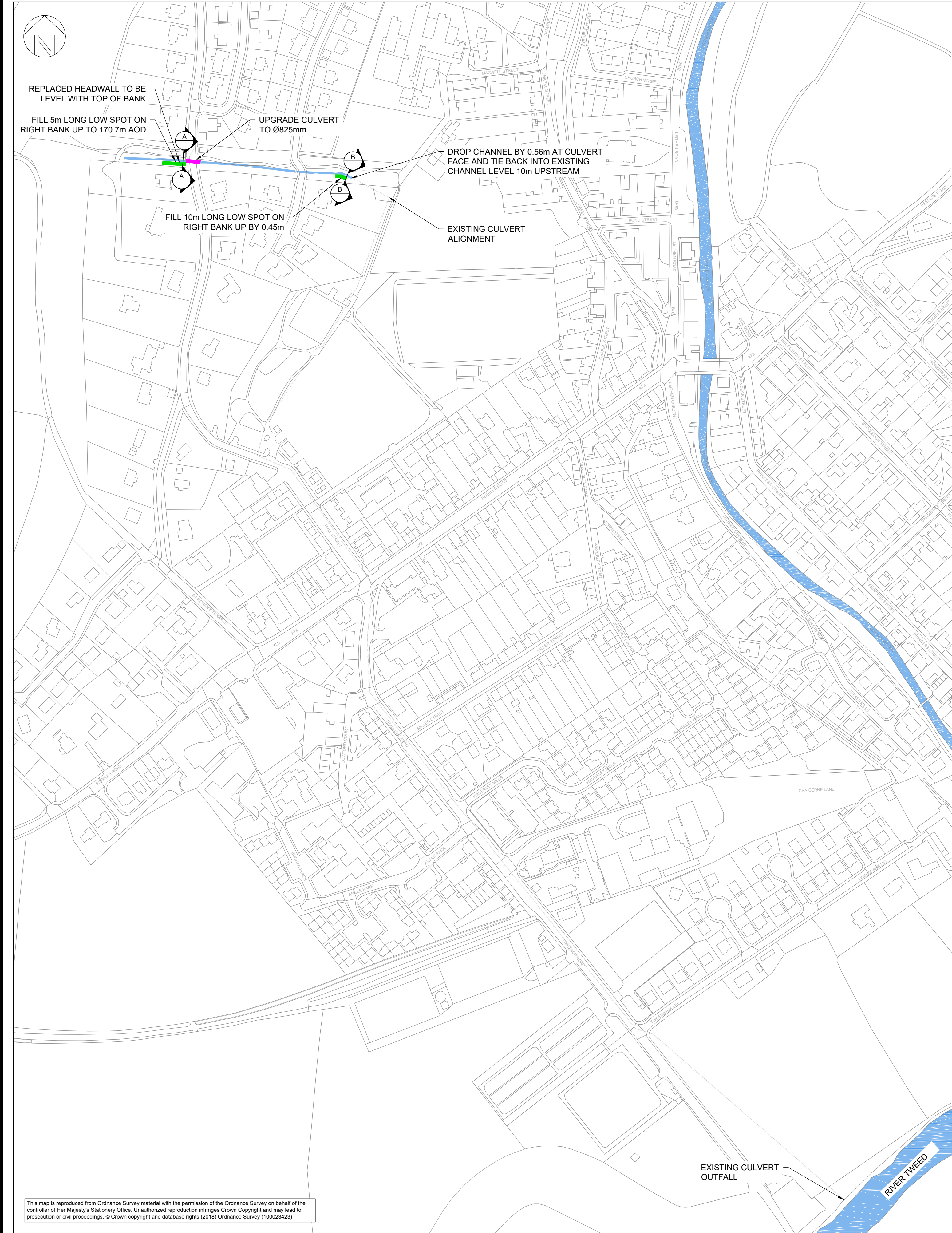


SECTION A-A
1:50



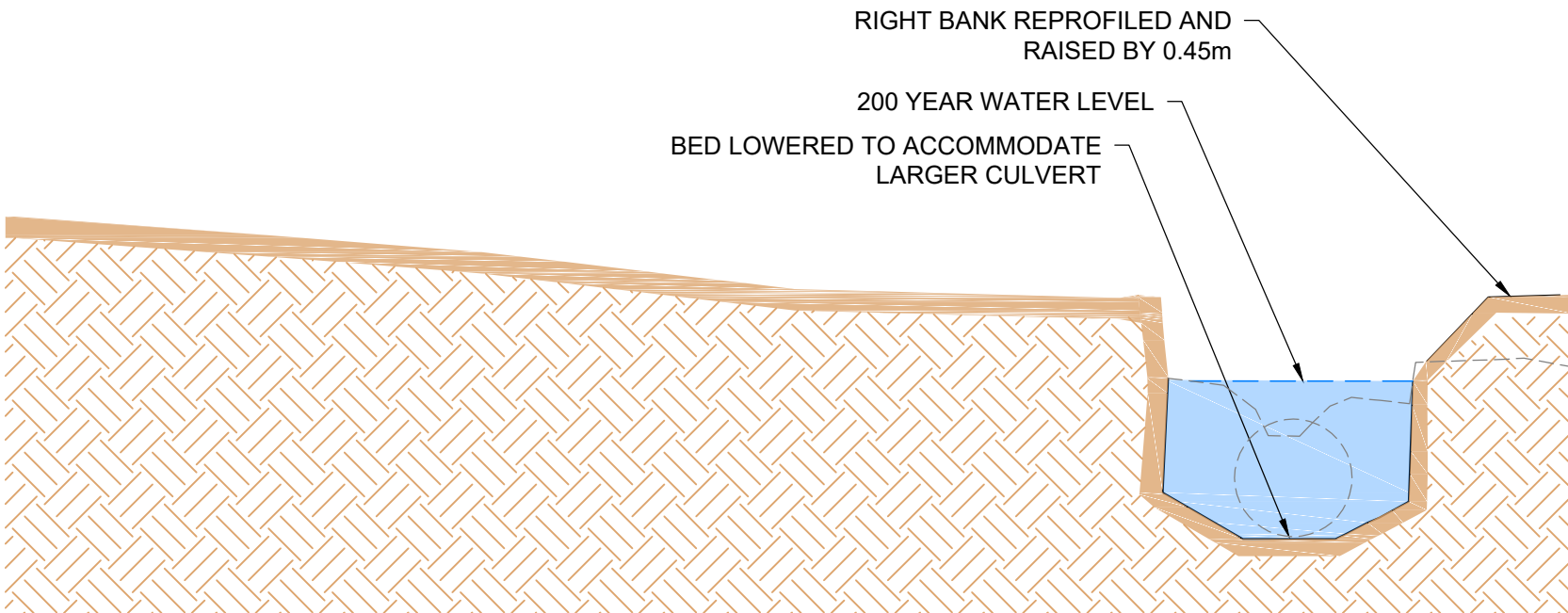
SECTION B-B
1:50

This map is reproduced from Ordnance Survey material with the permission of the Ordnance Survey on behalf of the controller of Her Majesty's Stationery Office. Unauthorized reproduction infringes Crown Copyright and may lead to prosecution or civil proceedings. © Crown copyright and database rights (2018) Ordnance Survey (100023423)

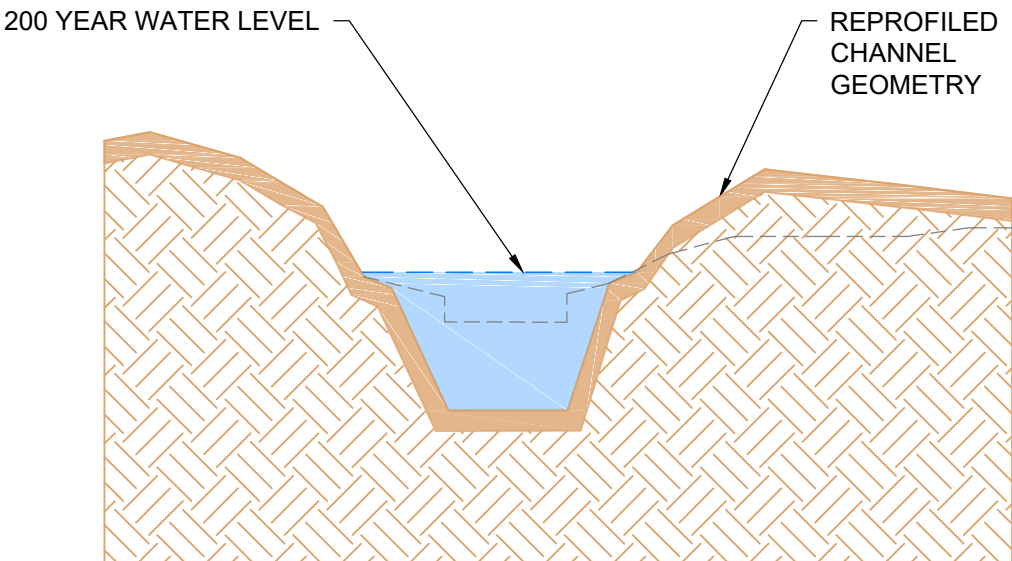


PLAN
1:2000

Innerleithen Option 5: Chapmans Burn Improved Upstream Channel Conveyance



SECTION A-A
1:50



SECTION B-B
1:50

OPTION SUMMARY. Work to the open channel upstream of the culvert to increase conveyance of burn and culverts and alleviate flood risk to nearby houses.

LEGEND	
---	EXISTING GROUND LEVEL
---	FINISHED GROUND LEVEL
---	200 YEAR FLOOD LEVEL
---	UPGRADED CULVERT
---	RAISED EMBANKMENT
---	CULVERT ALIGNMENT
---	EXISTING WATERCOURSE

P02	Comments		Background mapping transparency reduced							
Rev.:	Date	02/10/18	Drawn	BH	Designed	JG	Checked	AP	Approved	
Client Approval										
A - Approved										
B - Approved with Revisions										
C - Do Not Use										
Purpose of Issue									Status	S1
Suitable for Coordination										

JBA
consulting

Unit 2.1
Quantum Court
Research Avenue South
Heriot Watt University
Edinburgh
EH14 4AP
United Kingdom
www.jbaconsulting.com
t +44 (0)131 3192940
f +44 (0)845 8627772
e info@jbaconsulting.com

Offices at Colleshill, Doncaster, Edinburgh, Exeter, Glasgow, Haywards Heath, Isle of Man, Leeds, Limerick, Newcastle upon Tyne, Newport, Peterborough, Saltair, Skipton, Tadcaster, Thirsk, Wallingford and Warrington

Project	Borders Flood Studies	
Title	Innerleithen: Option 5 Chapman's Burn Improved upstream channel conveyance	
Client	for  	

The property of this drawing and design vested in Jeremy Benn Associates Ltd. It shall not be reproduced in whole or in part, nor disclosed to a third party, without the prior written consent of Jeremy Benn Associates Ltd.			
Scale	As Shown @ A1	Drawn: A Coad	13/02/18
		Designed: J Garrett	12/02/18
		Checked: A Pettit	13/02/18
		Approved:	
Project Number:	2017s5526		
Drawing Number	AEM-JBAU-IL-CB-IM-C-1300	Revision P02	

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
1) Property Level Protection (PLP) - Leithen Water (0.5% AP - 200 year)	47 of 48	No impact	Natural flood management opportunities have been identified and could be incorporated within the scheme to provided additional environmental benefits.	Intrusive into people's homes, will require reinstallation every 25 years. Some flood damages are associated with each flood event, as well as clean up cost. Roads and gardens are not protected.	All properties protected with PLP will also be protected under the 200 year climate change event, additional properties will require PLP as the 200 year climate change flood extent is larger.	Option should be presented to public for comment. Signage relating to flooding and sand bag stores should be erected. Ensure Innerleithen residents are aware of the Resilient Community Programme	BCR 3.4
2) Direct Defences – Leithen Water (0.5% AP - 200 year)	48 of 48	Minimal direct impact		In order to avoid excess wall lengths only properties who are anticipated to suffer flood damages above floor level have been targeted for protection. The minimum required wall length is 450 m with a wall height of between 450mm to 900mm. Gardens and low level damage to homes will still be experienced by several properties	This option will not protect properties from flood events in excess of the 200 year event. Designing to the 200 year plus climate change event is requires a wall length of approximately 800 to 1000m and would require raising of the A72 Road Bridge to avoid wall heights in excess of 2.5 m.	Test reliability of flood warning system and consider improving it by installing an additional gauge further up the catchment	BCR 4.3
1) Property Level Protection (PLP) - Chapman's Burn (0.5% AP - 200 year)	24 of 31	No impact	No suitable additional NFM measures	Intrusive into people's homes, will require reinstallation every 25 years. Some flood damages are associated with each flood event, as well as clean-up cost. Roads and gardens are not protected.	All properties protected with PLP will also be protected under the 200 year climate change event, additional properties will require PLP as the 200 year climate change flood extent is larger.	Installation of a flow gauge on the Chapman's Burn for flood warning, calibration and flow estimates.	BCR 4.3
3) Culvert Upgrade – Chapman's Burn	31 of 31			Replacement of culverts shall be disruptive to the community for access and noise.	Channel and culvert could be made larger now to accommodate further increase in flows.		BCR 0.7
4) Offline Storage – Chapman's Burn (0.5% AP - 200 year)	31 of 31	A portion of the existing culvert could be replaced with an open channel instead of a larger culvert		Offline storage embankment peak height is approximately 1.3m at street level so should not be too much of a visual impact. The offline storage is utilising an existing playing field, the playing field is to be maintained but will require some redevelopment.	Channel, storage culvert could be made larger now to accommodate further increase in flows.		BCR 1.3
5) Channel Upgrade – Chapman's Burn (50% AP - 2 year)	3 of 28	No impact		Effect of flood water after upgrade needs to be assessed in greater detail	Channel could be made larger now to accommodate further increase in flows.		BCR 32



Preferred Options and recommendations

If taken forward and selected by SEPA's Prioritisation process then the preferred option for the Leithen Water is Option 2 - Direct Defences With an in channel debris screen upstream of the A72 Road Bridge. This could be implemented alongside natural flood management.

The short term recommendations for the Chapman's Burn is:

- Improved channel conveyance
- Flow gauging for improved flow estimates
- Telemetry on FPS screen

In the long term, depending on the collected gauge data, a flood protection scheme should be progressed for Chapman's Burn

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 was confirmed with a site visit at sample locations. The NFM measures which have been proposed for the Leithen Water include:

- Improved and management practices
- Working within the banks (buffer strips, debris dams)
- Woodland planting
- Wetland creation and leaky barriers

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



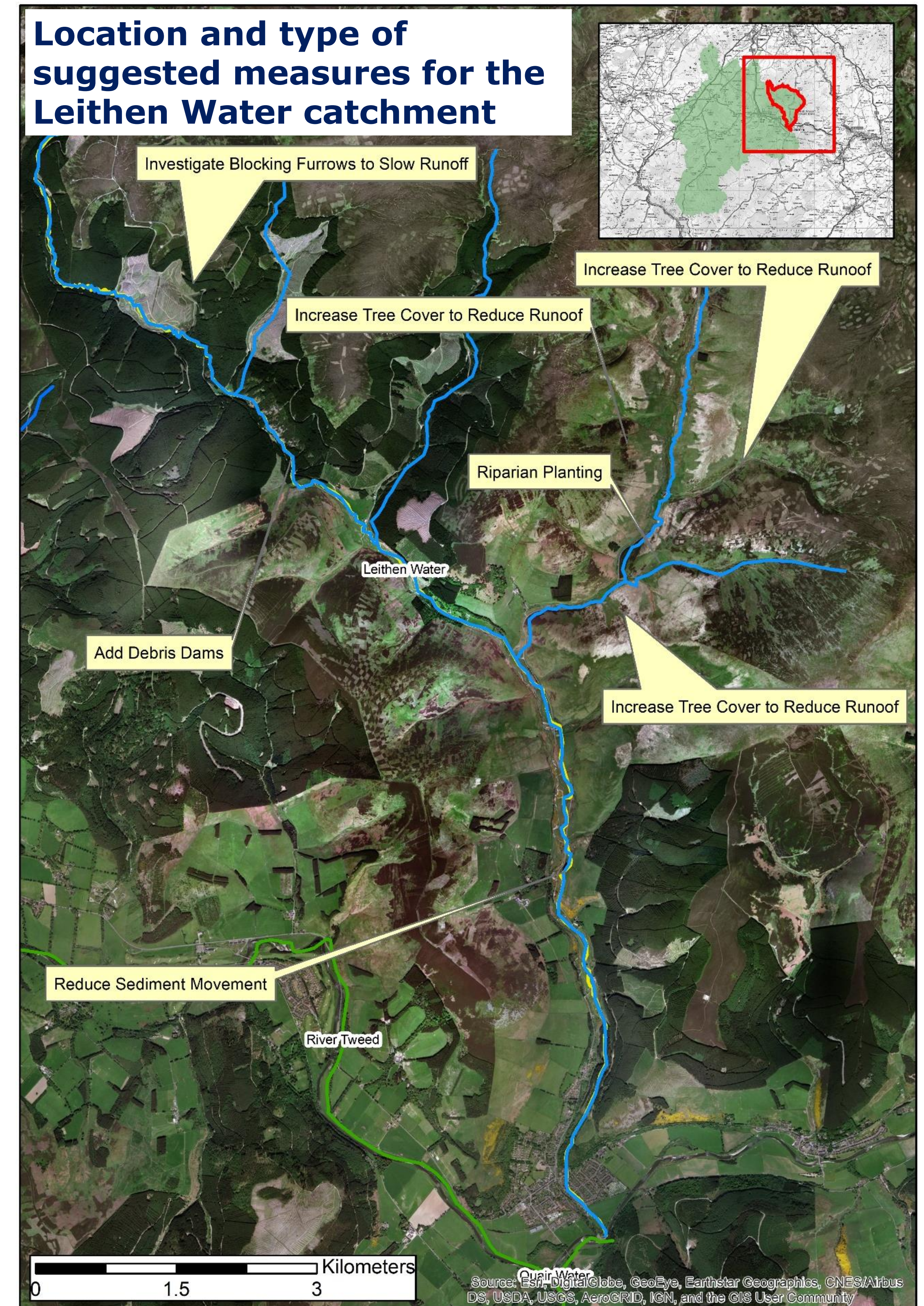
Typical example of wetland creation



Typical example of in-channel debris barrier



Typical example of young woodland



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

