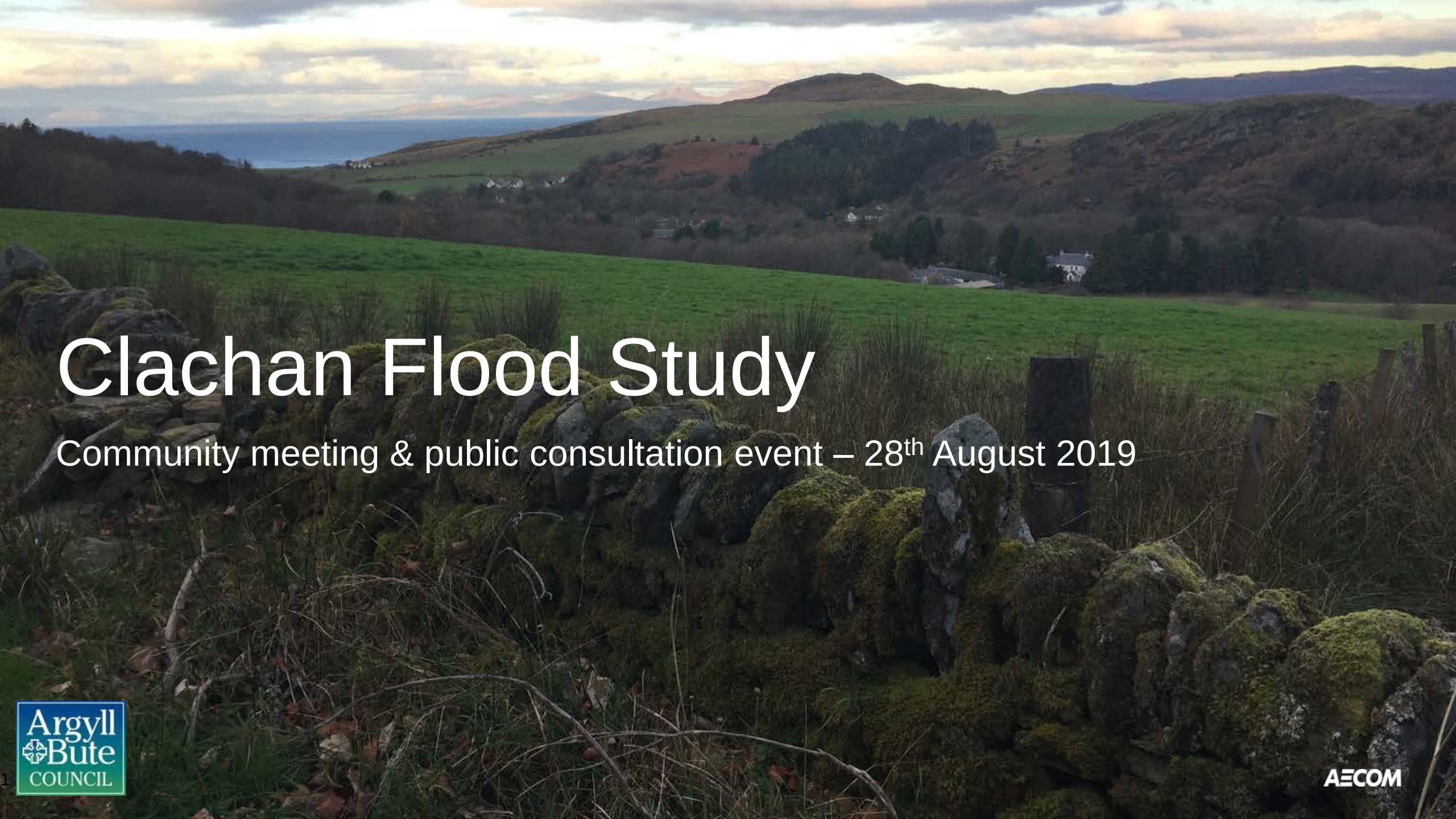

Clachan Flood Study

Community meeting & public consultation event – 28th August 2019

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Community Meeting - Structure

– Background and why we are here today

– What has been done since the last meeting?

– What options were considered?

– How did we appraise and prioritise the options?

– What options did we develop?

– What are the next steps?

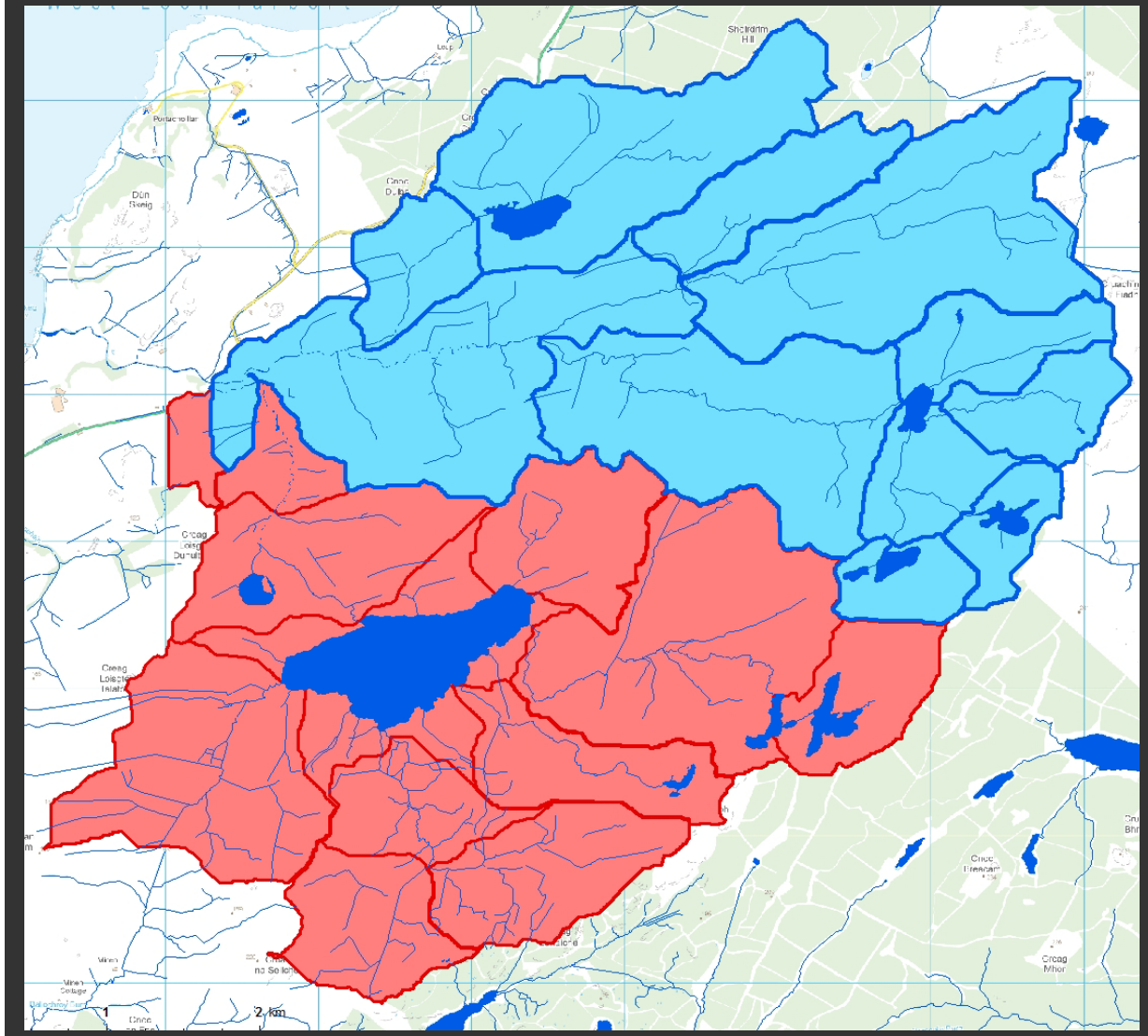
– Questions

Clachan – study background

– Village not included in PVA but has now been added by SEPA in NFRA 2018

– Forestry Commission Scotland, SEPA, Scottish Water and ABC met community in 2017 to discuss a way forward

– AECOM subsequently awarded the flood study to continue this work in Spring 2018



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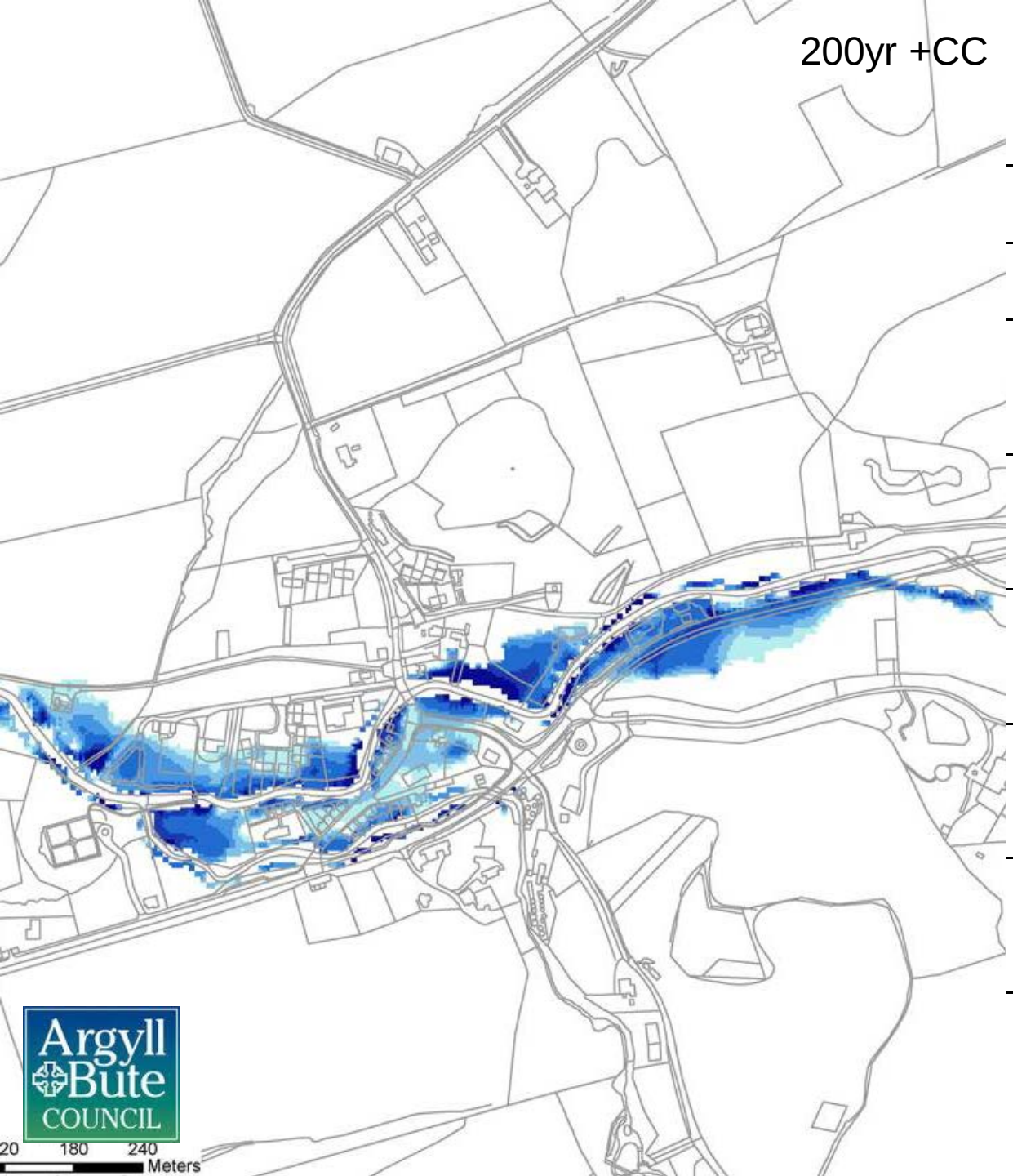

Summary of work to date

- Data gap analysis completed
- Baseline flood modelling completed - Dec ‘18
- Community meeting to discuss past flooding and possible options
- Options longlisting within AECOM team and with ABC
- Workshop with AECOM, Community rep, ABC, FCS, SEPA and SW to discuss options – Feb ‘19
- Second Public meeting to collect community feedback on long list options – Apr ‘19
- Qualitative assessment of long listed options to get short list
- Full Options Appraisal of short list options

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The purpose of this presentation

- We have now undertaken a holistic appraisal of short listed options and are consulting on the outcomes
- We would like your feedback so that we can consider it as part of the final preferred solution
- This will be provided to SEPA for inclusion in the National Prioritisation for Flood Risk Management Works

- The purpose of this presentation is to:
  - Tell you about the work carried out
  - Describe the proposed options
  - Explain how you can make your views heard

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Our last public presentation – April 2019

What you told us at this event:

– There was a general understanding and support for catchment wide interventions

– There was a general understanding that a positive cost-benefit ratio for hard-engineered solutions may be difficult to achieve for Clachan

– There was strong support for the removal of the weir.

– Public concerns about timeframes and when a solution would be in place

– Attendees wanted to know how potentially affected landowners have been consulted

– A number of people voiced support for PLP solution as “quick win”

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Our last public presentation – April 2019

At the last meeting, we had a 5 categories covering 29 options:

1. Local Options

Redirect overland flow and drainage

Property Flood Protection

Ongoing Forestry Management

Self Help

2. Pluvial Options

Tree planting at cross contour

Understorey planting in existing woodland

Hedgerow planting and associated swales

Land management measures

Leaky barriers on steep watercourses

3. Allt Mor Options

Modify management regime for Loch Ciaran

Increase storage in Loch Na Beiste

Tree planting and leaky barriers on tributary

Wetland/ storage area on right bank of Allt Mor

4. Clachan NFM Options

Wetland enhancement & ditch blocking

Riparian woodland

Hillslope planting

5. Hard Engineering Options

Weir modification/or removal

High flow diversion channels

Upsize culvert at driveway

Flood defences at vulnerable

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Screening of Options – what did we consider?

Technical	Is the proposed option technically feasible?
Legal	Are there any legal blockers to the option?
Financial	Is the cost to build the option exorbitant or likely to be within the level of economic damage caused by flooding?
Environmental	Will the option have negative environmental impact beyond short-term and manageable construction impacts?

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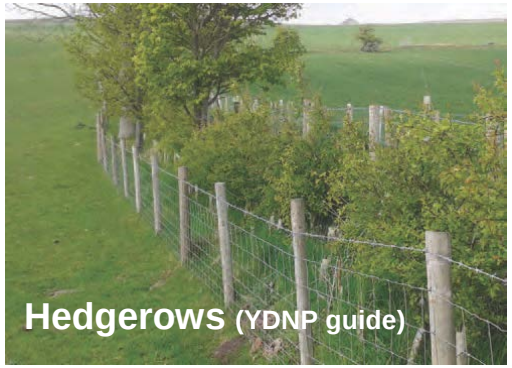
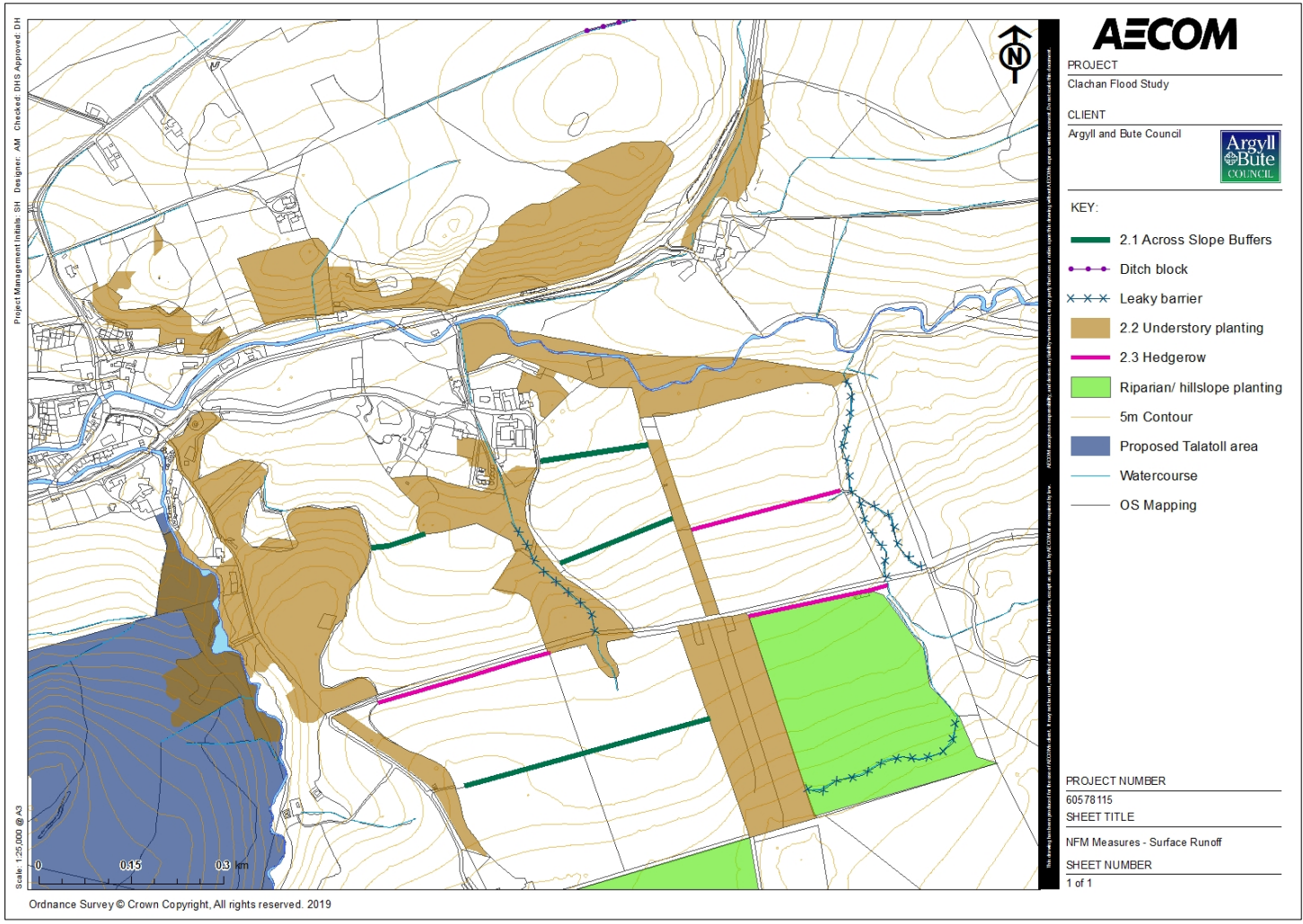
Discounted Options from Long List

2. NFM Pluvial Options

- Tree planting at cross contour buffer strips.
- Understory planting in existing woodland
- Hedgerow planting and associated swales
- Land management measures



- Current focus is river flooding
- Limited potential for prioritisation
- Land management by other agencies
- Long term land use changes may be taken forward outside this study



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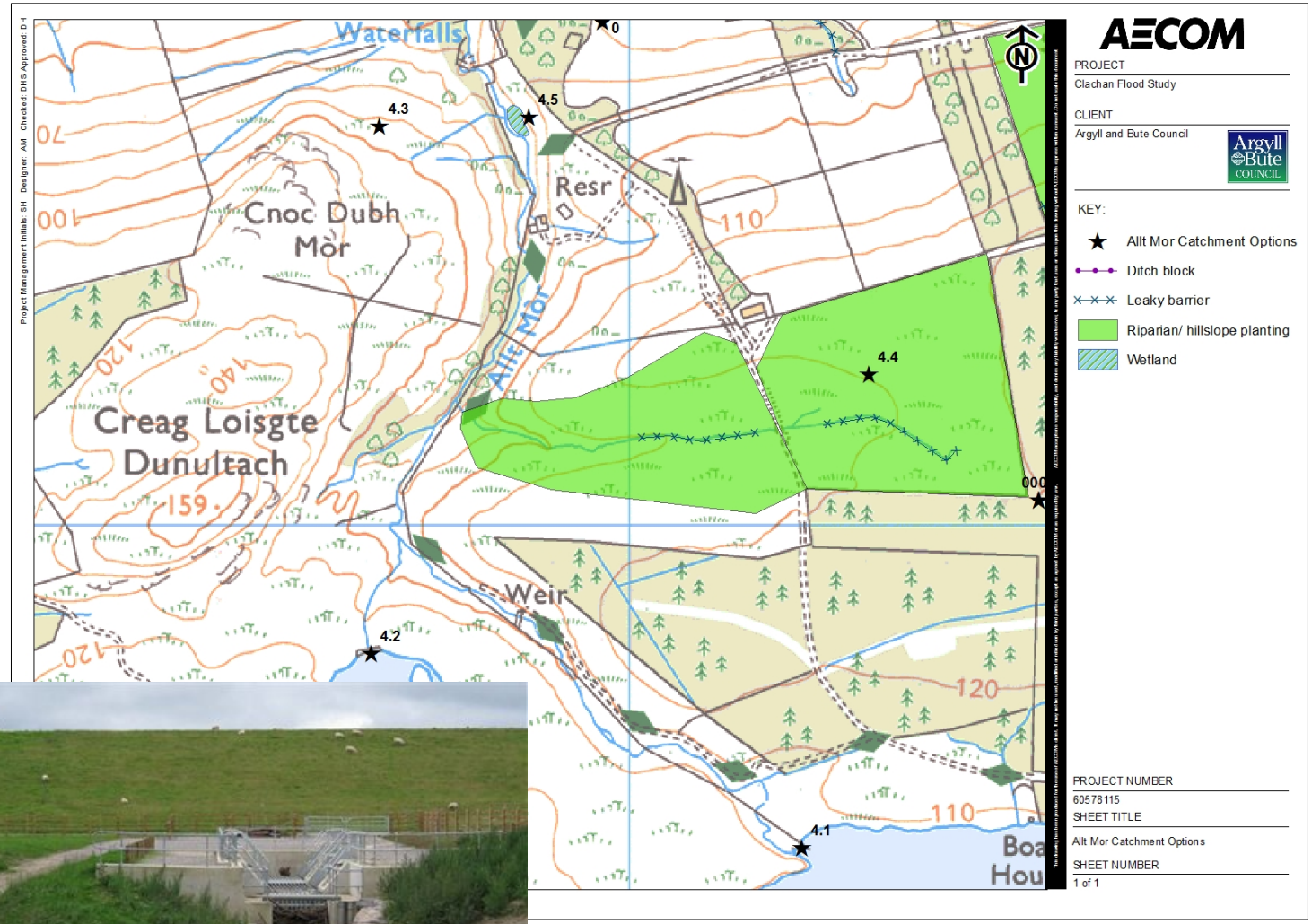
Discounted Options from Long List

3. Allt Mor Options

- 4.1 Modify management regime for Loch Ciaran
  - Technical – No real opportunity to enhance attenuation volume to proportionally reduce risk
  - Technical – Challenging construction
  - Cost – Would outweigh limited benefit
  - Legal – Reservoirs Act

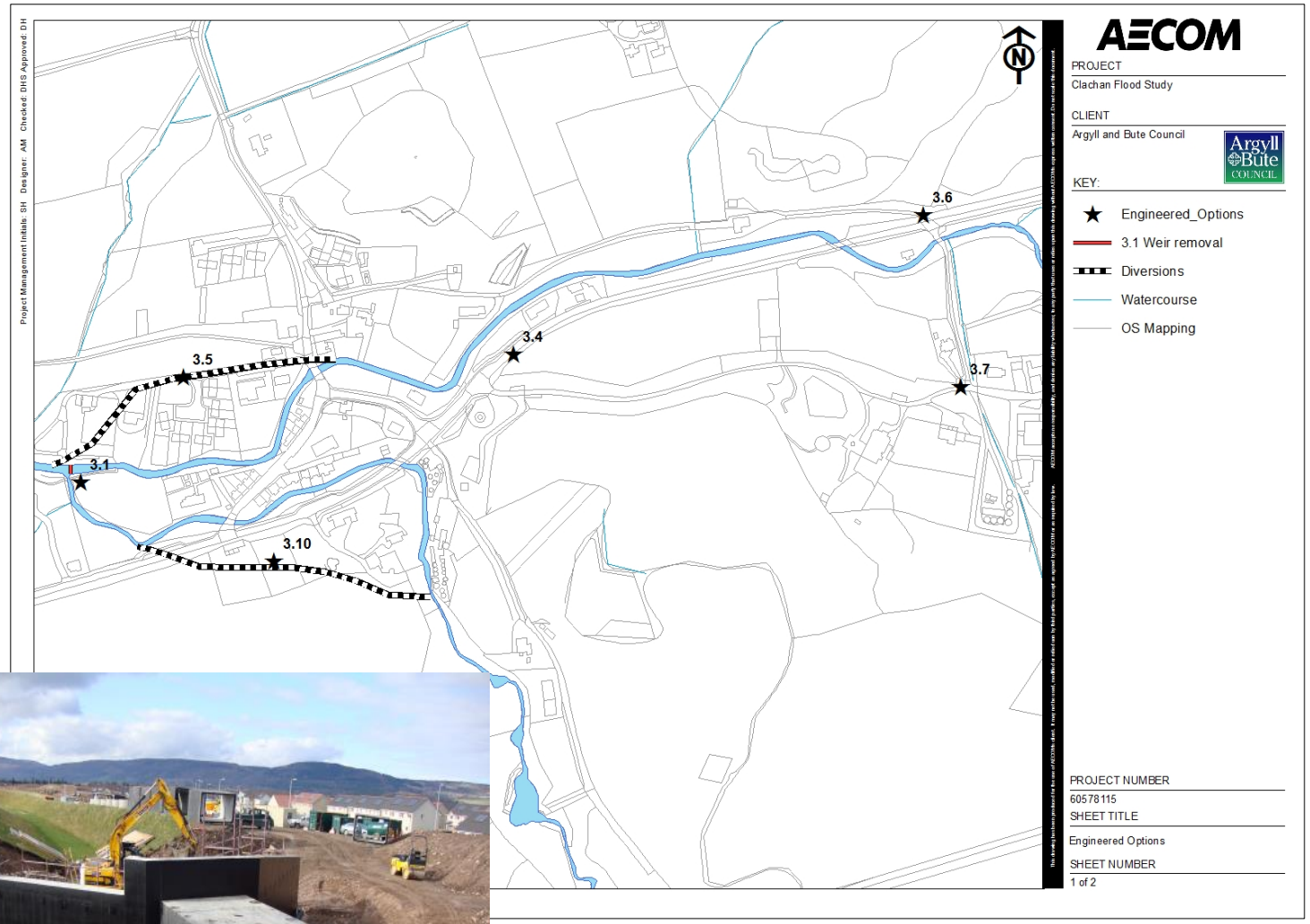
- 4.2 Increase storage in Loch Na Beiste
  - Technical – Ad hoc structure
  - Technical – Small catchment – limited impact flood risk benefit
  - Technical – sync of peak flows



Discounted Options from Long List

5. Hard Engineering Options

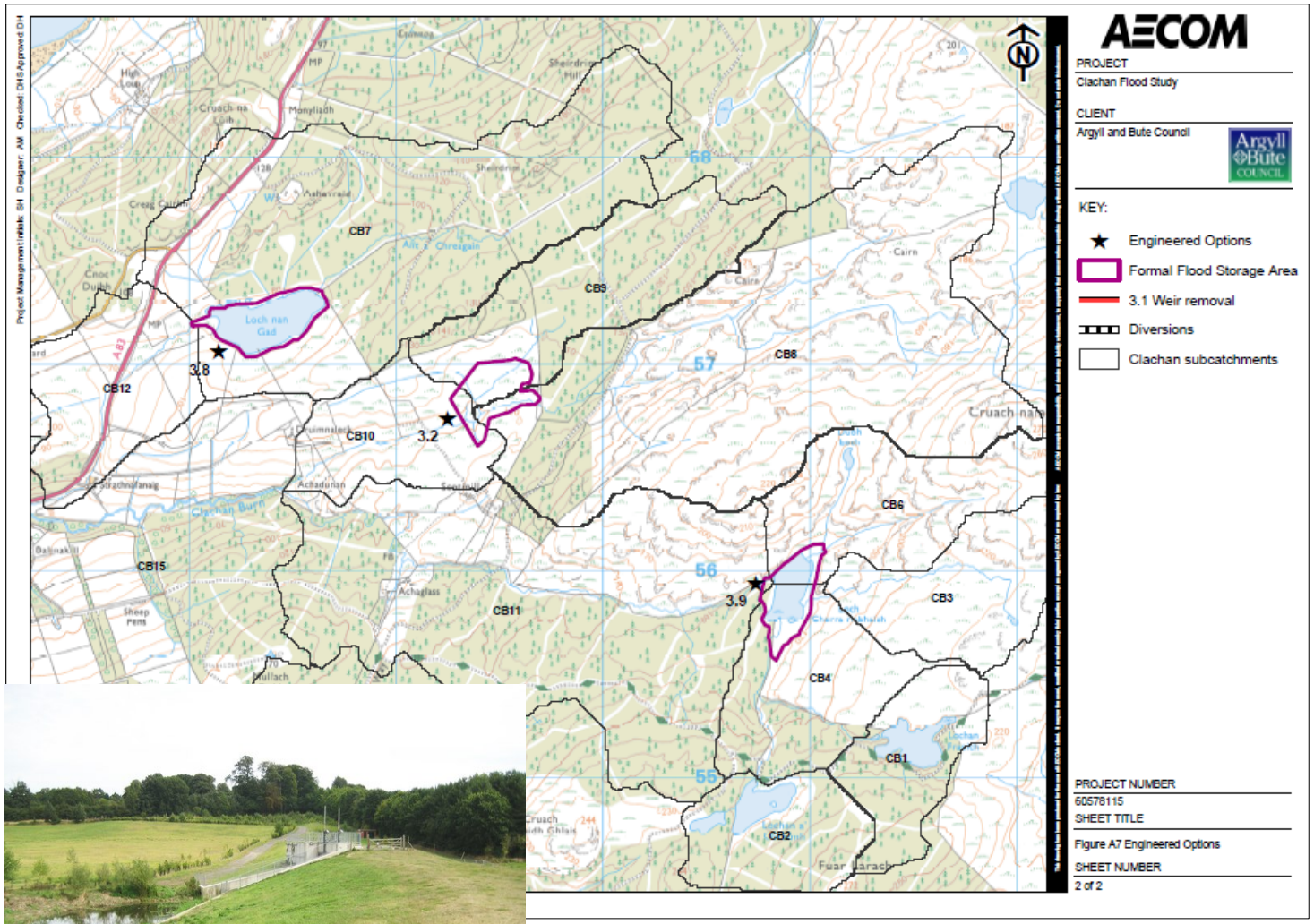
- 3.4 Upsize culvert at A83
  - Technical – likely to push problem downstream
  - Cost prohibitive – high cost for minor local gain
- 3.5 High flow diversion channel – Clachan Burn
  - Technical – space and access challenge
  - Cost prohibitive – order of £700K
- 3.6 Improve conveyance of ditch at driveway
  - Taken forward for maintenance
- 3.10 High flow diversion channel – Allt Mor
  - Technical – space and access challenge
  - Technical – services and disruption
  - Cost prohibitive – order of £500K



Discounted Options from Long List

5. Hard Engineering Options

- 3.2 Storage in the upper Clachan Burn
  - Technical – Tested in model 25% reduction in peak flow
  - Cost prohibitive – order of £980K
- 3.8 Loch Nan Gad Storage
  - Technical - Already heavily attenuated – contributes 0.2% of flows,
  - Technical – testing in model showed no positive impact
- 3.9 Loch Chorra-riabhaich Storage
  - Technical - Already heavily attenuated – contributes (9%) toward flow
  - Testing in model showed no positive impact on flooding



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Short List

Options for full assessment and appraisal

1. NFM Catchment wide
2. Weir removal
3. Direct Defences within Clachan
4. NFM Catchment wide + weir removal
5. NFM Catchment wide + direct defences
6. Weir removal and direct defences
7. NFM Catchment Wide, weir removal and direct defences
8. Property Flood Protection

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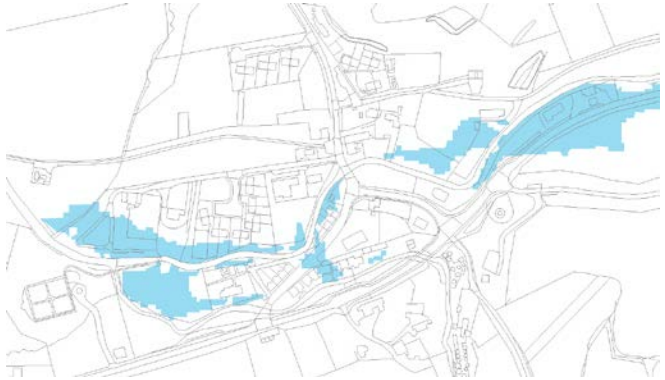
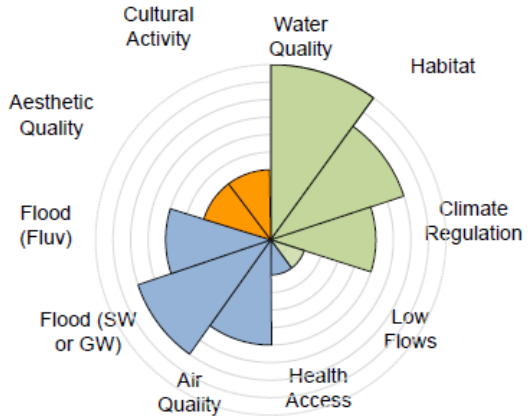
What has been done since the last meeting?

Development and appraisal of short listed options



Hydraulic Modelling

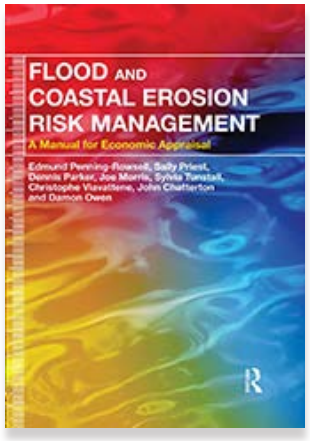


Environmental Assessment

Costing

Schematic Design

Multi-criteria Appraisal



Damage Assessment

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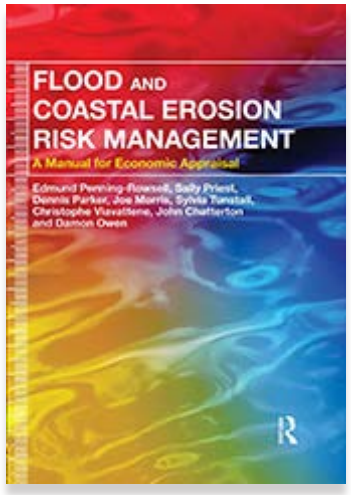
How did we appraise short list options?

Economic appraisals:

- Government funding - economic benefits of an option should be greater than the costs.

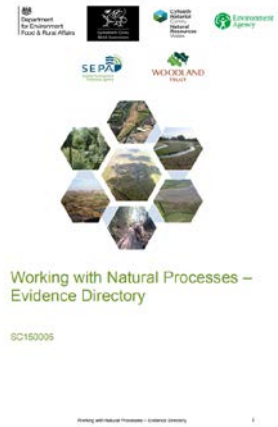
- Our assessment included:
  - Property damages
  - Clean-up costs
  - Emergency services
  - Other damages



Social and environmental appraisals:

- Economically viable and also show wider social and environmental benefits
- CBR <1 previously rejected - social and environmental value being increasingly realised

- We looked at:
  - Health benefits, Risk to life, social vulnerability
  - Possible impacts during construction
  - Water, Ecological, heritage, landscape etc. environments
  - Flora, fauna and biodiversity
  - Air and soil
  - Climatic factors



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What Options did we develop? *Option 1 NFM Catchment wide*

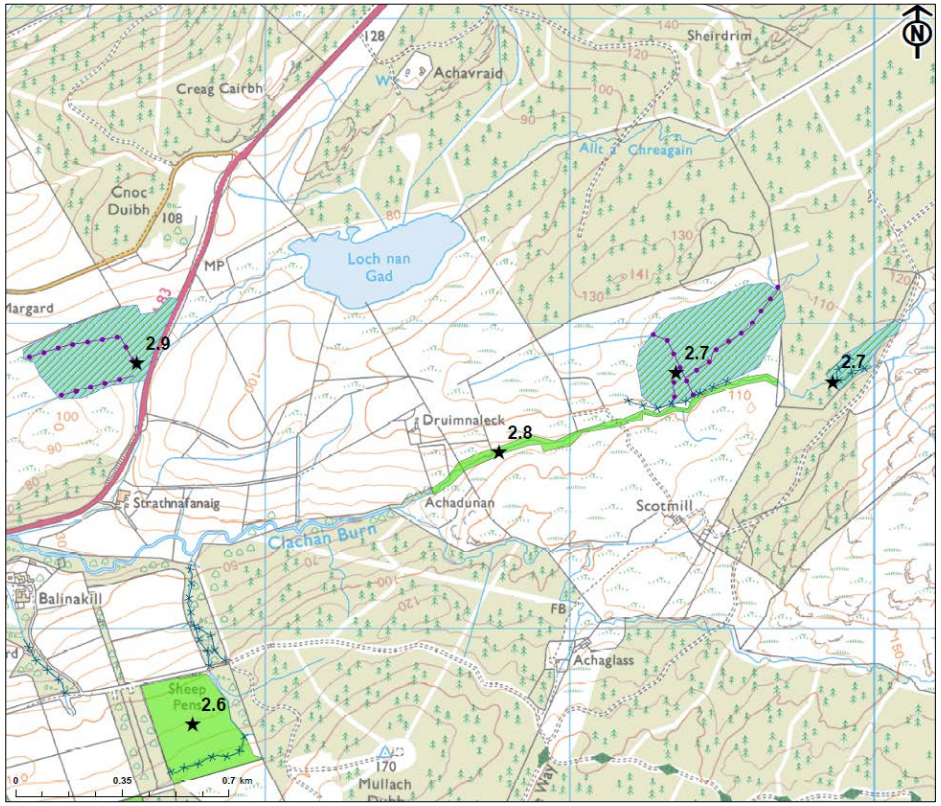
NFM measures have small local impacts which can allow incremental gains across the catchment. NFM options were therefore tested together.

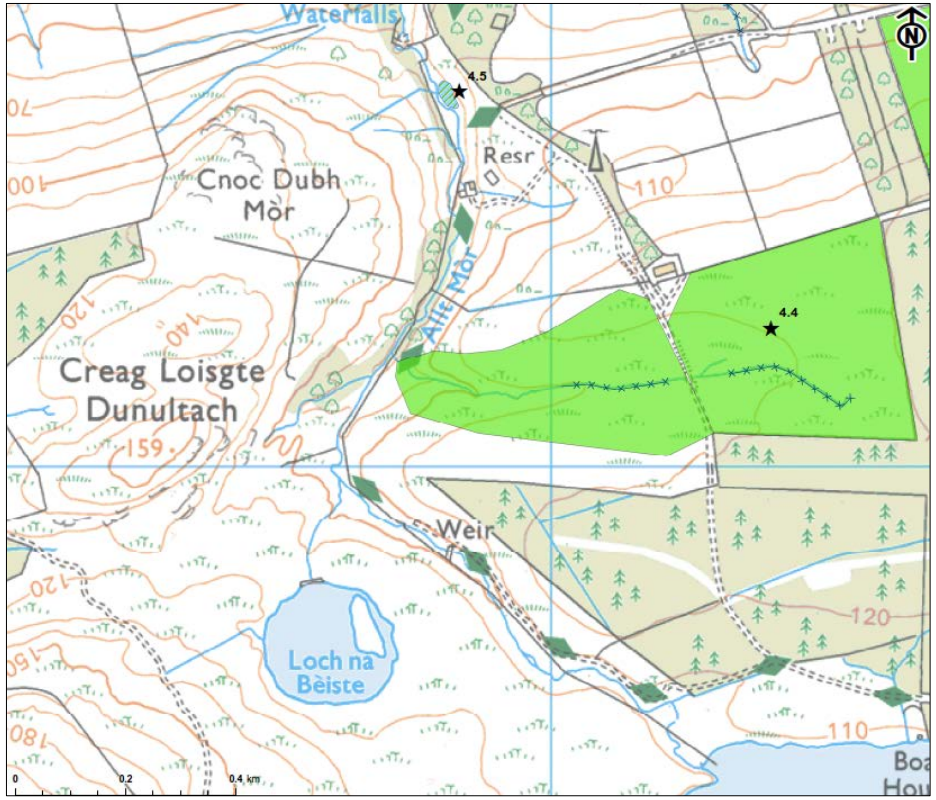
Clachan Catchment

- Riparian planting (2.8, 2.6).
- Installation of leaky barriers
- Wetland storage in pockets (2.7 and 2.9).
- Engineered log jams in ditches

Allt Mor Catchment

- Leaky barriers in ditches (4.4)
- Wetland creation (4.5)

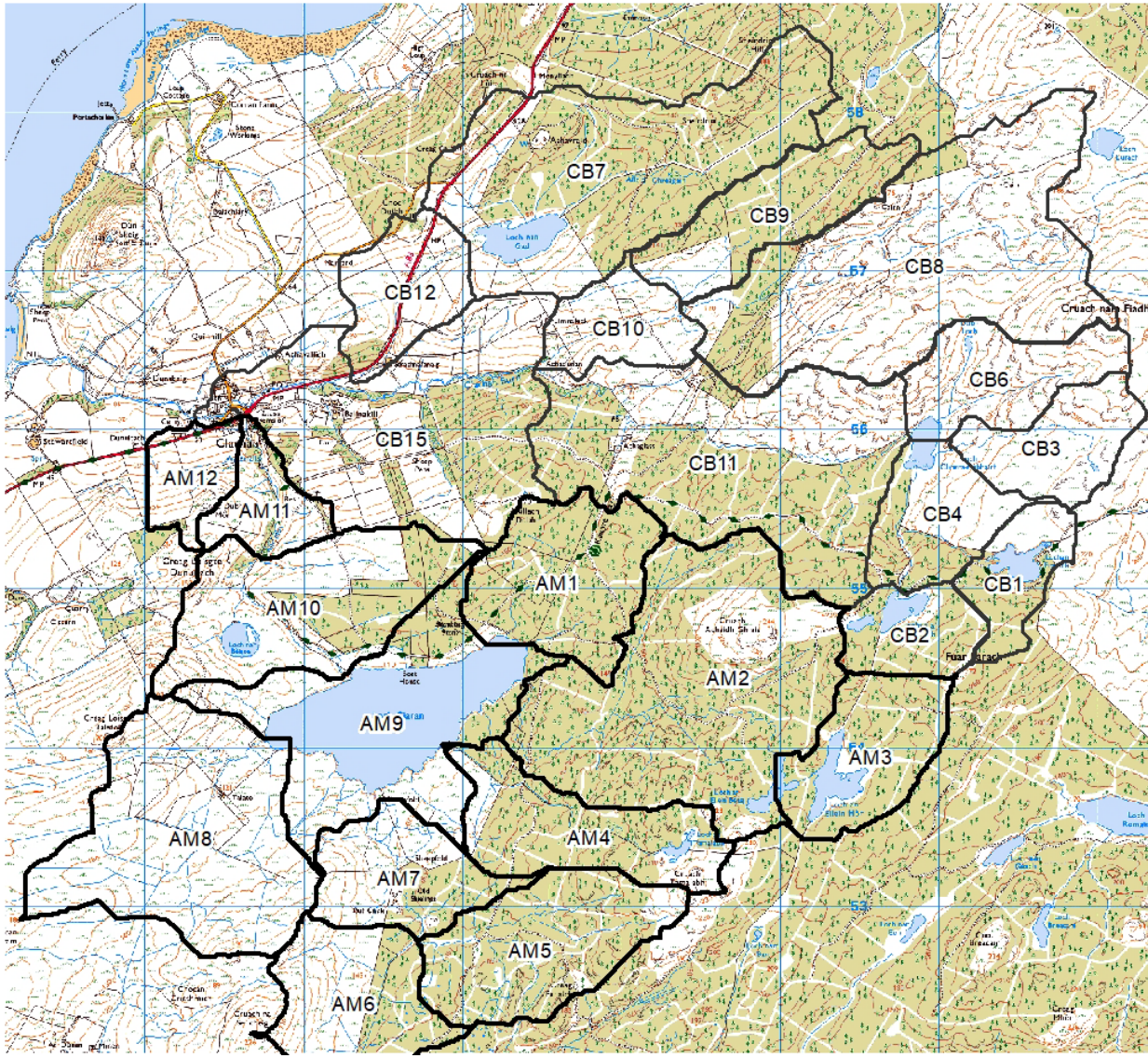


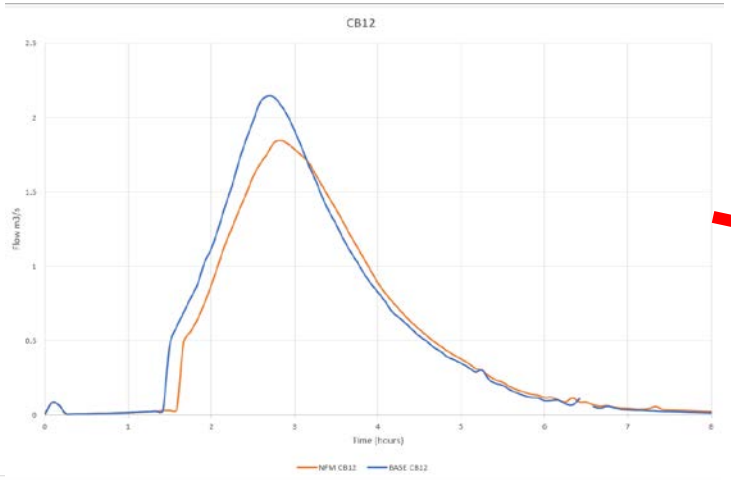


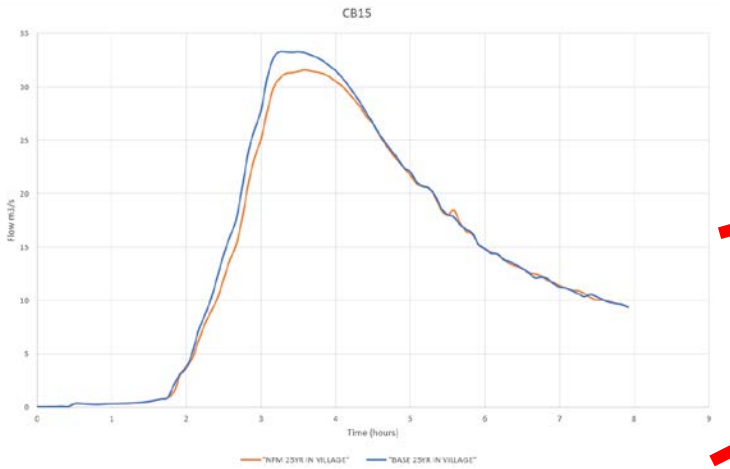
Option 1 NFM Results

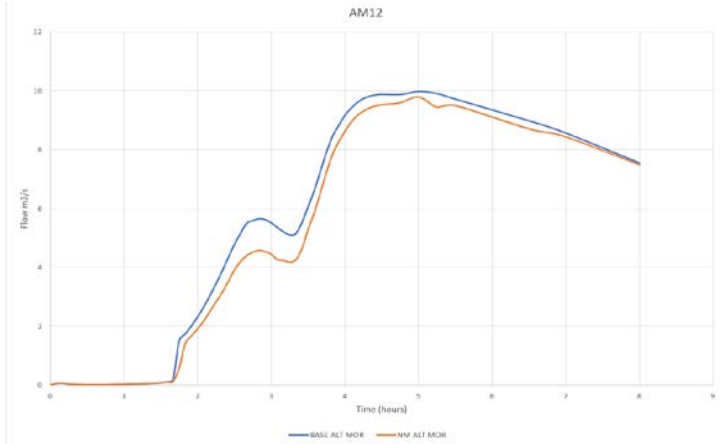
CB8, CB9, CB10, CB11,CB12, AM11 and AM12 - highest contributions of flow to the village per km^2

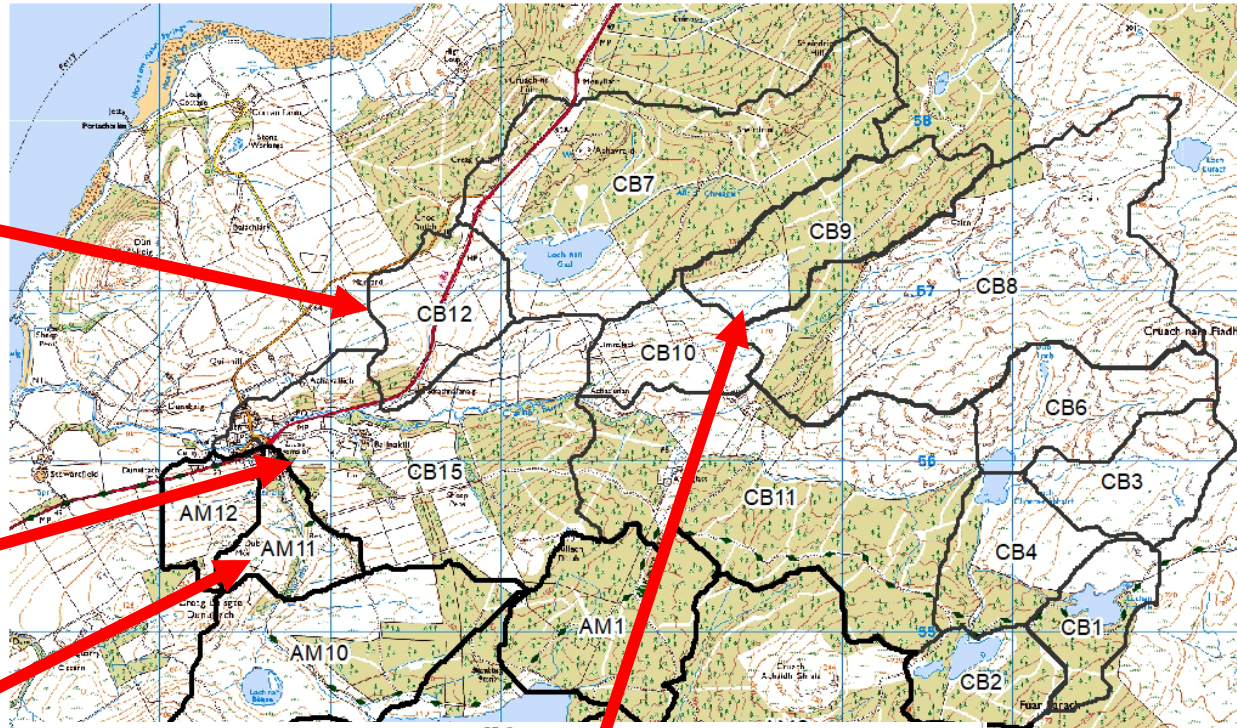
Location	Subcatchment	Base Time to peak (hours)	Peak flow Baseline (m^3/s)	NFM Time to peak (hours)	Flow NFM (m3/s)	Increase in time to peak (mins)	% reduction in subcatchment peak flow
Smaller Scotmill Wetland (2.7)	CB8	3.2	10.8	3.5	**9.9**	**+15mins**	**8%**
Larger Scotmil Wetland (2.7)	CB9	3.0	1.7	3.7	**0.7**	**+40mins**	**60%**
Downstream Scotmill Wetlands (2.8)	CB10	3.1	3.3	3.3	**3.1**	**+15mins**	**4%**
Downstream Strathnafanaig wetland (2.9)	CB12	3.1	2.1	3.1	**1.8**	**+10mins**	**14%**
Within Clachan	CB15	2.7	33.3	3.6	**31.6**	**+25mins**	**5%**
Downstream Allt Mor wetland	AM12	2.8	5.6	2.8	**4.6**	**0**	**19**

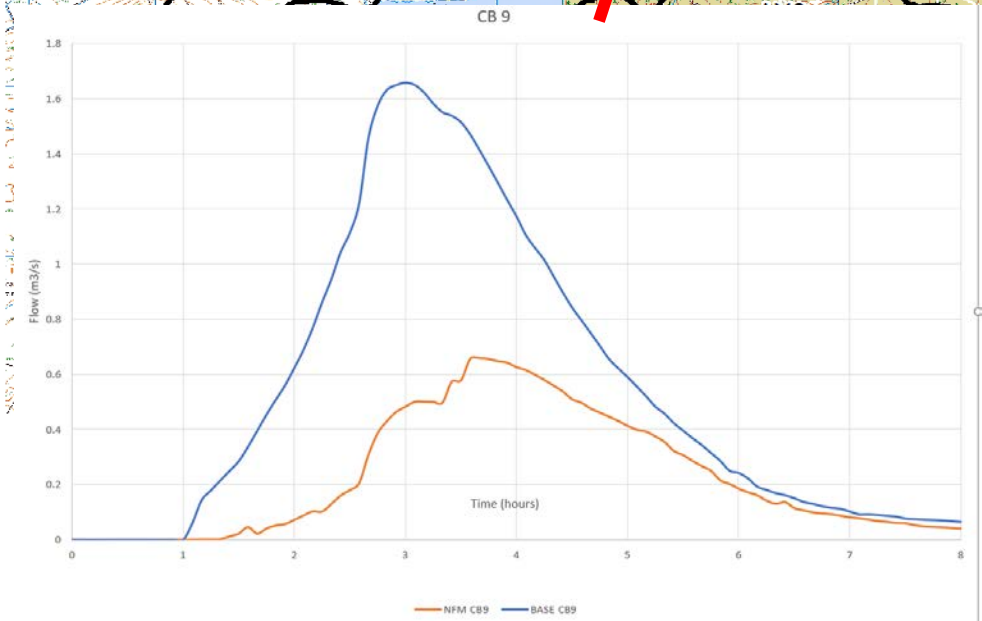



CB12
Flow m3/s
Time (hours)
NFM CB12
BASE CB12


CB15
Flow m3/s
Time (hours)
"NFM 25YR IN VILLAGE"
"BASE 25YR IN VILLAGE"


AM12
Flow m3/s
Time (hours)
BASE ALT MOR
NM ALT MOR


CB7
CB9
CB8
CB12
CB10
CB6
CB15
CB3
AM12
AM11
CB11
CB4
AM1
CB1
AM10
CB2


CB 9
Flow (m3/s)
Time (hours)
NFM CB9
BASE CB9

Option 1 NFM Results

Flood risk benefits

- Reduction in risk to A83,
- No overtopping to gardens directly downstream of Clachan burn road bridge at 1 in 10 yr event,
- Minor benefit to Allt Mor, reduction in flood depths around 50mm,
- Most benefit realised up to 1 in 25 year event,
- 18 properties with reduced risk.

Economics

- £300K - Whole Life Cost
- **0.42 - Benefit Cost Ratio**

Social and environmental impacts

- Climate regulation,
- Carbon sequestration,
- Improvement in water quality,
- Habitat provision and increased biodiversity,
- Improved fish habitat.


Engineered leaky barrier


Ditch block for wetland creation

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What Options did we develop? Option 2 Clachan Burn Weir

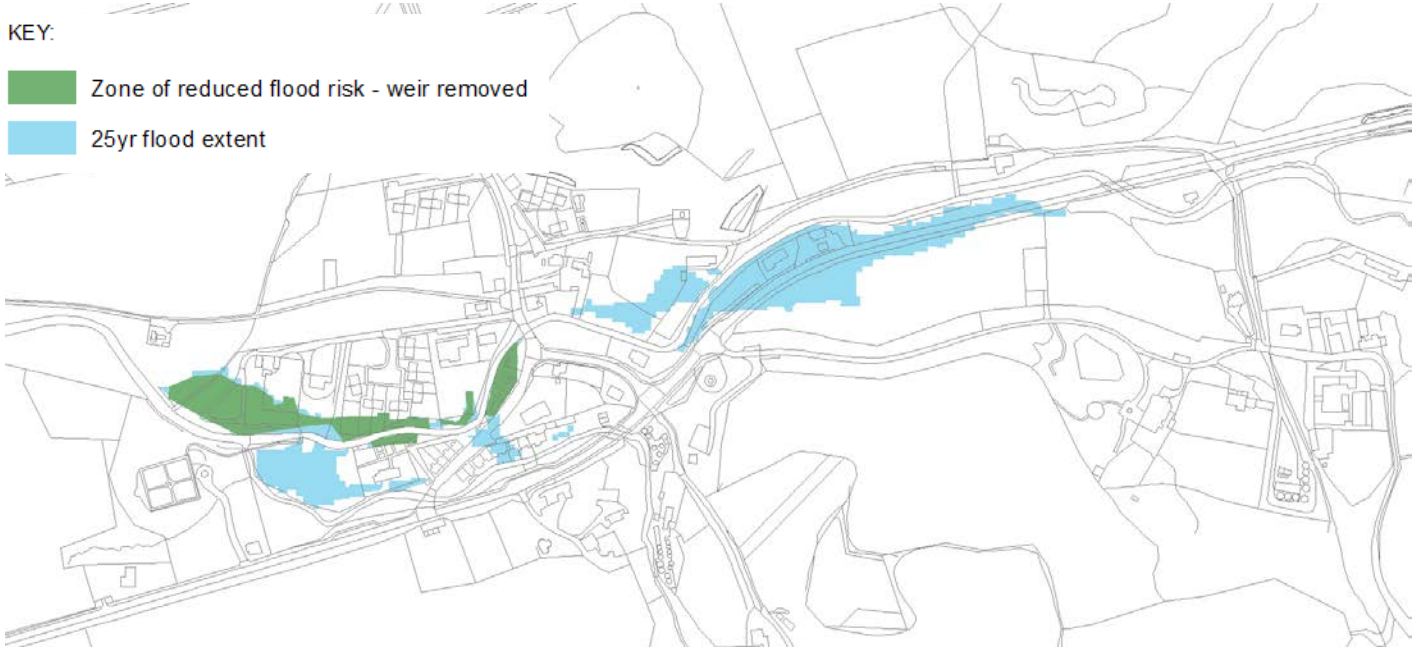
Increase local channel capacity by flushing out built up sediment & lowering water level

Flood risk benefits

- No overtopping to gardens directly downstream of road bridge or at caravan park at 1 in 10 year event,
- 15 properties with reduced flood risk,
- Bank protection required 45m upstream to offset increased velocities,
- No impact upstream of road bridge or along Allt Mor.

Social and environmental impacts

- Increased in-stream biodiversity,
- Improved fish migration and habitat,
- Restoration of channel morphology.



Economics

- £170K - Whole Life Cost
- **1.06 - Benefit Cost Ratio**

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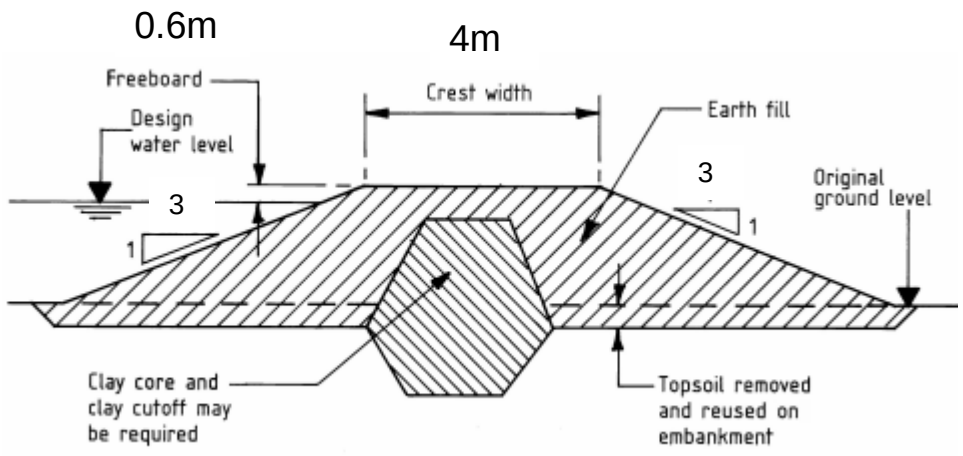
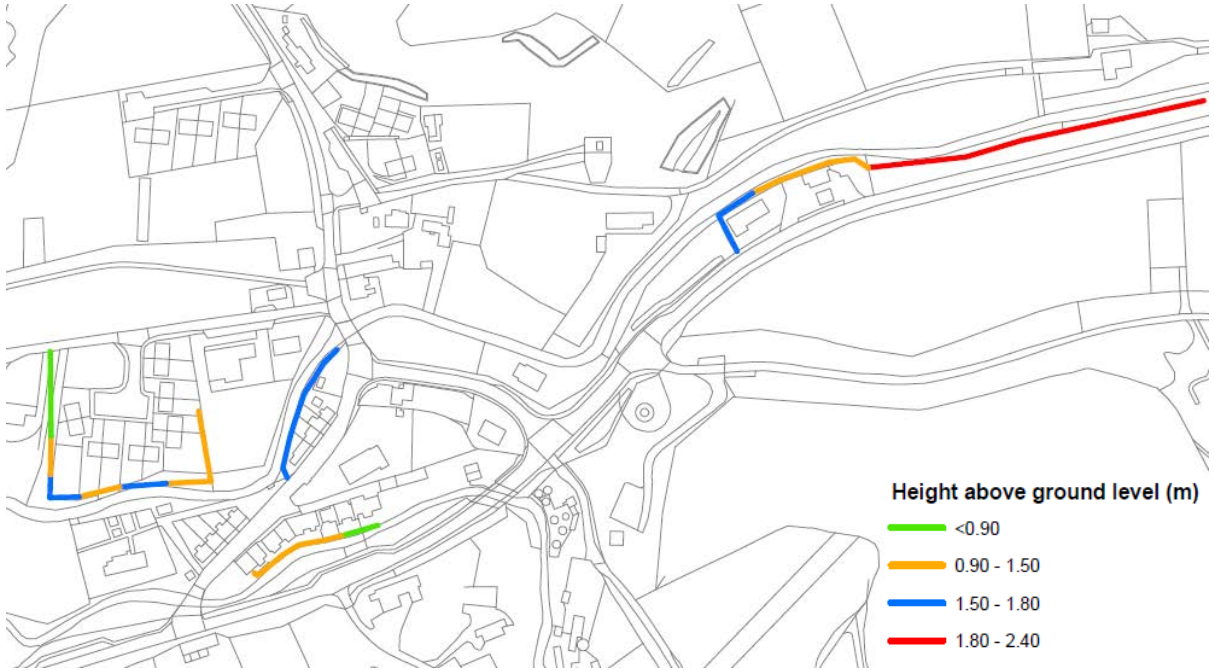
What Options did we develop? Option 3 Direct Defences

Four key areas to protect most vulnerable properties: Clachan Filling Station, downstream of the road bridge, Mansecroft and Allt Mor where overtopping originates.

- Based on available space at key points in the catchment, flood walls as opposed to embankments are required.
- Height determined by iterative testing in hydraulic model based on 1 in 200 year water level and associated push of water downstream.
- 609m of flood walls required ranging from 0.9 – 2.4m high





Option 3 Direct Defences Results

Flood risk benefits

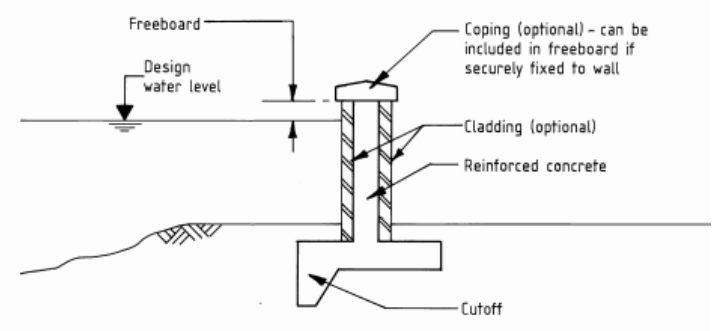
- High Standard of Protection - 18 properties protected to 1 in 200 year standard

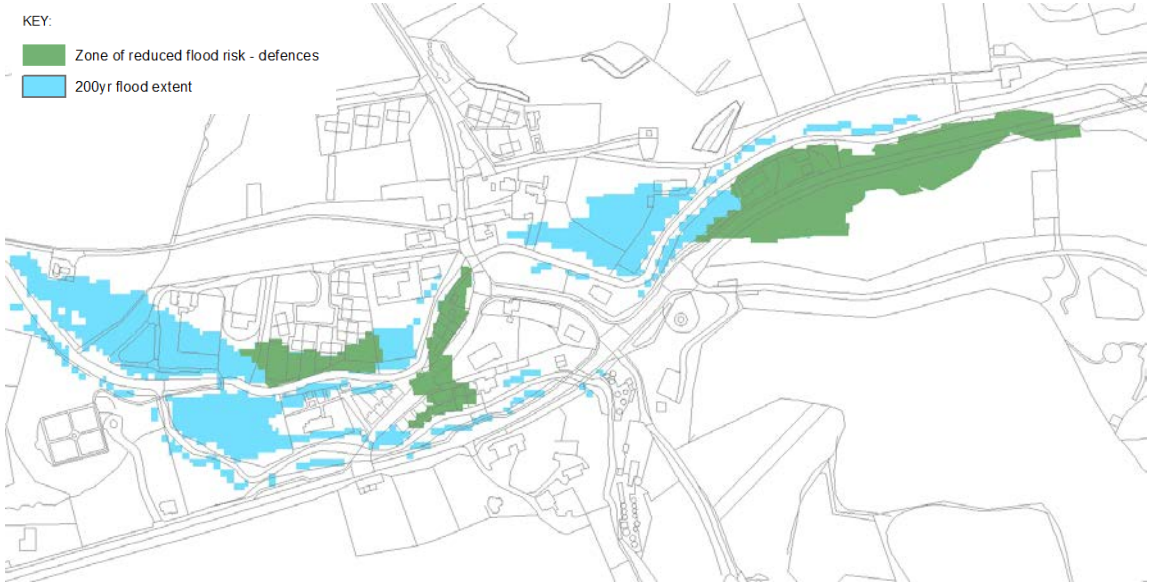
Economics

- £3.2M - Whole Life Cost
- **0.04 - Benefit Cost Ratio**

Social and environmental impacts

- Protection of A83 and Clachan Filling Station maintaining community link,
- Reduced stress due to visual comfort of defence,
- Visual impact on connection with watercourse,
- Significant tree felling required near filling station,
- Reduced pollution associated with flooding.





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What Options did we develop? Option 4 NFM catchment wide with weir removal

Partnering the attenuating impact of NFM upstream with the removal of the weir to increase capacity of the channel – to boost the flood risk benefits of both options

Flood risk benefits

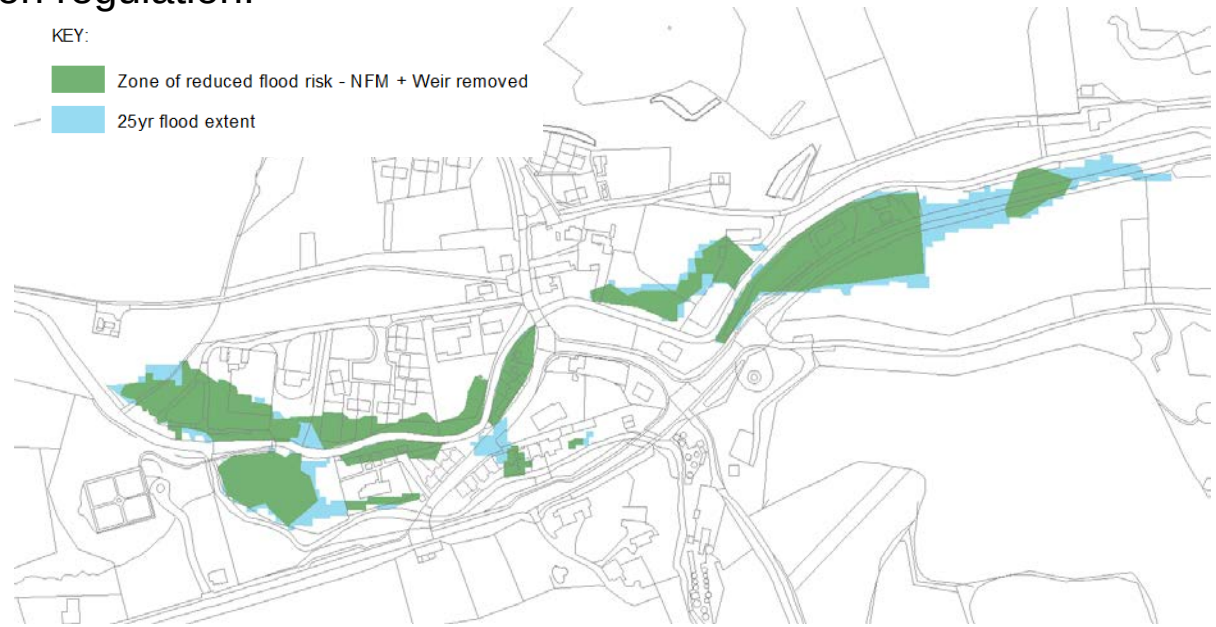
- Desynchronization of peaks between the two burns,
- No overtopping directly downstream of road bridge, caravan park & Longrigg up to 1 in 10 yr event,
- Reduced risk to 23 properties at smaller return period events,
- Does not solve all issues but reduces impact at smaller, frequent events.

Economics

- £336K - Whole Life Cost
- **0.59 - Benefit Cost Ratio**

Social and environmental impacts

- Climate regulation & carbon sequestration,
- Reduced risk to A83 maintain community link,
- Improved fish migration and habitat,
- Erosion regulation.



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What Options did we develop? Option 5 NFM and direct defences

NFM upstream and flood walls - defences more viable?

Flood risk benefits

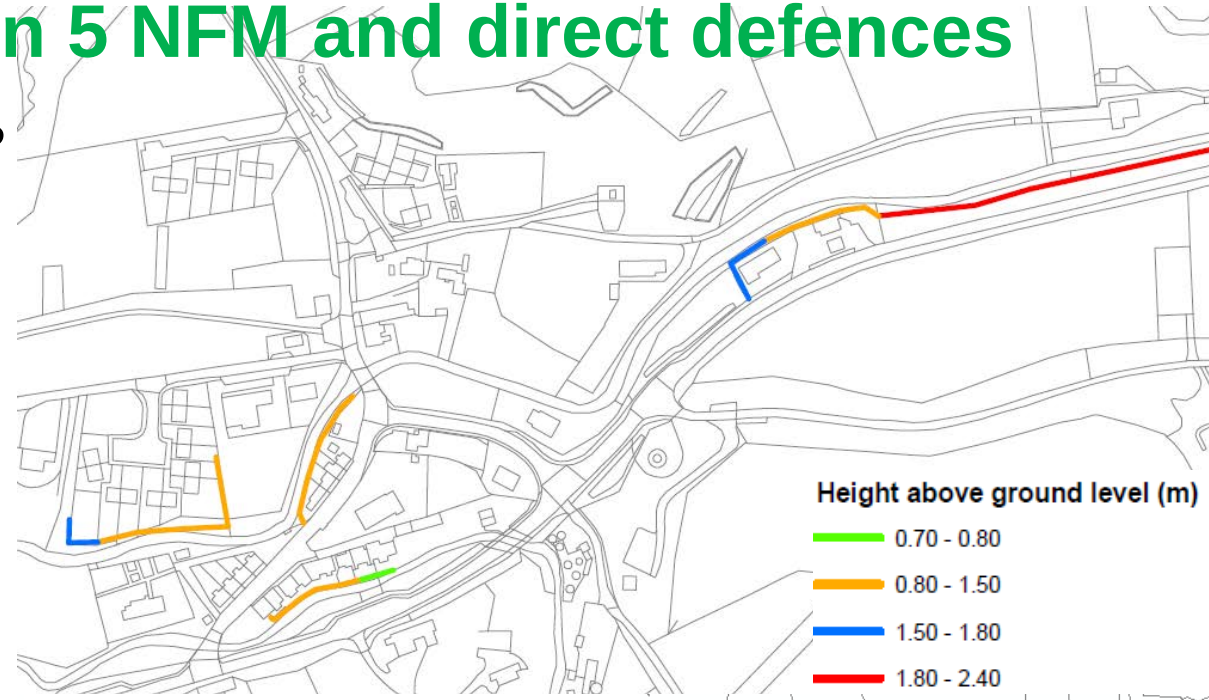
- High Standard of Protection (SoP) - 100 year SoP to 18 properties,
- Reduces height of defences at Clachan Burn required by around 200mm,
- Reduces length of defences required to 546m.

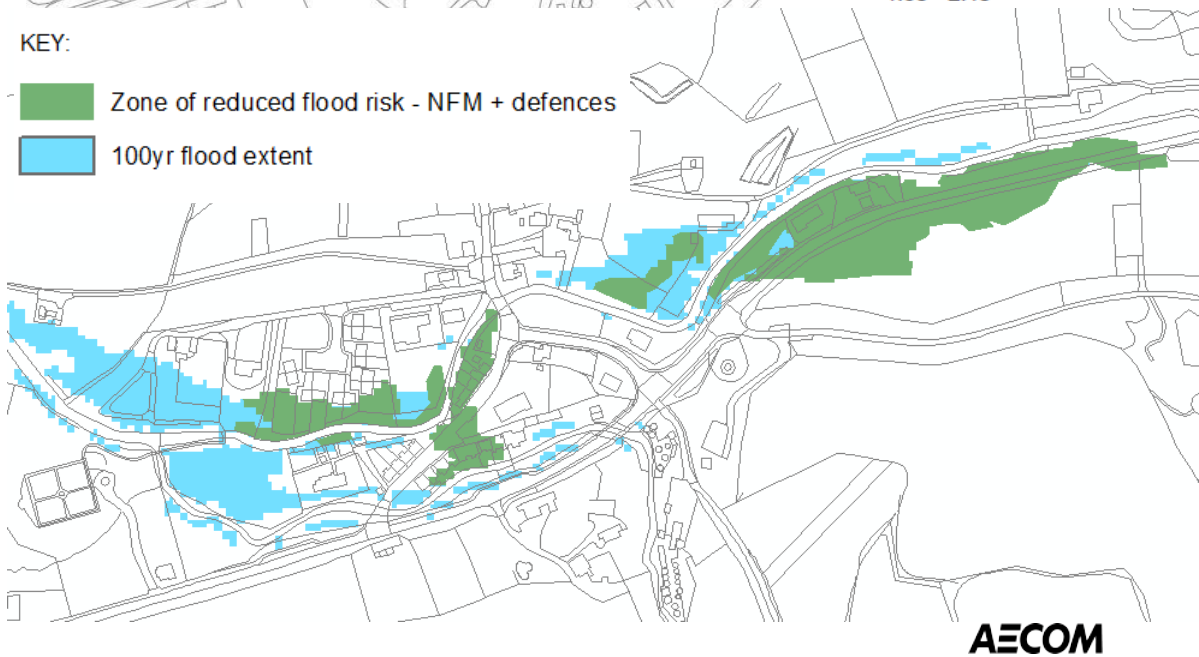
Social and environmental impacts

- Climate regulation & carbon sequestration,
- Improved fish habitat,
- Erosion regulation,
- Negative visual impact on connection with watercourse,
- Significant tree felling required near filling station.

Economics

- £2.5M - Whole Life Cost
- **0.09 - Benefit Cost Ratio**





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What Options did we develop? Option 6 Weir removal and direct defences

Flood walls and weir removal - defences more viable?

Flood risk benefits

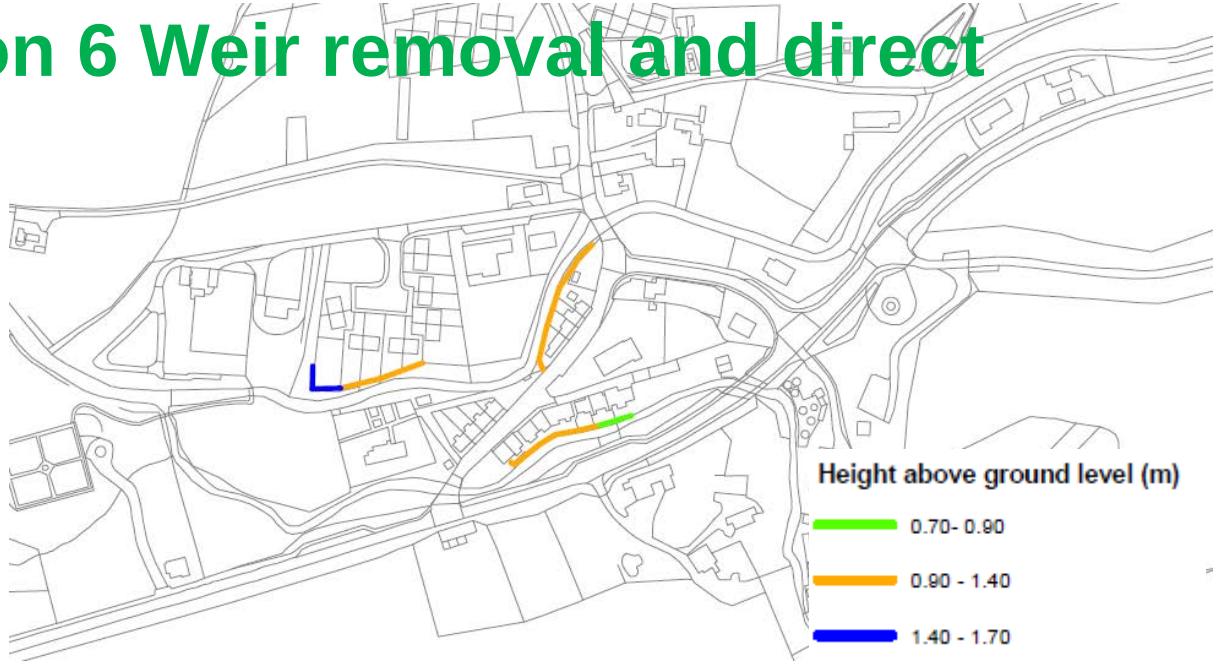
- High Standard of protection - 100 year SoP to 18 properties,
- Reduces height of defences required by up to 300mm.

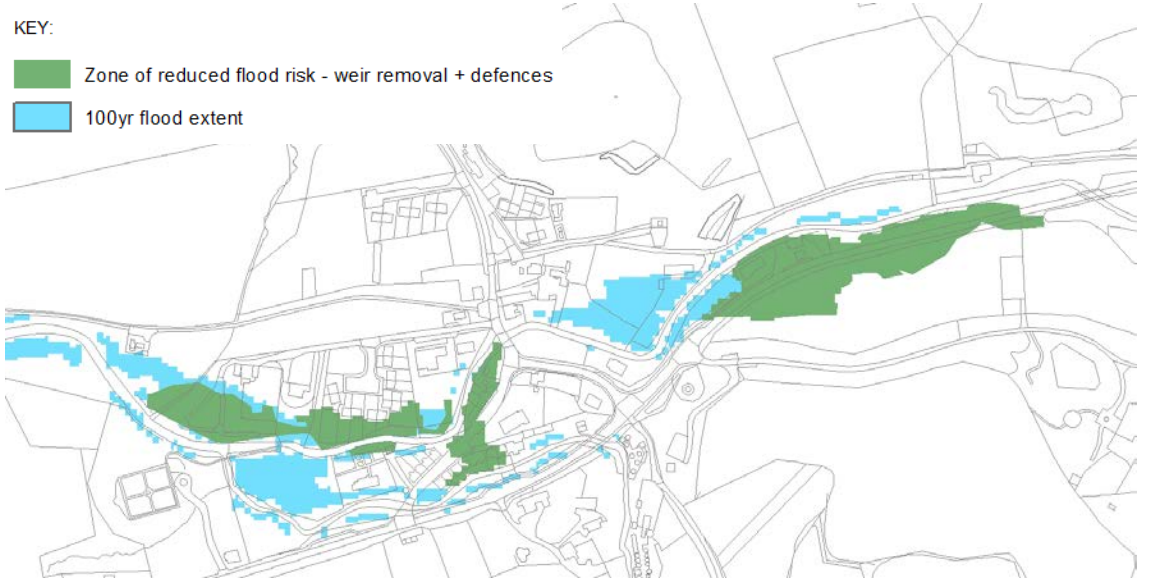
Economics

- £2.1M - Whole Life Cost
- **0.11 - Benefit Cost Ratio**

Social and environmental impacts

- Climate regulation,
- Carbon sequestration,
- Habitat provision,
- Improved fish habitat,
- Erosion regulation,
- Reduced stress,
- Visual impact on connection with watercourse,
- Significant tree felling required near filling station,
- Reduced pollution associated with flooding,
- Protection of A83 and Clachan Filling Station maintaining community link.





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What Options did we develop? Option 7 NFM + Weir removal + direct defences

NFM, weir removal and flood walls - defences more viable? Defences focused on most vulnerable receptors

Flood risk benefits

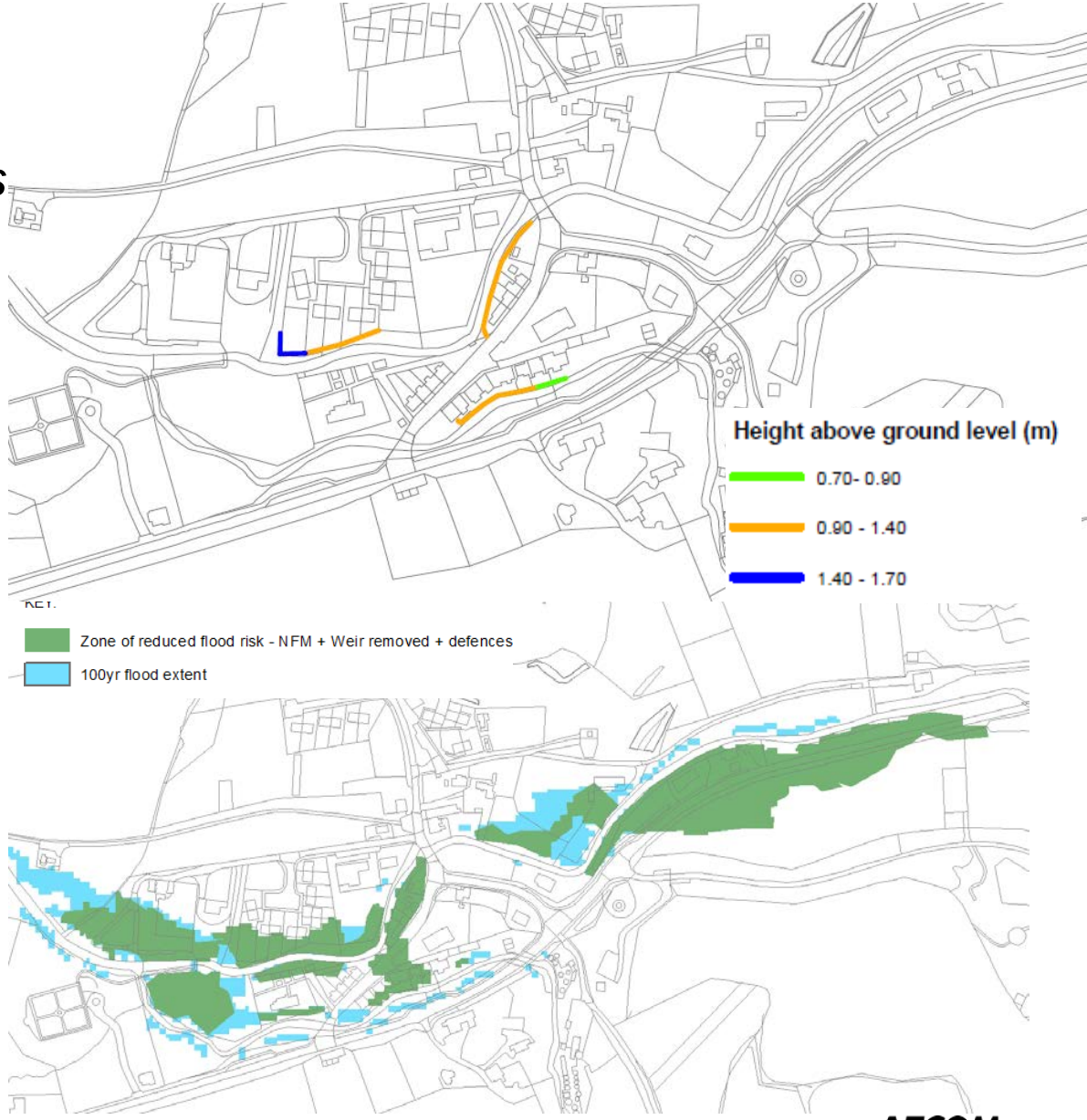
- High SoP - 100 year SoP to 16 properties,
- Reduces height of defences required by 600mm.

Economics

- £1M - Whole Life Cost
- **0.26 - Benefit Cost Ratio**

Social and environmental impacts

- Climate regulation,
- Carbon sequestration,
- Habitat provision,
- Improved fish habitat,
- Erosion regulation,
- Reduced stress,
- Visual impact on connection with watercourse,
- Significant tree felling required near filling station,
- Reduced pollution associated with flooding,
- Protection of A83 and Clachan Filling Station maintaining community link.



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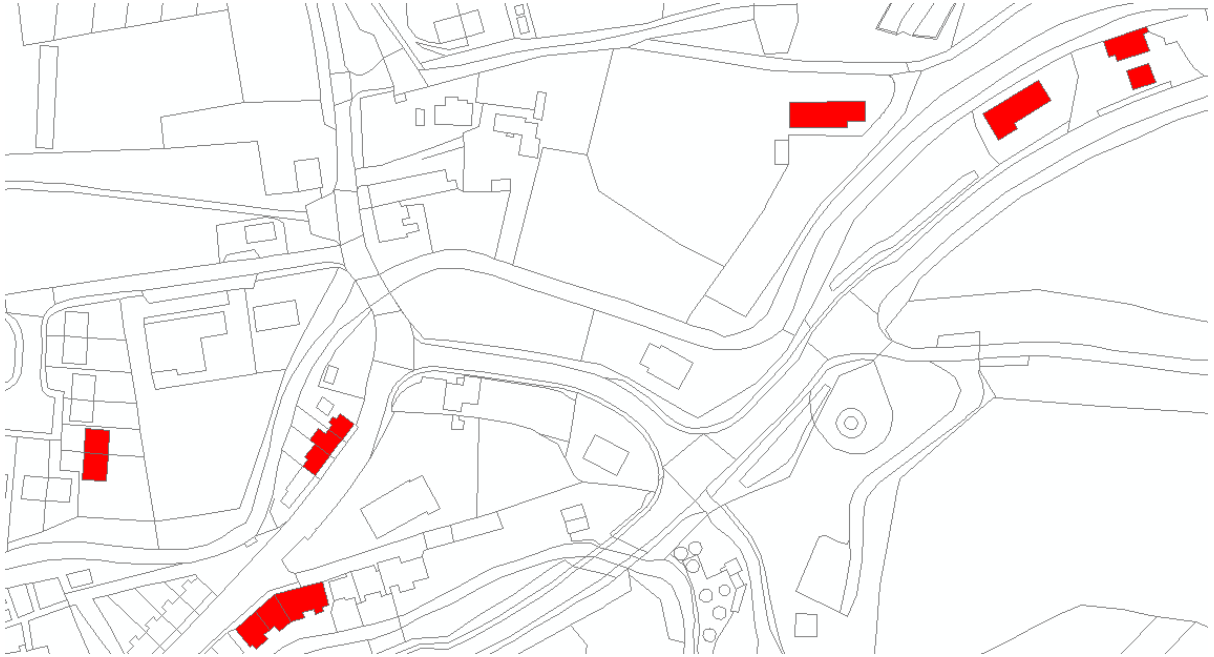
What Options did we develop? Option 8 Targeted Property Level Flood Protection

Resilience measure to prevent internal flooding of properties. Targeted properties where economically viable



Flood risk benefits

- High SoP - 200 year SoP to 16 properties,
- Will offer no protection to roads, gardens etc.
- Allt Mor properties would experience significant benefit.

Economics

- £94K - Whole Life Cost
- **1.03 - Benefit Cost Ratio**

Social and environmental impacts

- Reduced pollution associated with flooding,
- Reduced stress associated with flooding.

We will look at partnering this option with weir removal alone

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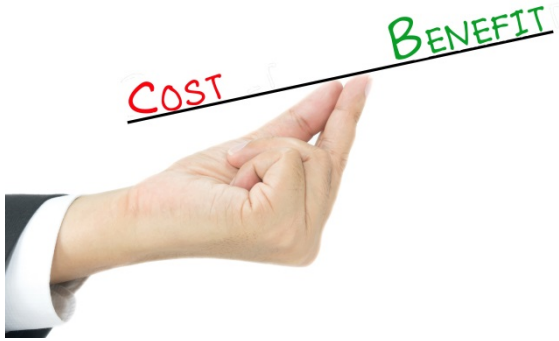
Prioritisation of Options

The short list options holistic appraisal has shown that the following options to be viable:

1. Removal of Clachan Burn Weir
2. Removal of Clachan Burn Weir and Catchment Wide implementation of Natural Flood Management
3. Installation of Property Level Flood Protection

The BCR of each of the above options is between 0.59 – 1.06.

The potential for significant social and environmental wider benefits with each of these options which enhances their viability



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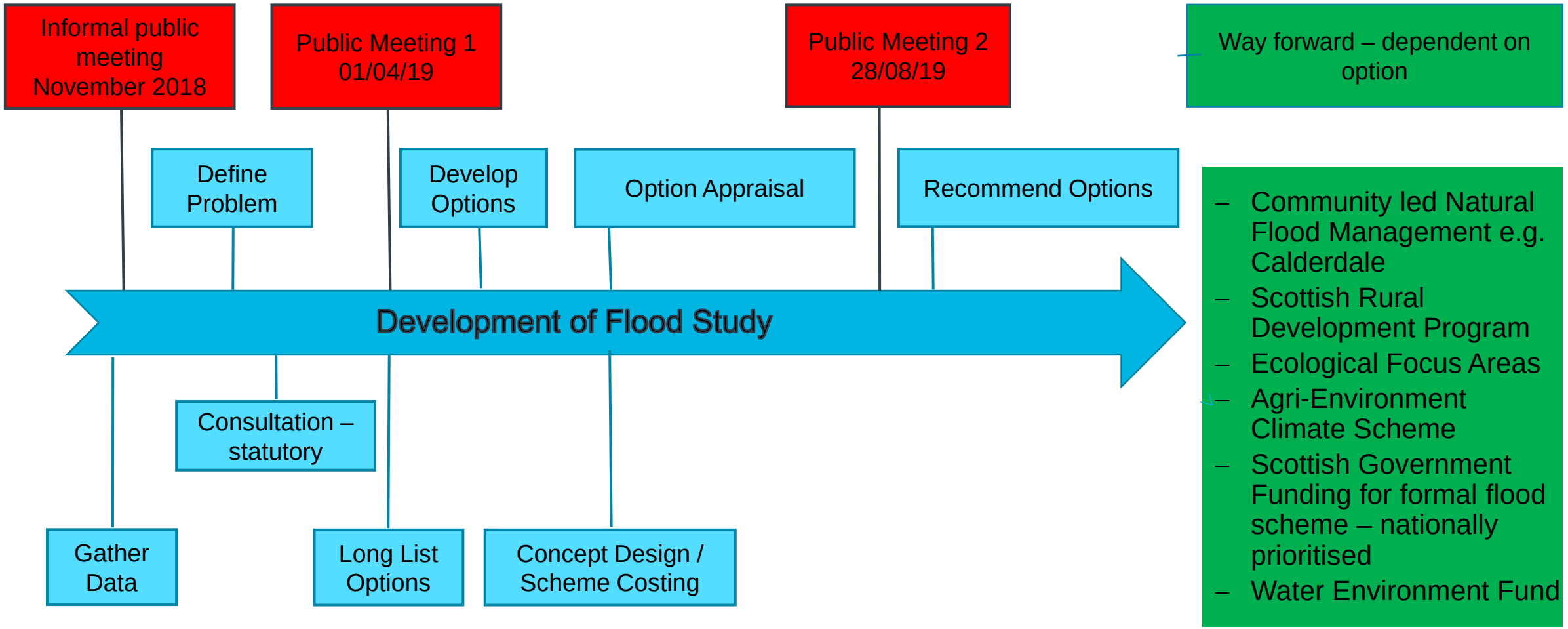
Next Steps



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Next Steps

– We will be available for further discussion here today 8 – 9pm

– A comment card is available for you to leave your feedback at the back of the room.

– You can also feed back to: sally.homoncik@aecom.com

– Draft report will be issued to community

– Report will feed into SEPA National Prioritisation

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Next Steps

- We would recommend this study is used as a driver to establish a Local Flood Action Group
- This should include the community and the different public bodies responsible for flood risk management
- This will enable identification of implementation strategies to deliver flood risk management measures identified for Clachan

Catchment Based Approach
Partnerships for Action

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