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Integrated Catchment Solutions Programme

The Design and use of the NFM modelling toolkit

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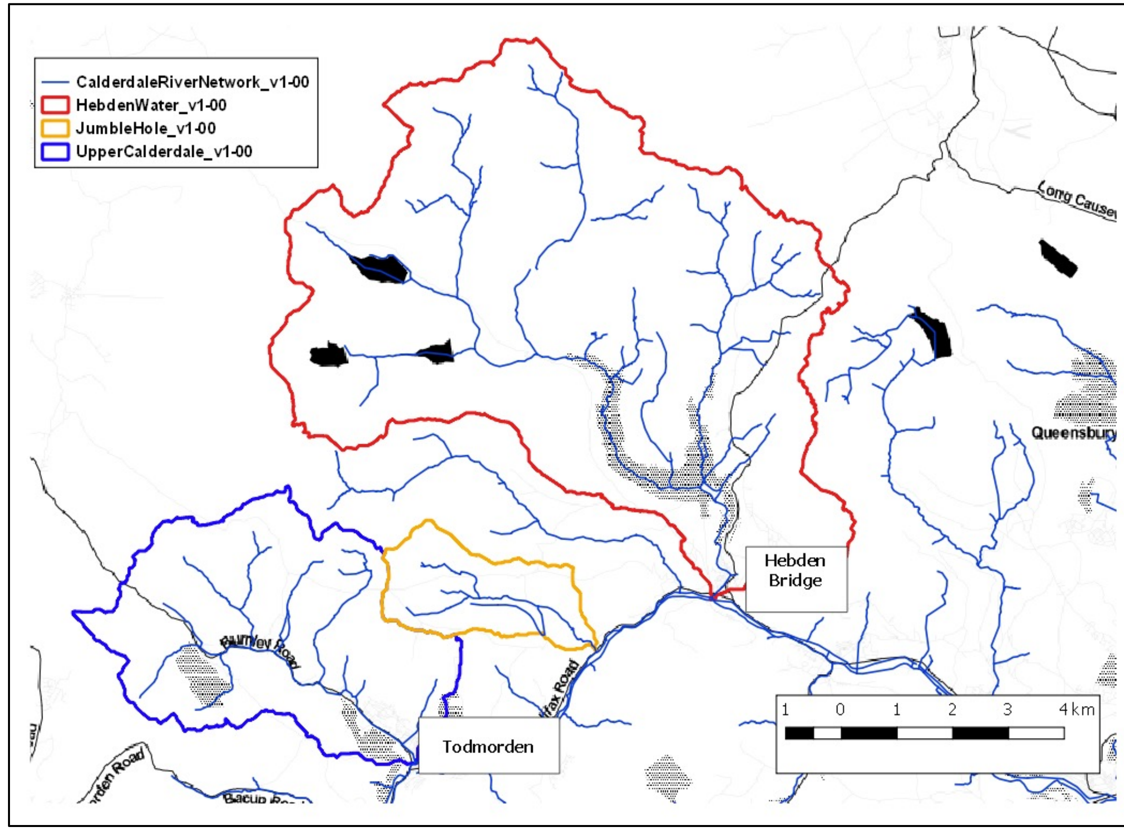
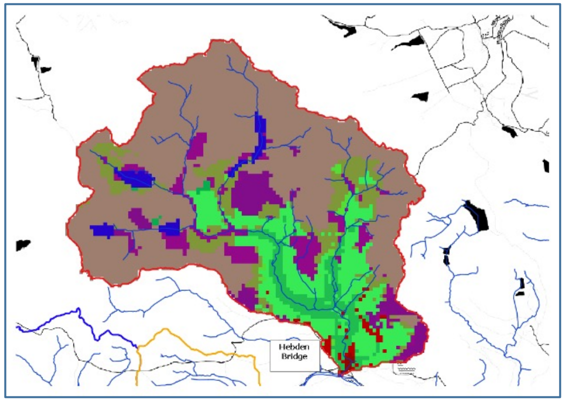
Project overview

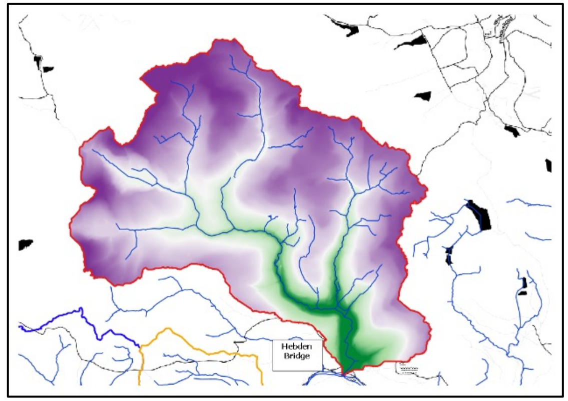
1) Determine the effects of field boundaries on flow pathways
2) Evaluate the connections between current land management and flooding
3) Prioritise and inform allocation of future NFM funding



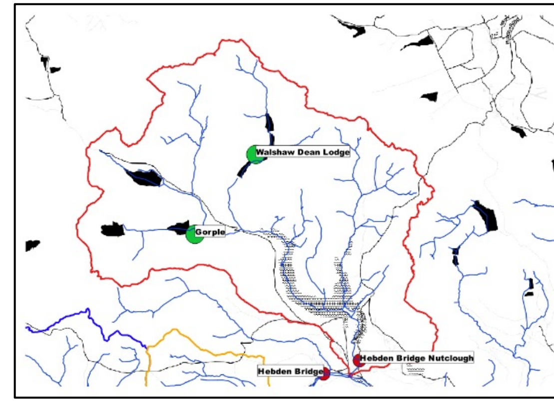
SD topmodel



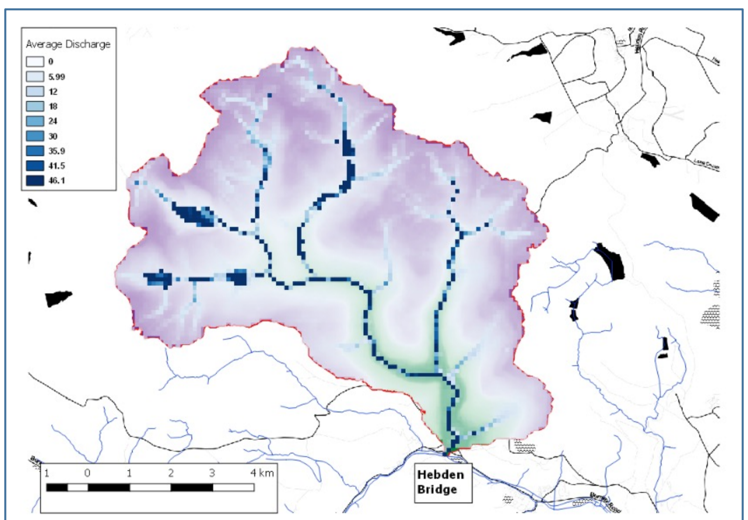
LandSAT derived landuse data

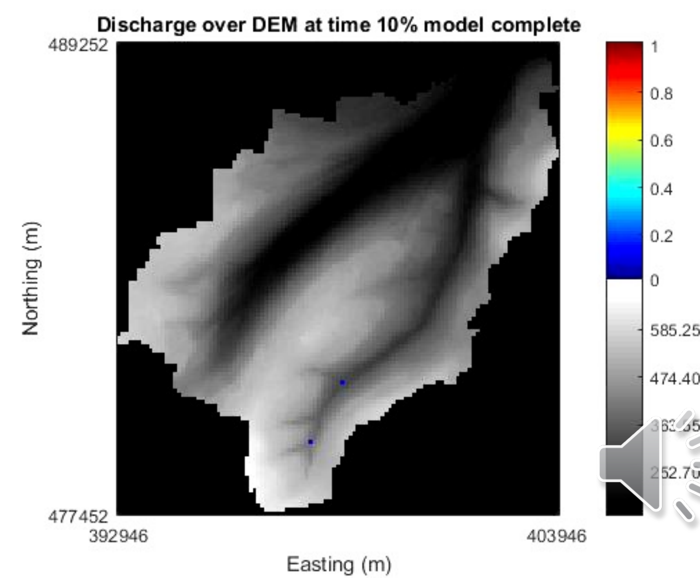


5m Terrain Data



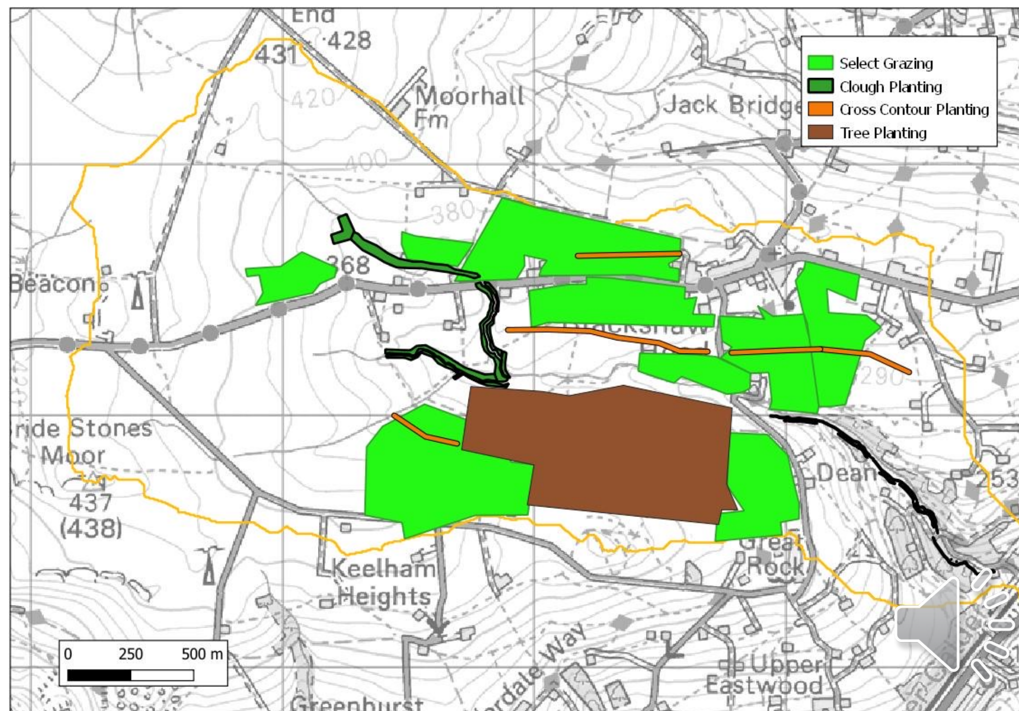
Rain and River gauge data





Scenarios tested

1) Boundaries
2) Horse paddocks
3) Livestock grazing
4) Riparian Access
5) Moorland management
6) Clough Planting
7) Tree planting
8) Soil improvement



Scenario results

Scenario	Average difference in peak value from baseline (%)	Average changes to timing of peak	Average changes to flow volume (%)
1 – Boundaries	- 6	+ 20 mins	- 2
2- Horse Paddocks	+ 0.13	-	+ 0.30
3 – Intensive Livestock grazing	+ 6	- 20 mins	+ 2
4 – Riparian Access	+ 0.5	- 5 - 10 mins	+ 1
5- Moorland management	+ 1	- 5 - 10mins	+ 0.5
6- Clough Planting	- 1	+ 5 - 10 mins	-1
7 – Tree Planting	- 2	+ 15 mins	-3
8 – Soil Improvement	-1.50	+ 15 -20 mins	-3

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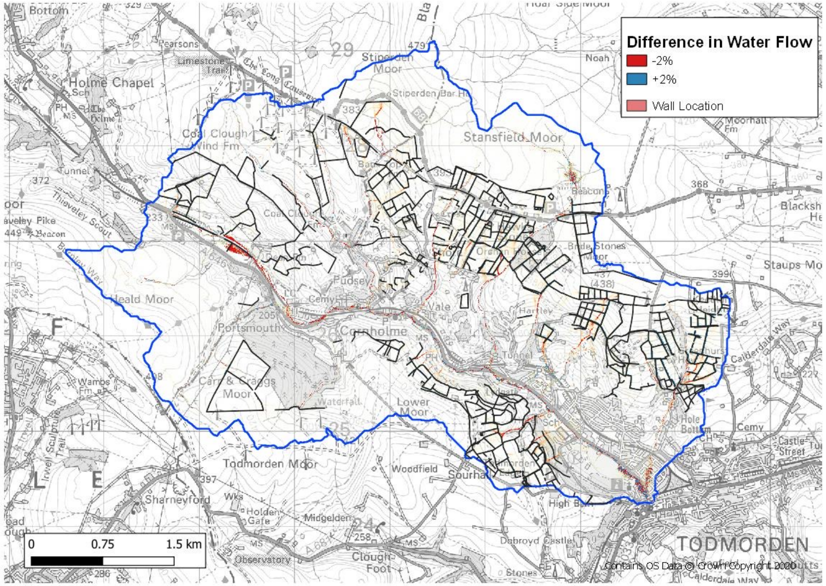
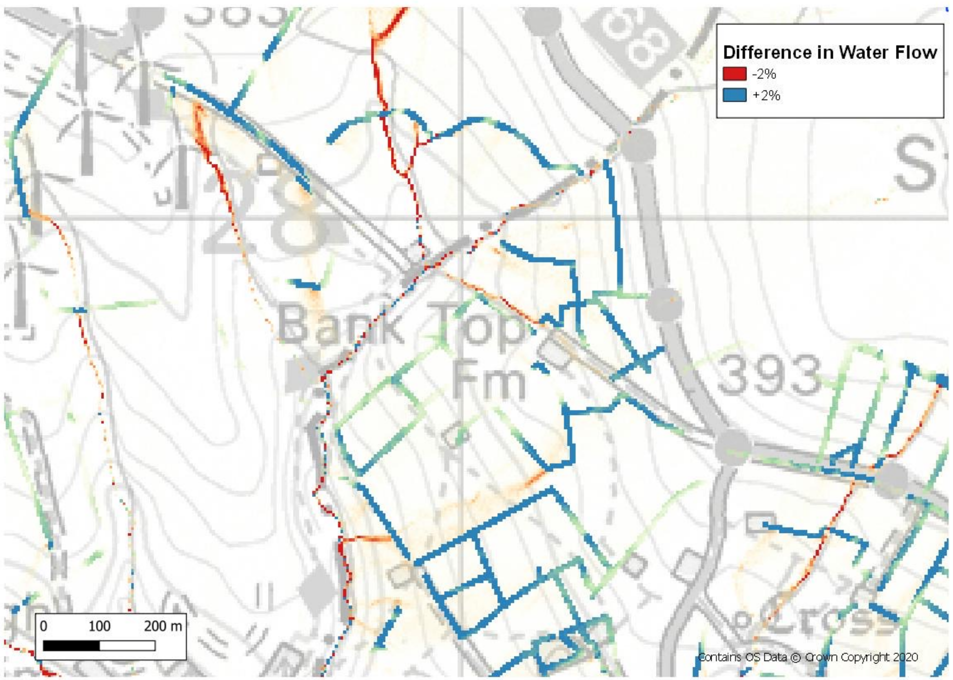


Scenario 1: No boundary walls

All dry stone walls are removed and compared to the baseline

Impact widely felt throughout the sub-catchments

Impact as large as 12% for some events



- Average decrease in peak flow value of 6%
- Overall reduction of around 2% in flood volume
- Delay of 20 minutes to flood peak

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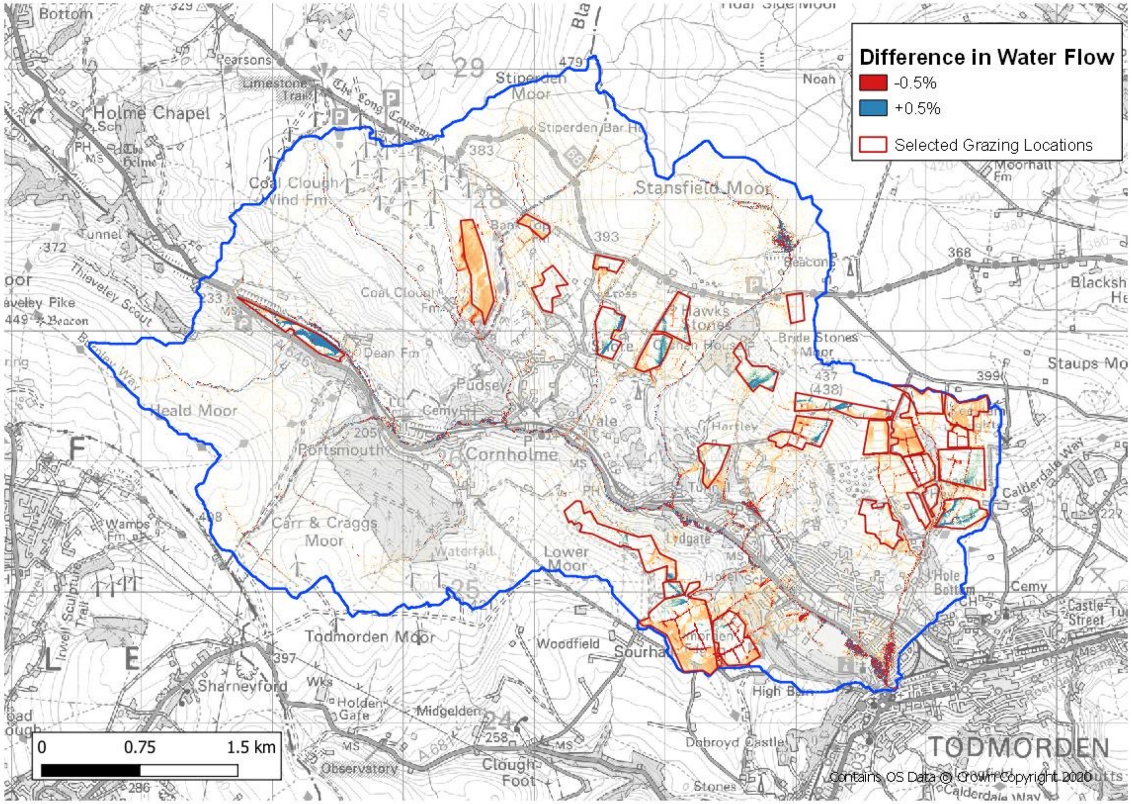
Scenario 3: intensive grazing

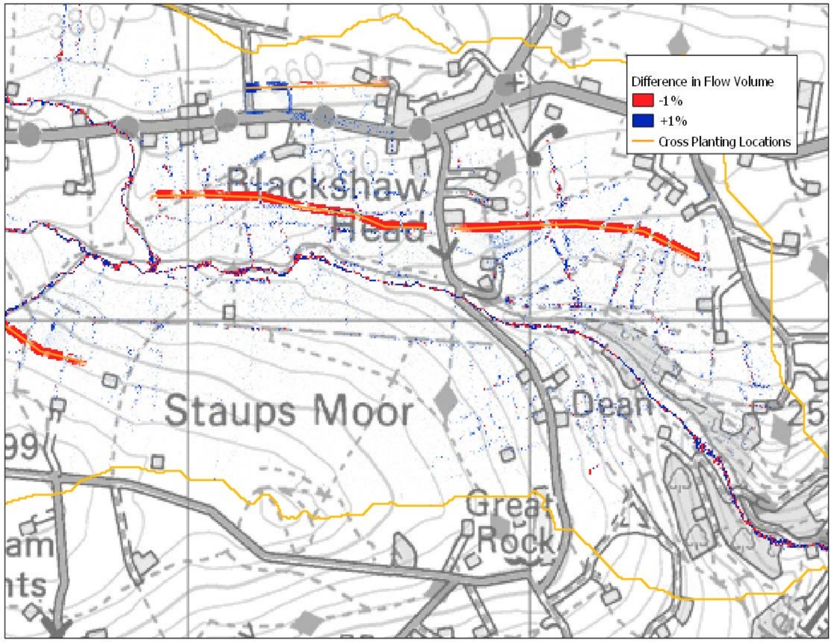


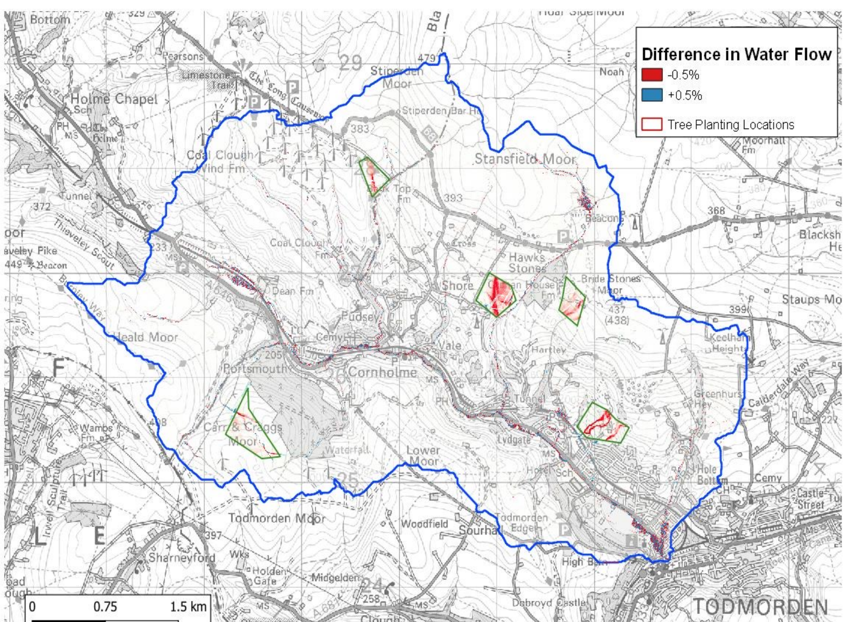
Grazing locations selected based on determining fields associated with farms, and locating grazed land near significant flow paths. These fields are converted to 'Heavily Grazed'

A wide impact, across the catchment, leads to noticeable impact to the peak at the bottom of the catchment

- Increase in peak flow value of 6%
- Reducing in the overall flood water of 2%
- Time to peak 20 minutes faster

Scenario 7: Tree Planting: Cross Planting vs Field Planting





Two tree planting strategies were picked – cross contour strips, and fields of trees

Locations determined either from the workshop, or examining the outputs from the baseline and determining the dominant flow paths in the catchment

Both have a positive impact, but fields of trees, rather than cross contour planting seems to be more effective

Cross slope:

- Decrease in peak flow of 1%
- Average reduction of flood volume by 1.5%
- Average delay to peak by 15 minutes

Field planting:

- Decrease in flood peak of 2%
- Average reduction of overall flood volume by 3%
- Average delay of peak by 15 minutes

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NFM Calderdale Fact Sheet – Upper Valley Gully Tree Planting

Planting trees in the gullies of upper valleys (or 'cloughs') of rivers provides multiple benefits to reducing the peak level of flood waters in catchments, by intercepting rainfall before it lands on the ground, increasing the capacity of the soil to absorb more rainfall and increasing the resistance of surface water flowing overland. Selectively planting trees along the top of watercourses also reduces the speed at which overland flow enters rivers. Using the rainfall runoff computer model SD-TOPMODEL in three sub catchments of the upper Calder valley, the benefits of upper valley tree planting were tested by identifying the headwater region of becks and streams that feed into the main water course, and simulating the effects of gully tree planting in these locations in comparison to the current baseline situation.

An example of the regions selected for upper valley woodland planting in the Upper Calder catchment upstream of Todmorden can be seen in Figure 1, which has a targeted area of 0.5km² (50 hectares). In general, the gully planting areas for the 3 catchments were in similar high slope locations, and avoided moor or peatland areas.

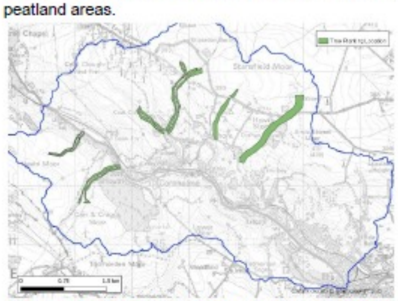

Figure 1: Location of the gully planting to be tested in the Upper Calder

Using measured differences between the properties of soil where the land cover is grass or woodland, the model was modified to woodland cover in the selected regions. Model parameters were changed to represent woodland by: depth of soil (50% deeper), lower water permeability (20% lower) and an increased resistance to water flowing across the land surface (50% greater).

An interception rate - the amount of rainfall that is captured by the tree canopy cover was also applied in the model.

The impact of the gully planting compared to the baseline computer model run for a mock storm event can be seen below, in Figure 2.

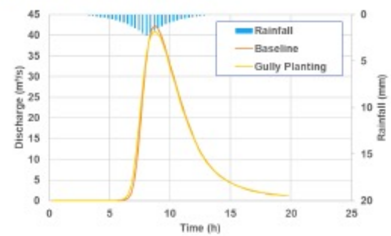

Figure 2: Comparison of the outflow for the baseline model against the gully planting model computer model runs

When comparing a baseline computer model run against the targeted tree planting computer model run for 6 rainfall events, (4 mock storm events and 2 recorded events), the modelled tree planting was found to have a beneficial impact to local flood risk, with an average decrease in the peak flow value of **1%**, an average reduction in the overall volume of flood water of **2%** and an average delay of **10-15 minutes** to the timing of the flood peak (Table 1).

Table 1: Summary of the difference in peak flow, changes to time of the peak and volume reduction from gully tree planting

Event	Peak Flow Decrease	Time to Peak Delay	Flood Volume Reduction
3 hour 1 in 10 year	2%	5 – 10 mins	1%
3 hour 1 in 100 year	2%	15 – 20 mins	4%
12 hour 1 in 10 year	>1%	5 – 10 mins	>1%
12 hour 1 in 100 year	1%	15 – 20 mins	1%
December 2015	1%	15 – 20 mins	>1%
June 2012	1%	15 – 20mins	1%

Overall, these results suggest that gully tree planting can alleviate flooding in lower reaches of rivers for relatively little ground tree cover by intercepting rainfall and overland flow before it enters a water course.

For more information about the results presented in this fact sheet please refer to the technical document hosted on the ICASP website or contact **icasp@leeds.ac.uk**

Factsheets

Available now on our website:

1. Field boundaries
2. Gully planting
3. Field tree planting
4. Cross slope tree planting
5. Intensive grazing
6. Soil improvement

https://icasp.org.uk/resources-and-publications/calderdale-natural-flood-management-project-resources/

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Conclusions

- Information from project will be used to provide evidence to support funding bids;
- Shows how effective each scenario is – can prioritise within catchments;
- Combined methods are best;
- Widespread interventions have biggest impacts;
- Improving soil and field boundaries are very important!
- Model is now being used in the Upper Rother catchment

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Any questions?

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