

## Comparison of Rainfall Event on 30<sup>th</sup> September 2022 with other Major Rainfall Events

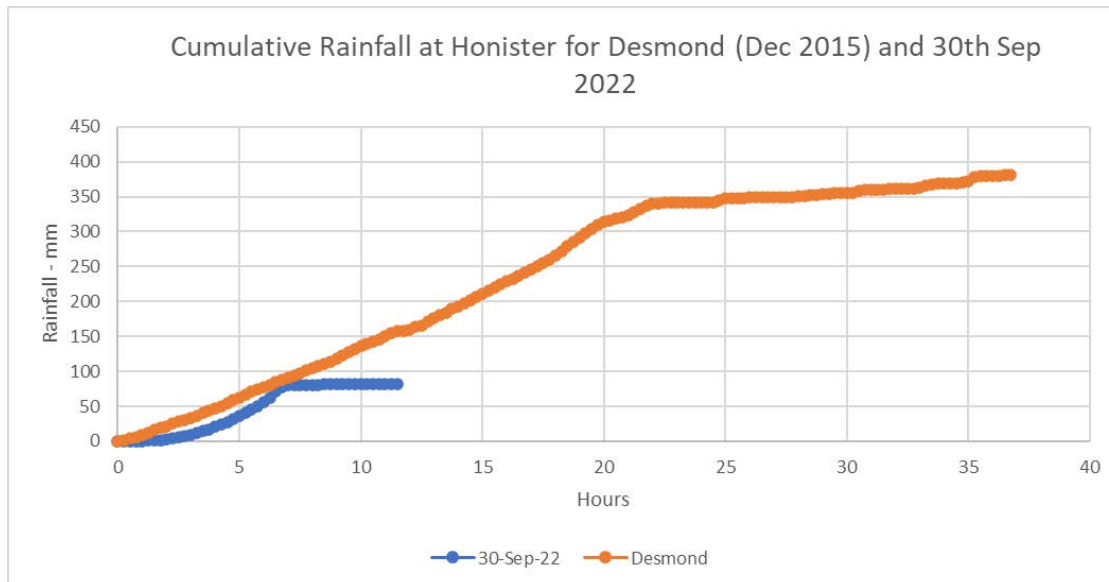
On 30<sup>th</sup> September a very heavy but relatively short rainfall event occurred over northern Cumbria, and particularly over the Borrowdale area. Significant flooding was experienced in Borrowdale, with the BBC reporting that one farm lost 58 sheep: [Sheep 'swept away' during Borrowdale flash flooding - BBC News](#).

In the table below I have compared this event with other major rainfall events in the recent past, namely Storm Desmond in December 2015, Storm Ciara in February 2020 and the 27<sup>th</sup> October 2021 rainfall, using 15 min data from the Honister rainfall gauge<sup>1</sup>.

Honister Gauge Data	30-Sep-22	Desmond	Ciara	27-Oct-21
Total rainfall - mm	82	381.8	172.8	369.2
Duration - hours	9	36.75	17.25	38
Highest 15 min reading -mm	9.2	6.8	5.6	6.2
Highest hourly total mm	26.2	25.6	19.8	21.2

At first glance the 30<sup>th</sup> September rainfall seems small in comparison, having a much lower total rainfall and being much shorter in duration. However, when looking at the highest recorded 15 min reading, it is significantly higher than those recorded for the other 3 events. Similarly the highest rolling 1 hour rainfall total (ie addition of four 15 min readings) is higher than for the other events.

This data shows that despite the short duration on the rainfall on 30<sup>th</sup> September, it was extremely intense, with 32% of the total rainfall falling within 1 hour. This is further illustrated by the graph below showing the cumulative rainfalls for 30<sup>th</sup> September and Storm Desmond.



During Desmond the rainfall was relatively steady throughout the first 22 hours of the storm, as shown by the nearly straight line nature of the cumulative rainfall plot. However, the much shorter rainfall of 30<sup>th</sup> September shows a distinct acceleration in the cumulative rainfall, nearly matching that of Desmond after 7 hours before the rainfall slackens and then stops.

The extreme intensity of the rainfall helps to explain why what appeared to be a relatively small event had such a severe local effect in the Borrowdale valley, comparable to that of much larger storm event.

The challenge that such short, localised but highly damaging rainfall events pose seems to me to have 2 approaches:

1. Is it possible to improve local forecasting to give a point where realistic warnings can be given to the local community in time for them to respond?
2. How can resilience measures be improved such that areas are better able to cope with extreme short term events?

The first of these approaches may well be difficult, however improvements in modelling, both of rainfall and its effect on local catchments (eg using such tools as the EA's model of the Derwent catchment developed for the 2021 Thirlmere reservoir modelling study?) may offer a way forward.

The second is perhaps more tractable in the short to medium term through catchment maintenance, such as river dredging, as suggested by one resident of Borrowdale. In the longer term structures such as embankments or "leaky" dams to allow normal river flows but create storm storage during high rainfall events could be mitigation measures. For example, a structure or structures that could hold back 25% of the rainfall during the worst hour of the rainfall on 30<sup>th</sup> September would need to hold approximately 300,000 m<sup>3</sup> of water, which at 1m depth would be equivalent to an area of 0.3 km<sup>2</sup> in a total catchment area of 46.3 km<sup>2</sup> (Derwent headwaters and Stonethwaite Beck). That is not a small volume to hold back and area required but should at least be considered.

1 - Date sourced under public sector information licensed under the Open Government Licence v3.0, supplied by the Environment Agency under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.