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Scenario DOCTORAL TRAINING PARTNERSHIP
NERC SCIENCE OF THE ENVIRONMENT

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Quantifying the effectiveness of a lowland Natural Flood Management scheme

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Natural Flood Management

Natural Flood Management (NFM) is an approach that aims to reduce flood risk through replicating, restoring, or enhancing natural features of the environment to store and/or slow floodwaters. NFM schemes are increasingly being implemented in catchments across the UK, but there are significant gaps in the evidence base for their effectiveness[1].

Littlestock Brook NFM Scheme

Evenlode Catchment, Oxfordshire

Milton-under-Wychwood is a village in West Oxfordshire that was significantly affected by flooding in July 2007. A NFM scheme has been developed by the Evenlode Catchment Partnership, a consortium of parties including Wild Oxfordshire and the Environment Agency[2].

Catchment Interventions

Field-corner storage bunds: Capture and store runoff from upslope contributing areas and spill-over from adjacent stream channel

Leaky dams: Push streamflow onto floodplain and into storage bunds

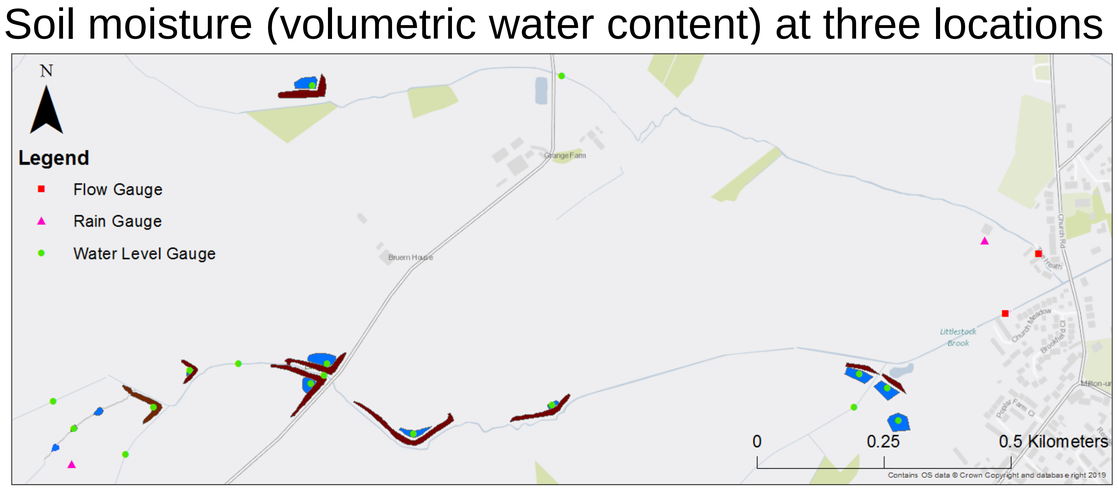
Tree planting: Reduce and slow runoff through increasing interception, evapotranspiration, infiltration and surface roughness

Left: Field-corner storage bunds partly filled after an intensive rainfall event in May 2018 (Image by Kestrel Photography)
Right: Leaky dam during low flow period

Hydrometric Monitoring

Continuous data is being collected in the Littlestock Brook catchment to achieve my research aims:

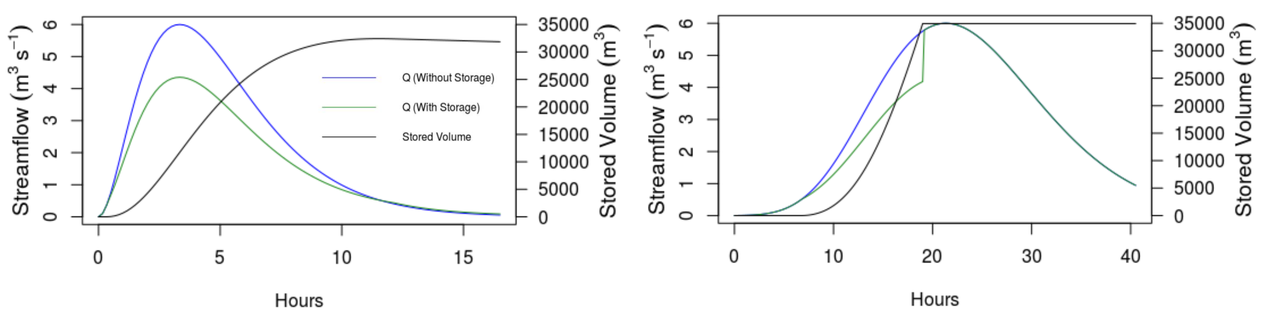
- Stream discharge at two locations
- Rainfall at two locations
- Bund water level (and volume) in all ten bunds
- Soil moisture (volumetric water content) at three locations



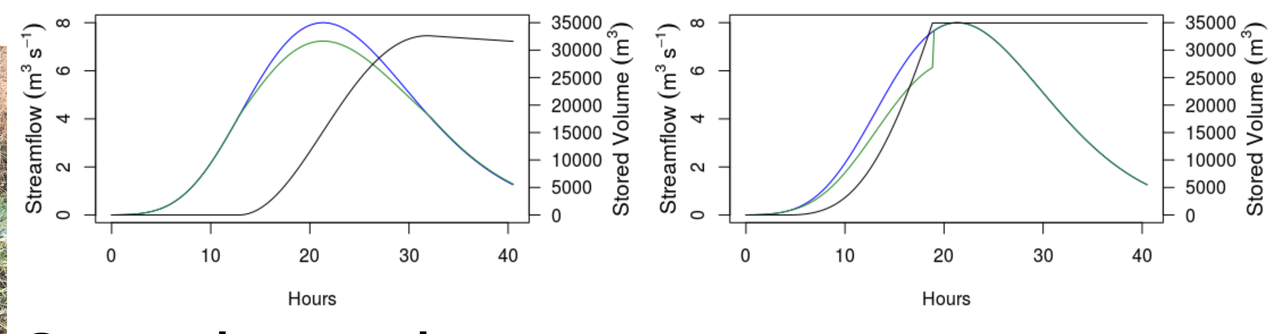
Factors Affecting Effectiveness of Storage Bunds

Approximately 35,000 m^3 of potential storage has been created in the catchment, equivalent to 5 mm depth over the total 7 km^2 catchment. The potential for mitigating flood peaks is clear, but the magnitude of attenuation for each individual storm will depend on how the timing of storage relates to streamflow volume. This will depend in turn on the hydrological processes responsible for runoff generation and bund filling/draining.

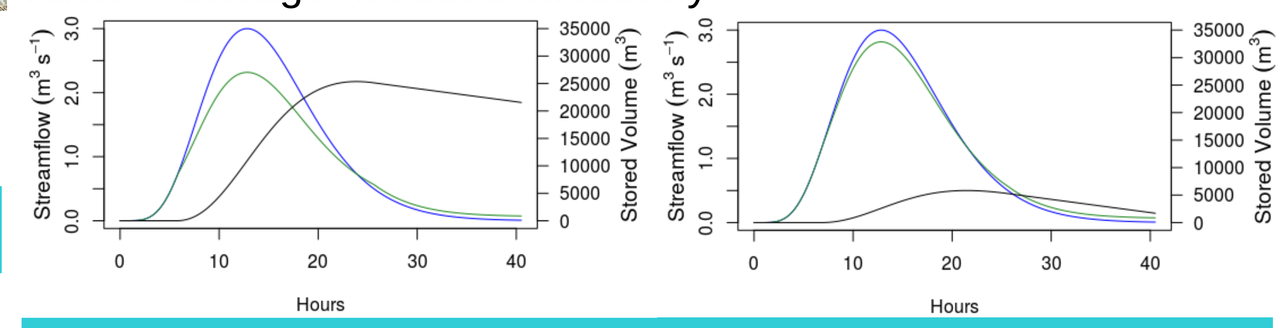
Storm duration: Left: Short duration, intensive storm – storage capacity used effectively. **Right:** Longer duration, less intensive storm – storage capacity reached before flood peak.



Threshold for bund filling: Left: Storage begins to fill at high level of stream discharge – storage capacity used effectively. **Right:** Storage begins to fill at low level of stream discharge – storage capacity reached before flood peak.



Storage interception rate: Left: Bunds intercepts large proportion of runoff. **Right:** Bunds intercept small proportion of runoff – storage not used effectively.



Research Aims

1. Develop an understanding of the dominant processes responsible for streamflow generation, bund filling and drainage and how these differ between events with different antecedent conditions and storm magnitudes/profiles
2. Develop a rainfall-runoff model for the Littlestock Brook that can be run with and without interventions
3. Using observed and modelled data, quantify the effectiveness of the Littlestock Brook NFM scheme over a wide range of antecedent conditions and storm profiles/magnitudes
4. Consider the implications of findings for future NFM scheme design

References

1. Dadson, SJ *et al.* (2017). 473. *Proceedings of the Royal Society A*
2. Old, J. *et al.* (2019), *Proceedings of the Institution of Civil Engineers - Engineering Sustainability*. pp. 1–8.

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