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Monitoring the effectiveness of connected ponds at fine sediment and phosphorus retention in a lowland agricultural stream

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Agricultural land is a key source of fine sediment and nutrients, often contributing significantly to diffuse pollution and catchment water quality issues. In the UK, recent efforts to mitigate agricultural diffuse pollution and reverse declines in the chemical and ecological status of waterbodies have focussed on catchment-based approaches. These nature-based solutions involve restoring, enhancing, or emulating natural processes to slow, store, and filter water and contaminants as they move through a catchment. Several studies in UK catchments show the potential benefits of retention ponds and constructed wetlands, however their functioning has been shown to vary according to their design and the catchment typology they are situated within.

To help further the evidence base on the effectiveness of ponds for mitigating diffuse agricultural pollution, we monitored a series of small, connected pond features (draining 0.3 km^2 of slowly permeable clay soils) created as part of the Littlestock Brook Natural Flood Management (NFM) scheme. This lowland NFM scheme, situated in the headwaters of the River Thames basin (South East England), targets the issues of flooding and diffuse pollution, and is delivered through the Evenlode Catchment Partnership and Environment Agency as part of a five-year project (2016-2021).

Water and sediment sampling were undertaken during both baseflows and stormflows to determine retention of sediment and phosphorus species within the ponds under varying hydrological conditions. Results demonstrate that during small to moderate storm events, the ponds were able to capture run-off and reduce peak concentrations of suspended solids and particulate phosphorus. However, during large magnitude events, the ponds became inundated and resuspension of previously deposited sediment caused a net loss of material from the system. We estimate that the annual settling flux within the pond series is 16.48 tonnes (±5.77) for sediment, and ~0.014 tonnes for phosphorus. This equates to 17% (±6) of the annual suspended

sediment load for the wider 3.4 km^2 sub-catchment area. This study highlights the complexities of sediment dynamics in connected pond features and the importance of maintenance for retention efficiency.