Particle size-specific river network dis-connectivity; a case study of anthropogenic impacts from the Rother Valley, West Sussex

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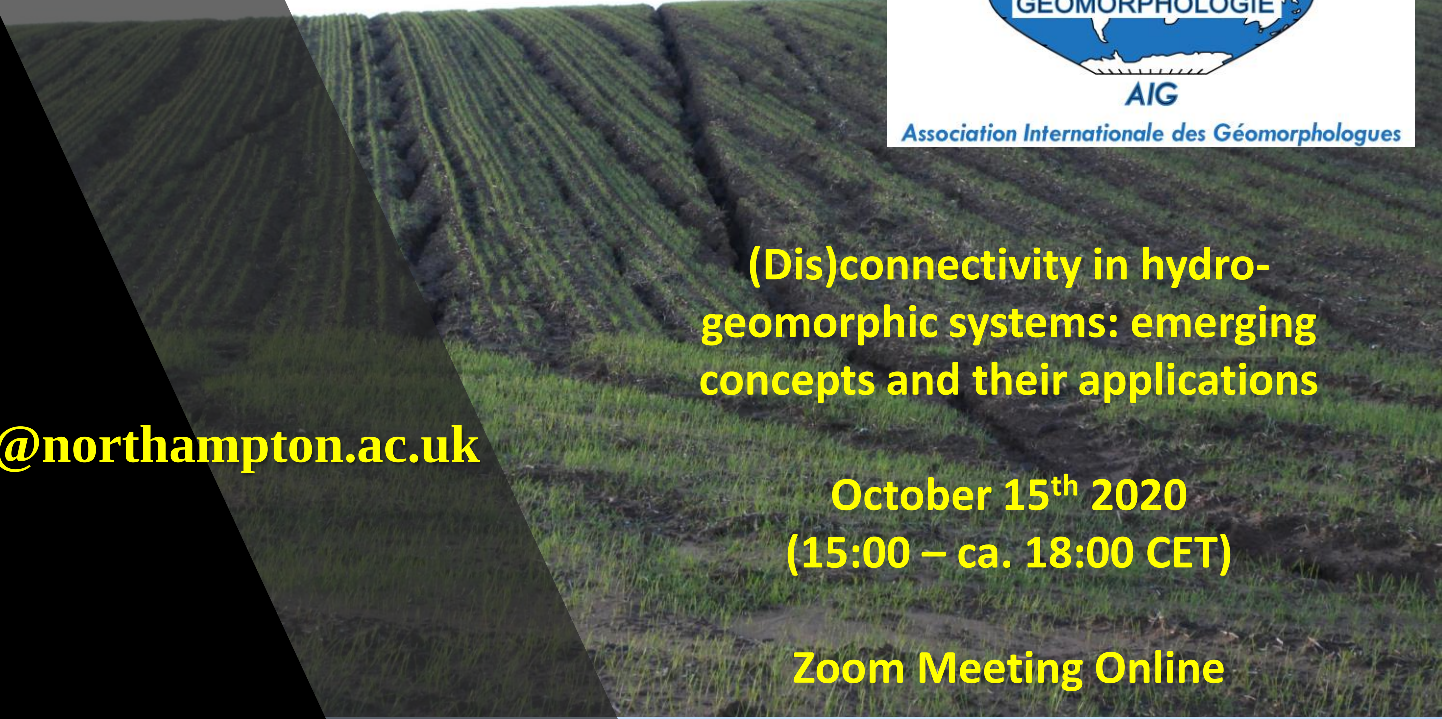


(Dis)connectivity in hydro-geomorphic systems: emerging concepts and their applications

October 15th 2020
(15:00 – ca. 18:00 CET)

Zoom Meeting Online

Anthropogenically Controlled Longitudinal Disconnectivity

Small ponds, detention basins, instream structures and reservoirs date back over many centuries in the UK

Reasons for construction include water supply, flood control, water power for medieval flour milling, iron ore crushing and fish farming and water diversion / storage for irrigation and canal navigation

These structures effect controls on both flow and sediment in complex ways over both time and space. Here we focus on sediment

Anthropogenically Controlled Longitudinal Disconnectivity

The River Rother has a long history of high sediment transport rates despite the presence of many of these features that disrupt longitudinal connectivity from hillslope to river and through the river corridor

We have been exploring these disconnections in terms of the amount stored, other sediment properties that allow us to identify sediment provenance and the effects of these structures on connectivity across different particle size ranges

Three brief case studies at different scales to illustrate the issue

Monitoring and Sampling sites in the River Rother Catchment

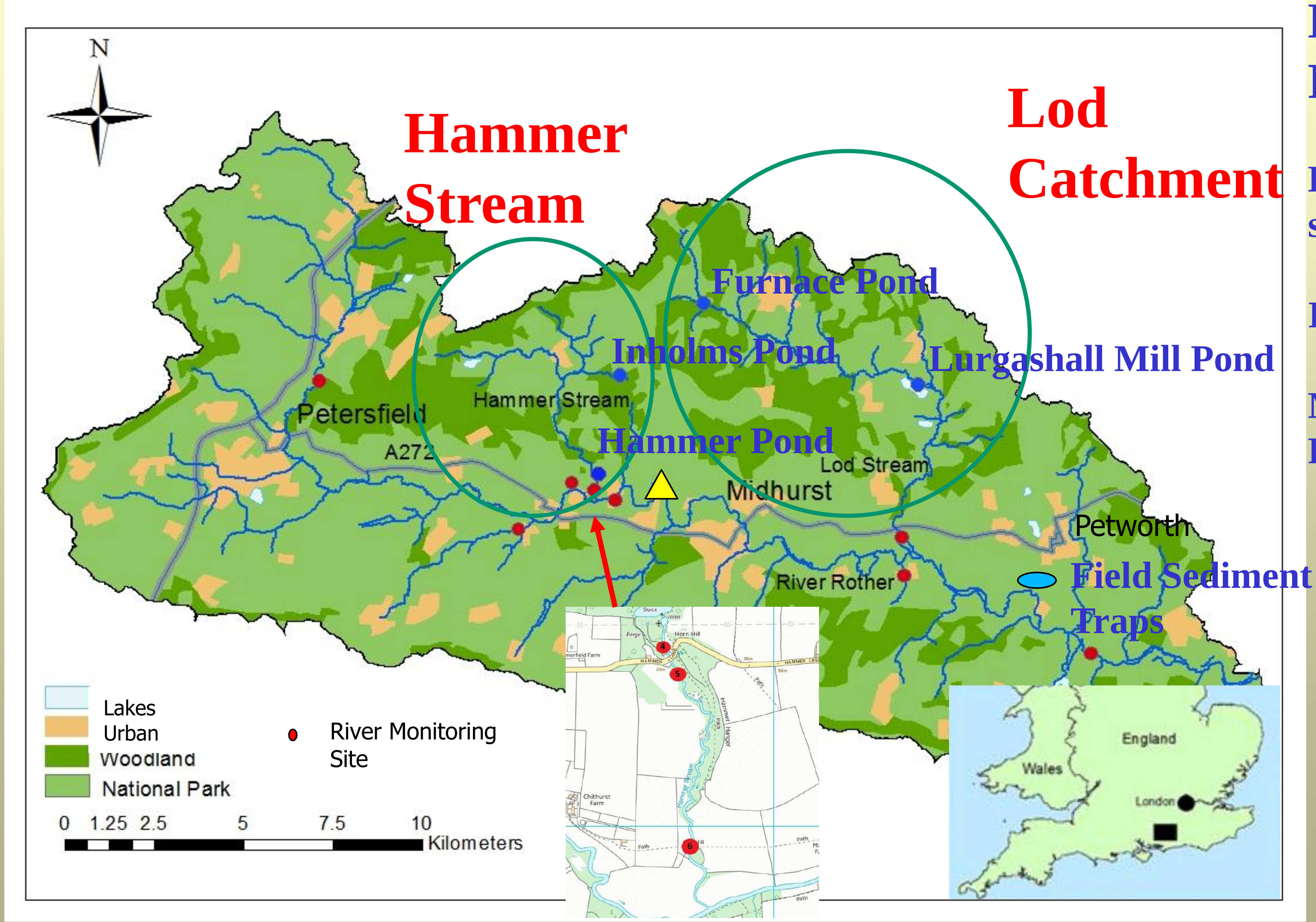
Area 350 km^2

Length 52 km

36% arable
27% pasture
30% forest
7% urban

46% of soil associations are vulnerable to erosion (Greensand)

910 mm rainfall Annually (1981-2010)



Longitudinal Features

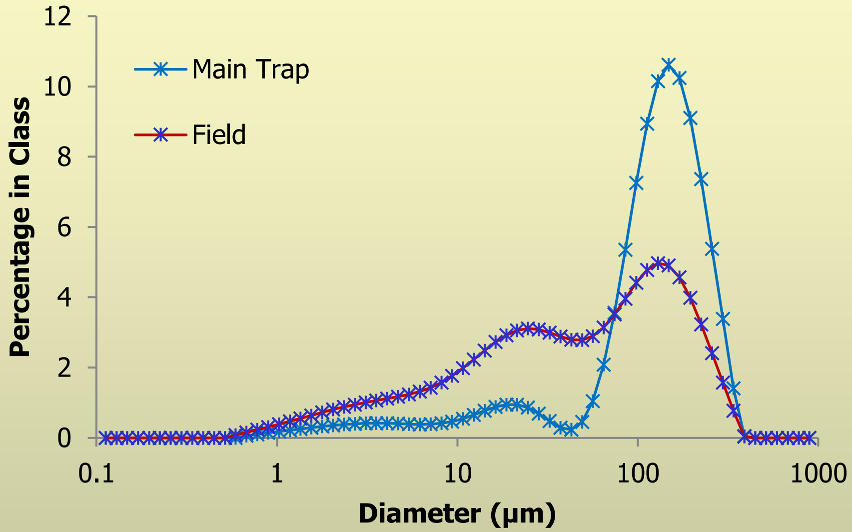
Edge of field sediment traps

Instream weirs

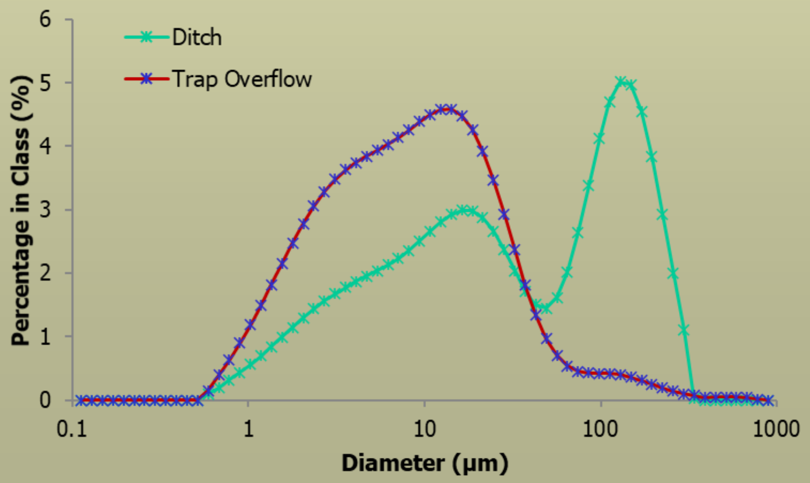
Medieval Reservoirs (Ponds)

Edge of Field Sediment Traps

Samples Taken from the Source Field and the Main Trap (Crows Hole)



Trap retains significant amounts of sand but loses most of the silt and clay



Sediment Concentration (mg l^{-1})

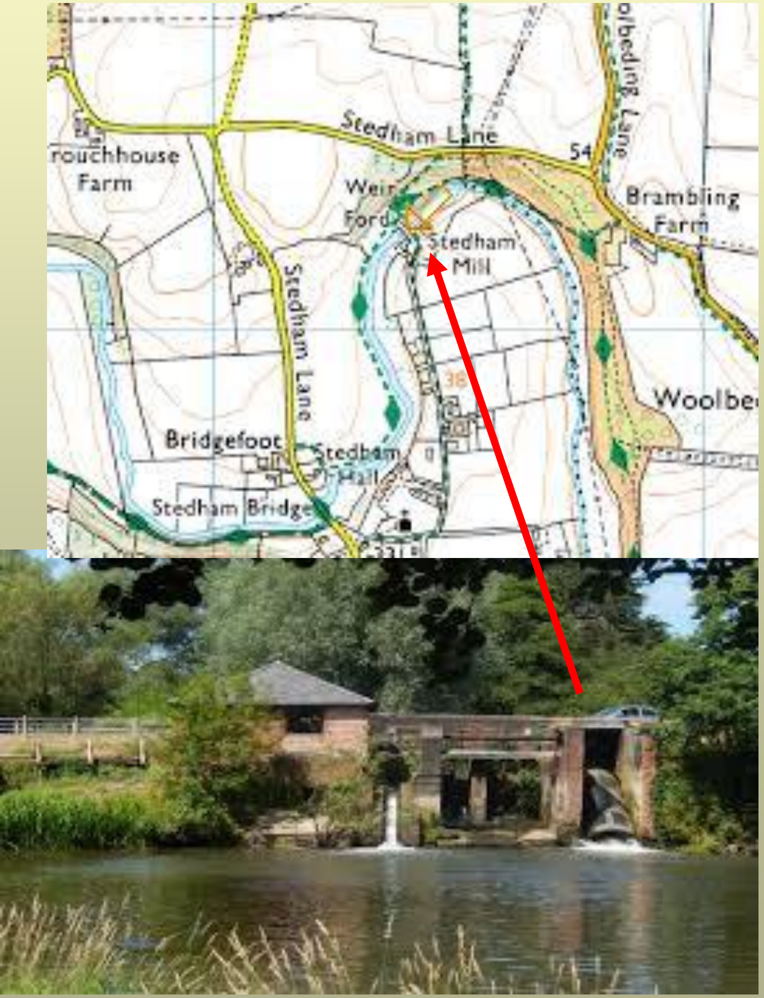
Ditch 3112.5
Trap Overflow 662.6

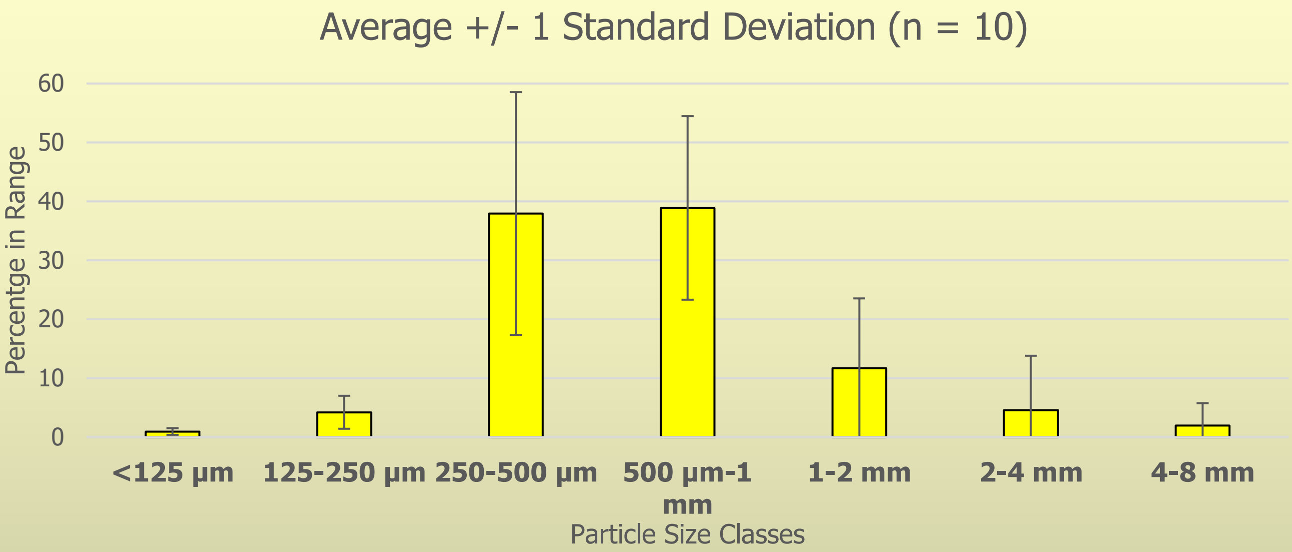
Significant decrease in concentration but increase in silt and clay

Sediment Accumulation Upstream of Weirs

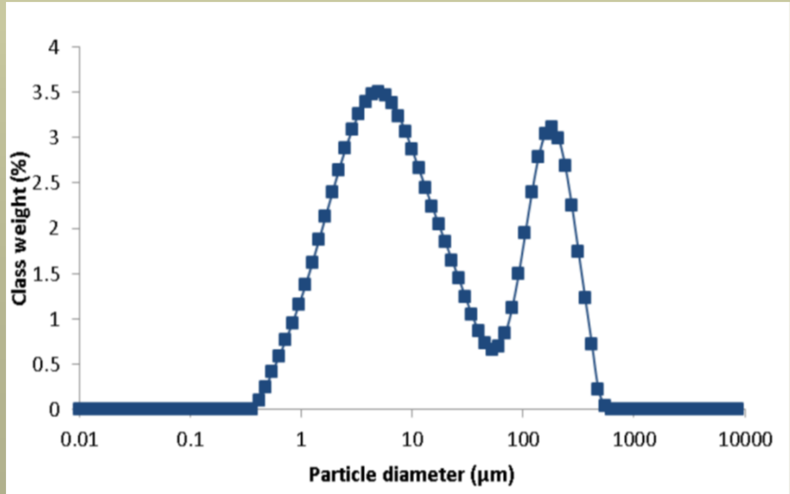
There are 15 major weirs on the River Rother

Over ~ 0.7 km upstream, ~ 3,500 t sediment (mostly sand) are stored on the channel bed





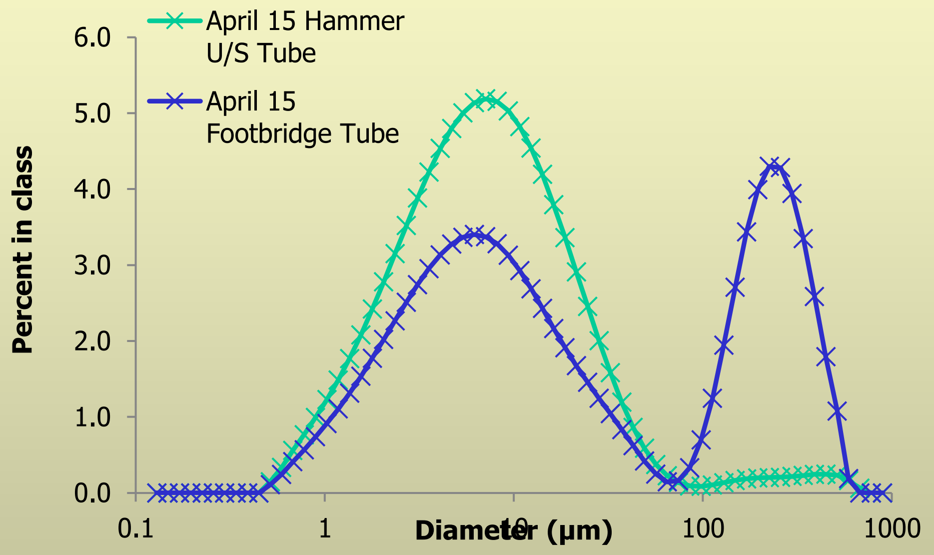
76% of the sediment stored on the river bed upstream of Stedham Mill weir was between 250 µm and 1 mm diameter

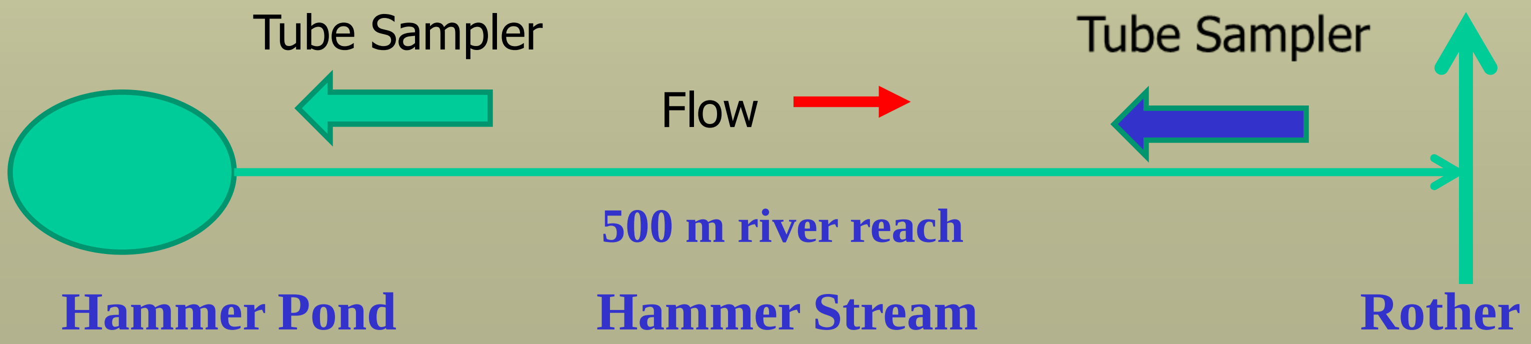


River suspended sediment collected from the Rother in a non-weir section contains sand but also significant amounts of silt and clay

Particle Size Impacts of Ponds; Samples from Integrated Tube Samplers

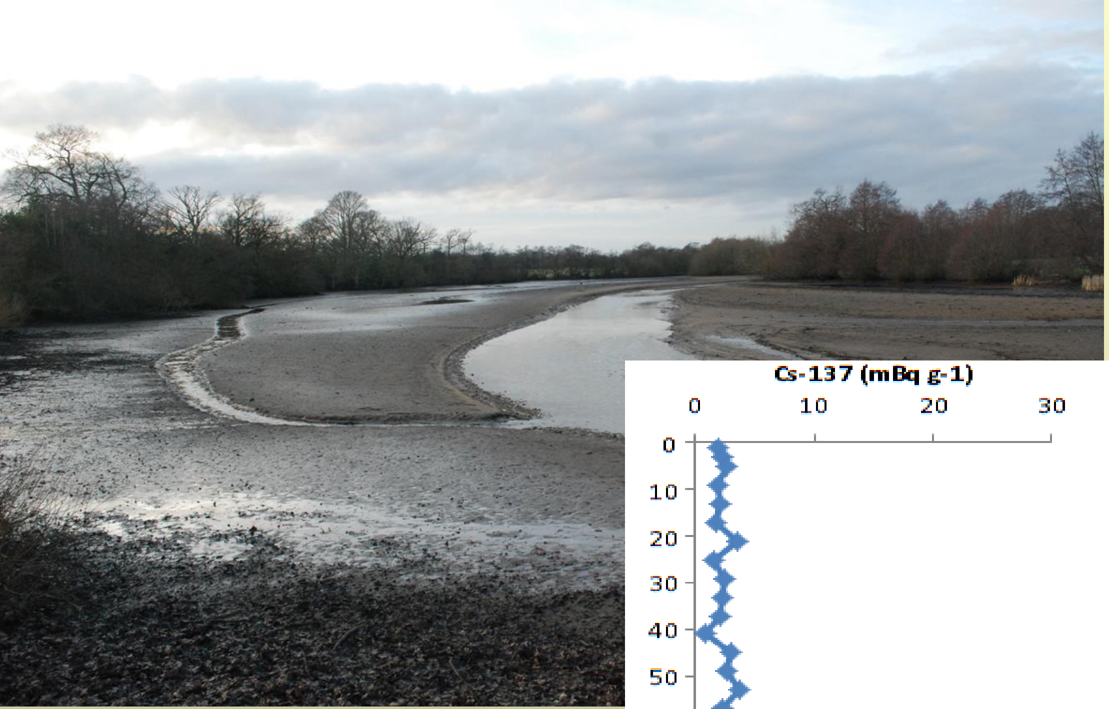
Samples downstream of Hammer Pond devoid of sand. Rapid recovery before Rother confluence



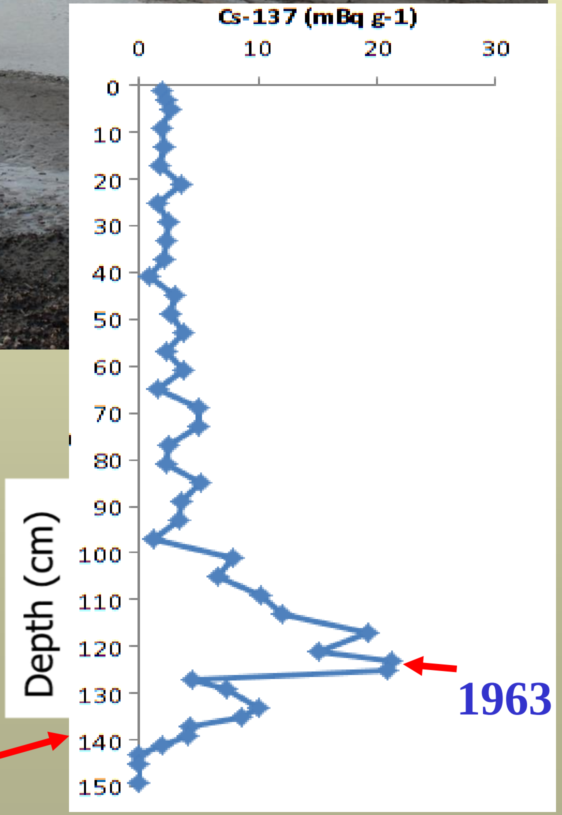


From Foster et al., 2019

Sediment Trapped in Ponds



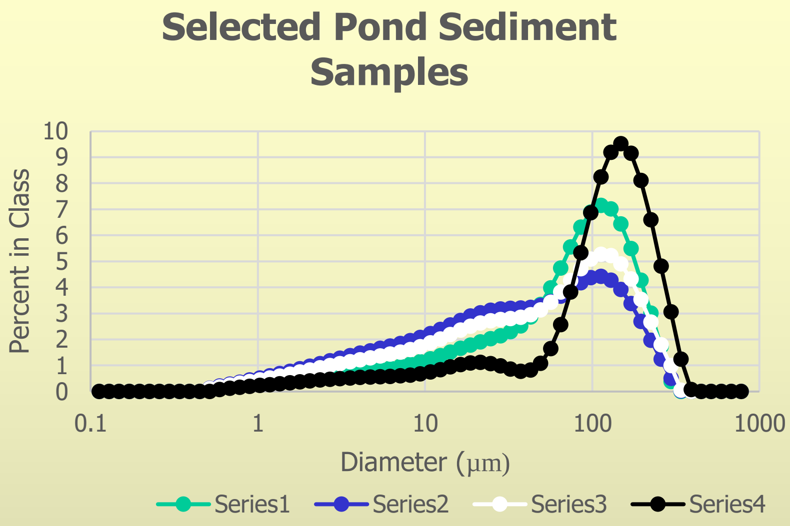
~ 5.5 m of sediment has accumulated in Lurgashall Mill Pond ~ 1600 AD

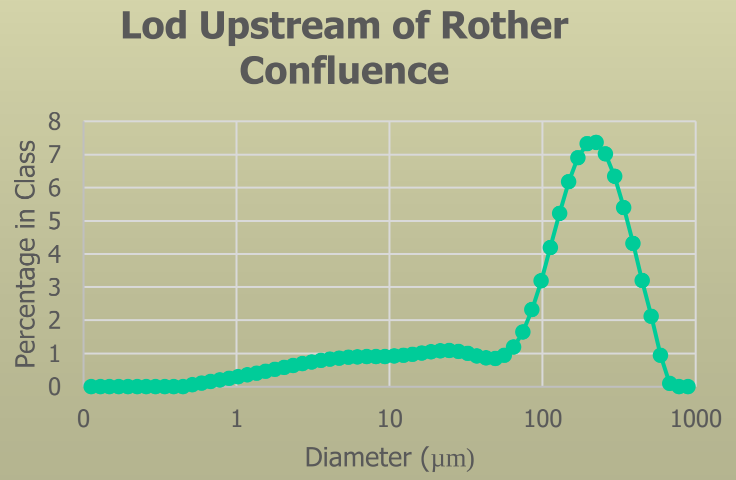


Sediment in dams has little sand and is mostly silt & clay. Average D90 for pond sediments = 96 µm, Average D90 for Lod Suspended sediment = 180 µm

Cs-137 profiles in Lurgashall Mill Pond suggest ~ 1.4 m of sediment accumulation since 1954

Raising of local base level by the dam of ~ 8m has seen progressive increase in valley sedimentation upstream for ~ 2km





Lurgashall Valley & Mill Pond Storage

75,000-90,000 t of sediment stored 1954-2016

40-47 t km^{-2} yr^{-1} (31.6 km^2 Lod catchment)

19-30 t km^{-2} yr^{-1} Sediment Yield for Rother 1985-95

(Sear, 1996)

Key Messages

Dis-connectivity

- **Operates and changes in significance at a range of spatial and temporal scales (e.g. most reservoirs are now ineffective due to low trap efficiencies)**

- **Is particle size specific. We have evidence to suggest that we need to treat sediment fractions differently as modelled sources of sand and silt are different in many of the sub-catchments we have explored in the Rother**

- **Will have complex effects on river habitat and on sediment quality**