


**British Geological Survey**  
NATURAL ENVIRONMENT RESEARCH COUNCIL

Applied geoscience for our changing Earth

## Measuring the contribution of groundwater and soil water to flooding

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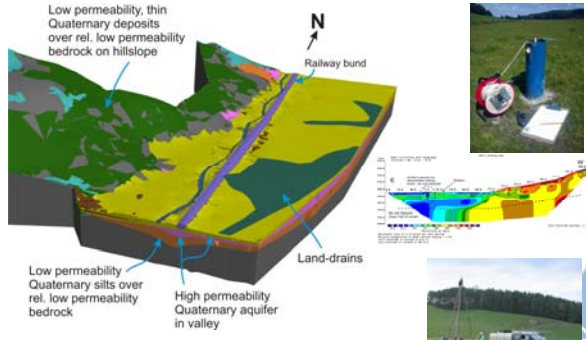
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SEPA, BGS, U Dundee,  
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SFG: The Eddleston Water Project 30 Oct 2014

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University of Dundee

## Phase 1: Characterising the floodplain in 3D



Low permeability, thin Quaternary deposits over rel. low permeability bedrock on hillslope

Low permeability Quaternary silts over rel. low permeability bedrock

High permeability Quaternary aquifer in valley

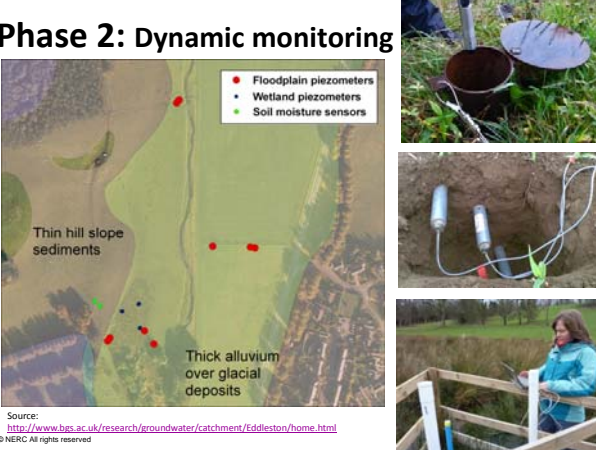
Railway bund

Land-drains

Source:  
<http://www.bgs.ac.uk/research/groundwater/catchment/Eddleston/home.html>

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## Phase 2: Dynamic monitoring



- Floodplain piezometers
- Wetland piezometers
- Soil moisture sensors

Thin hill slope sediments

Thick alluvium over glacial deposits

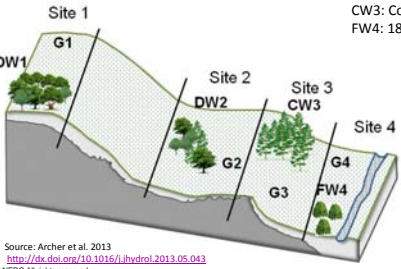
Source:  
<http://www.bgs.ac.uk/research/groundwater/catchment/Eddleston/home.html>

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## Hill slope soil permeability

Measure soil K in paired grid areas within the hillslope and floodplain of grassland and forest areas

DW1: 500 yr old deciduous forest  
DW2: 180 yr old deciduous forest  
CW3: Conifer forest 45 yr old  
FW4: 180 yr old Wetland woodland



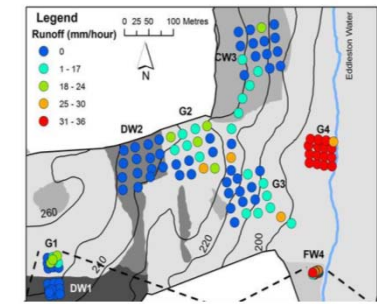
Site 1  
Site 2  
Site 3  
Site 4

DW1  
DW2  
CW3  
FW4  
G1  
G2  
G3  
G4

Source: Archer et al. 2013  
<http://dx.doi.org/10.1016/j.jhydrol.2013.05.043>

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## Infiltration capacity



Legend  
Runoff (mm/hour)

- 0
- 1 - 17
- 18 - 24
- 25 - 30
- 31 - 36

Old broadleaf woodland have 10-15 times higher permeability than soils under neighbouring coniferous forest and pasture land.

Soil K also related to parent geology

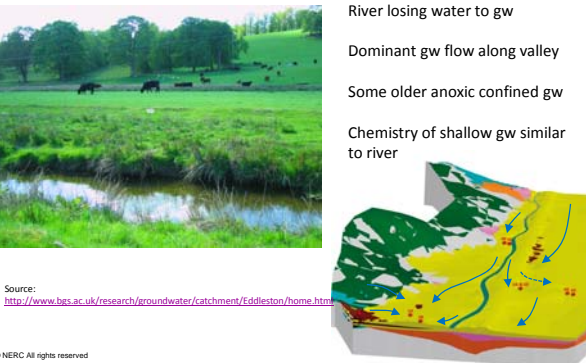
Soils on flood plain: low permeability

Runoff from a 1 in 10 rainfall event

Source: Archer et al. 2013  
<http://dx.doi.org/10.1016/j.jhydrol.2013.05.043>

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## Groundwater - Baseline



River losing water to gw

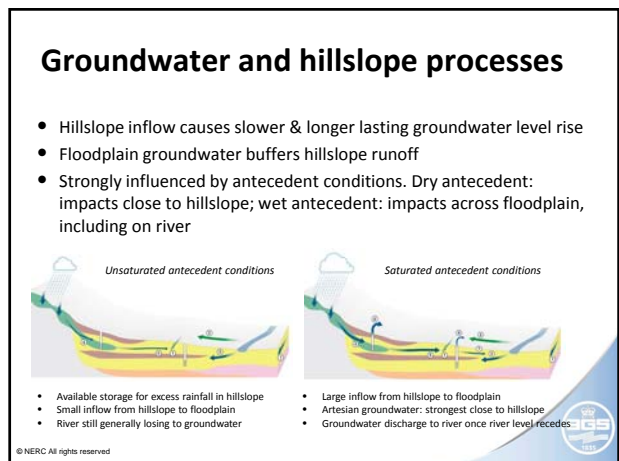
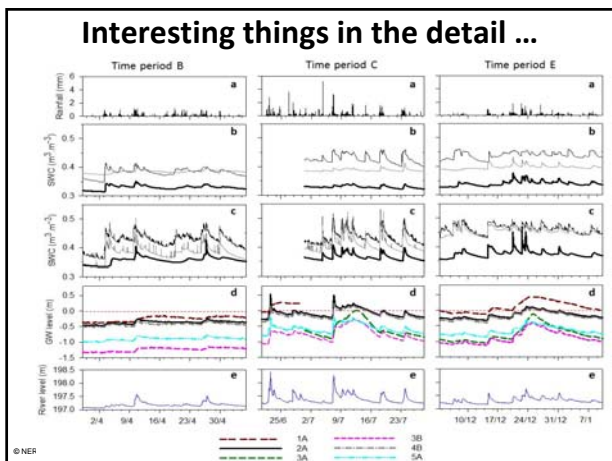
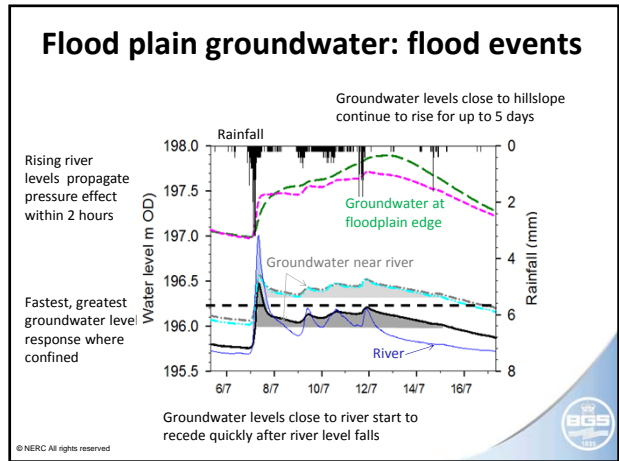
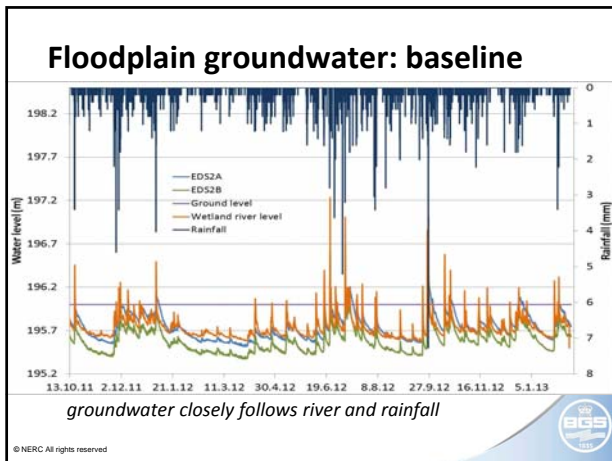
Dominant gw flow along valley

Some older anoxic confined gw

Chemistry of shallow gw similar to river

Source:  
<http://www.bgs.ac.uk/research/groundwater/catchment/Eddleston/home.html>

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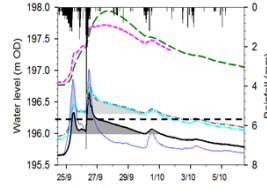
### Lessons learned

1. There is a strong relationship between soil permeability and land use – established deciduous forests most permeable
2. Groundwater across most of the floodplain, except near its edges, is more closely coupled to river flow than local rainfall
3. Groundwater at the edge of the floodplain is weakly coupled to river flows, but strongly connected to rainfall infiltrating on adjacent hillslopes
4. The combination of soil water storage on hillslopes and groundwater storage in floodplain aquifers acts as an important buffer to flooding



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### Still learning !



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